THE

WORKS

OF THE HONOURABLE

ROBERT BOYLE.

In SIX VOLUMES.

To which is prefixed

The LIFE of the AUTHOR.

VOLUME THE FIFTH.

A NEW EDITION.



Ex rerum Causis Supremam noscere Causam.

N. Grevedon inv. et delin.

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MDCCLXXII.

AN ESSAY OF THE GREAT EFFECTS Of even LANGUID and UNHEEDED MOTION.

Whereunto is annexed,

An EXPERIMENTAL DISCOURSE of ſome little obſerved Cauſes of the INSALUBRITY and SALUBRITY of the AIR and its Effects. [Being part of an intended NATURAL HISTORY of the AIR.]

ADVERTISEMENT of the PUBLISHER.

IT is thought fit the reader ſhould be informed, that the enſuing tract (about the effects of languid motions) was deſigned to be a part of the author's notes about the origin of occult qualities, and ſhould have come abroad together with the papers about the effluvia of bodies (moſt of which are already publiſhed;) and accordingly it was printed ſeven or eight years ago: which circumſtance is here mentioned, to give a reaſon, why ſeveral particulars were omitted in the body of the diſcourſe, that will be found annexed to the end of it: for theſe occurring to the author, whilſt he curſorily read over the tract itſelf, when it was upon the point to be made publick, it was thought fit rather to ſubjoin them by way of a ſhort appendix, than to let any thing be loſt, that ſeem'd pertinent to ſo difficult and uncultivated a ſubject, as that they belong to. The reader is farther to be advertiſed, that of the three preliminary diſcourſes, which the author intended for introductory ones to what he deſigned to ſay more particularly about the mechanical origin or production of occult qualities, one was concerning the relations betwixt the pores of bodies and the figures of corpuſcles: but that the great intricacy and difficulty he found in this copious ſubject made him conſent, that the diſcourſe of local motion, which ſhould have accompanied it to the preſs, ſhould be printed long before it. And thoſe papers about pores and figures having been for a great while out of the author's power, he now to gratify the ſtationer with ſomething, that may, in their ſtead, make up the formerly printed eſſay a book of a convenient bulk, has put into his hands what now comes forth, about ſome unheeded cauſes of the healthfulneſs and inſalubrity of the air; which being chiefly attributed to ſubterraneal ſteams, ſubtile and for the moſt part inviſible, are as near of kin to the other effluviums treated of in the introductory diſcourſe, as is requiſite to keep the mention, that is made of them in this book, from appearing very incongruous.

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An ESSAY of the GREAT EFFECTS of even LANGUID and UNHEEDED LOCAL MOTION.

CHAP. I.

HOW ſuperficially ſoever the local motion of bodies is wont to be treated of by the ſchools, who admit of divers other motions, and aſcribe almoſt all ſtrange things in phyſicks to ſubſtantial forms and real qualities; yet it will become us, who endeavour to reſolve the phænomena of nature into matter and local motion, (guided, at the beginning of things, immediately, and ſince regulated, according to ſettled laws, by the great and wiſe author of the univerſe,) to take a heedful notice of its kinds and operations, as the true cauſes of many abſtruſe effects. And though the induſtry of divers late mathematicians and philoſophers have been very laudably and happily exerciſed on the nature and general laws of this motion; yet I look upon the ſubject, in its full extent, to be of ſuch importance, and ſo comprehenſive, that it can never be too much cultivated, and that it compriſes ſome parts, that are yet ſcarce cultivated at all. And therefore I am not ſorry to find myſelf obliged, by the deſign of theſe notes, (written, as you know, to facilitate the explicating of occult qualities) to endeavour to improve ſome neglected corners of this vaſt field, and to conſider, whether, beſides thoſe effects of local motion, which are more conſpicuous, as being produced by the manifeſt ſtriking of one body againſt another, where the bulk, *&c.* of the agent, together with its celerity, have the chief intereſt; there may not be divers effects, wont to be attributed to occult qualities, that yet are really produced by faint or unheeded local motions of bodies againſt one another, and that oftentimes at a diſtance?

BUT, before I enter upon particulars, this I muſt premiſe in general, (which I have elſewhere had occaſion to note to other purpoſes,) that we are not to look upon the bodies we are converſant with, as ſo many lumps of matter, that differ only in bulk and ſhape, or that act upon one another merely by their own diſtinct and particular powers; but rather as bodies of peculiar and differing internal textures, as well as external figures: on the account of which ſtructures many of them muſt be conſidered as a kind of engines, that are both ſo framed and ſo placed among other bodies, that ſometimes agents, otherwiſe invalid, may have notable operations upon them; becauſe thoſe operations being furthered by the mechaniſm of the body wrought on, and the relation, which other bodies and phyſical cauſes have to it, a great part of the effect is due, not preciſely to the external agent, that it is wont to be aſcribed to, but in great meaſure to the action of one part of the body itſelf (that is wrought on) upon another, and aſſiſted by the concurring action of the neighbouring bodies, and perhaps of ſome of the more catholick agents of nature. This notion or conſideration being in other papers particularly confirmed, I ſhall not now inſiſt upon it, truſting, that you will not forget it, when there ſhall be occaſion to apply it in the following notes.

THERE may be more accounts, than we have yet thought of, upon which local motions may perform conſiderable things, either without being much heeded, or without ſeeming other than faint, at leaſt in relation to the conſiderableneſs of the effects produced by them. And therefore I would not be underſtood in an excluſive ſenſe, when in the following diſcourſe I take notice but of a few of the above-mentioned accounts; theſe ſeeming ſufficient, whereto, as to heads, may be conveniently enough referred the inſtances I allot to this tract.

AND

And concerning each of theſe accounts, I hold it requiſite to intimate in this place, that I mention it only, as that, whereon ſuch effects of local motion, as I refer to it, do principally depend: for otherwiſe I am ſo far from denying, that I aſſert, that in divers caſes there are more cauſes than one, or perhaps than two of thoſe here treated of apart, that may notably concur to phænomena directly referred to but one or other of them.

To come then cloſer to our ſubject, I ſhall take notice, that among the ſeveral things, upon whoſe account men are wont to overlook or undervalue the efficacy of local motions, that are either unheeded or thought languid, the chief, or at leaſt thoſe, that ſeem to me fitteſt to be treated of in this paper, are thoſe, that are referrible to the following obſervations.

CHAP. II.

OBSERVATION I.

Men are not uſually aware of the great efficacy of celerity, even in ſmall bodies, and eſpecially if they move but through a ſmall ſpace.

WHAT a rapid motion may enable a body to do, may be judged by the powerful and deſtructive effects of bullets ſhot out of cannons, in compariſon of the battering engines of the antients, which, though I know not how many times bigger than the bullets of whole cannon, were not able to batter down walls and towers, like bullets, whoſe bulk, compared with theirs, is inconſiderable. Other examples of a like nature might be without impertinency alledged on this occaſion; but becauſe the latter part of our propoſition contains that, which I chiefly aim at, I ſhall proceed to inſtances fit to prove that.

I have ſometimes cauſed a ſkilful turner to turn for me an oblong piece of iron or ſteel, and placing my naked hand at a convenient diſtance to receive the little fragments, perhaps for the moſt part leſſer than ſmall pins heads, as they flew off from the rod, they were, as I expected, ſo intenſely heated by the quick action of the tool upon them, that they ſeemed almoſt like ſo many ſparks of fire; ſo that I could not endure to continue my hand there. And I remember, that once aſking an expert workman, whether he (as I had ſometimes done) did not find a troubleſome heat in the little fragments of braſs, that were thrown off, when that metal was turning? he told me, that heat was ſometimes very offenſive to his eyes and eye-lids. And when I aſked, whether it was not rather as duſt caſt into them, than from their heat? he replied, that, beſides the ſtroke, he could ſenſibly feel a troubleſome heat, which would make even his eye-lids ſore: and that ſometimes, when he employed a rough tool, that took off ſomewhat greater chips, he had found the heat ſo vehement, that not only it would ſcorch his tender eye-lids, but the thick and hard ſkin of his hands; for proof whereof, he ſhewed me in one of his hands a little bliſter, that had been ſo raiſed, and was not yet quite gone off.

And enquiring about theſe matters of a famous artiſt employed about the finiſhing up of caſt ordnance, he confeſſed to me, that, when with a ſtrong, as well as peculiar engine he and his aſſociates turned great guns very ſwiftly, to bring the ſurface to a competent ſmoothneſs, the tools would ſometimes throw off bits of metal of a conſiderable bigneſs, which, by reaſon of their bulk and their rapid motion, would be ſo heated, as to burn the fingers of the country-people, that came to gaze on his work, when he, for merriment ſake, deſired them to take up ſome of thoſe pieces of metal from the

ground: which I thought the more remarkable, becauſe, by the contact and coldneſs of the ground, I could not but ſuppoſe their heat to have been much allayed; not to mention, that I learnt from an experienced artificer, that in turning of braſs the little fragments of that metal acquire an intenſer heat, than thoſe of iron.

I REMEMBER alſo, that to vary the experiment mentioned juſt before this laſt, by making it with a body far leſs ſolid and heavy, than braſs or iron, I cauſed an artificer to turn very nimbly a piece of ordinary wood, and holding my hand not far off, the powder, that flew about upon the operation, ſtruck my hand in many places with that briſkneſs, that I could but uneaſily endure the heat, which they produced where they hit; which heat, whether it were communicated from the little, but much heated, fragments to my hands, or produced there by the briſk percuſſion on my hand, or were the joint effect of both thoſe cauſes, it will however be a good inſtance of the power of celerity even in very ſmall bodies, and that move but a very little way.

IT is conſiderable to our preſent purpoſe, that by an almoſt momentary percuſſion, and that made with no great force, the parts, even of a vegetable, may be not only intenſely heated, but brought to an actual ignition; as we have ſeveral times tried, by ſtriking a good cane (of that ſort which is fit for ſuch experiments) with a ſteel, or even with the back of a knife; for, upon this colliſion, it would ſend forth ſparks of fire like a flint.

To the ſame purpoſe may be alledged, that, by but dextrouſly ſcraping good loaf-ſugar with a knife, there will be made ſo briſk an agitation of the parts, that ſtore of ſparks will be produced. But that is more conſiderable, which happens upon the colliſion of a flint and a ſteel: for though vitrification be by chymiſts eſteemed the ultimate action of the fire; and though, to turn ſand or ſtones, though very finely powdered, into glaſs, it is uſually required, that it be kept for divers hours in the intenſe fire of a glaſs-houſe; and though, laſtly, the glaſs-men complain, that they cannot bring flints or ſand to fuſion without the help of a good proportion of Borillia or ſome other fixed ſalt; yet both actual ignition and vitrification are brought to paſs almoſt in a moment by the bare vehemence of that motion, that is excited in the parts of a flint, when it is ſtruck with a ſteel: for thoſe ſparks, that then fly out, (as an ingenious perſon has obſerved, and as I have often ſeen with a good microſcope,) are uſually real and permanent parcels (for the moſt part globulous) of ſtone vitrified and ignited by the vehemence of the motion. And that this vitrification may be of the ſtone itſelf, though ſteel be a metal of a far more fuſible nature than a flint, I am induced to think, becauſe I have tried, that not only flints with ſteel, but flints with flints, and more eaſily pieces of rock-cryſtal between themſelves, will by colliſion ſtrike fire. And the like effect of colliſion I have found myſelf in ſome precious ſtones, harder than cryſtal. And afterwards inquiring of an ingenious artificer that cuts diamonds, whether he had obſerved the like, when diamonds were grated on by the rapid motion of his mill? he replied, that he obſerved diamonds to ſtrike fire almoſt like flints, which was afterwards confirmed to me by another experienced cutter of gems: and yet having made divers trials on diamonds with fire, he would not allow, that fire itſelf can bring them to fuſion.

The cauſe of a flint's ſparkling. Mr. *Hooke.*

NOR are fluid bodies, though but of ſmall dimenſions, to be altogether excluded from the power of making conſiderable impreſſions on ſolid bodies, if their celerity be great.

WHETHER the ſun-beams conſiſt, according to the anatomical doctrine, of very minute corpuſcles, that, continually iſſuing out of the body of the ſun, ſwiftly thruſt on one another in phyſically ſtraight lines; or whether, as the Carteſians would have it, thoſe beams be made by the briſk action of the luminary upon the contiguous fluid, and

and propagated every way in ſtraight lines through ſome æthereal matter harboured in the pores of the air; it will be agreeable to either hypotheſis, that the ſun-beams, refracted or reflected by a burning-glaſs to a focus, do there, by their concourſe, compoſe a ſmall portion of fluid matter; and yet the celerity, wherewith the ſoft and yielding ſubſtance is agitated, enables ſo few of them, as can be circumſcribed by a circle not a quarter of an inch in diameter, to ſet afire green wood in leſs than a minute, and (perhaps in as little time as that) to melt not only tin and lead thinly beaten, but, as I have tried, foliated ſilver and gold.

THE operation of ſmall portions of fluid matter on ſolid bodies wil be farther exemplified in the fourth chapter, by the effects of the blown flame of a lamp on glaſs and metals; ſo that I ſhall here need but to point in general at the wonderful effects, that lightning has produced, as well by the celerity of its motion, as by the matter, whereof it conſiſts: of which effects hiſtories and the writings of meteorologiſts afford good ſtore; and I have been an admiring obſerver of ſome of them, one of the laſt of which was, the melting of metal by the flame in its paſſage, which probably laſted but the twinkling of an eye.

AND even a ſmall parcel of air, if put into a ſufficiently briſk motion, may communicate a conſiderable motion to a ſolid body; whereof a notable inſtance (which depends chiefly upon the celerity of the ſpringy corpuſcles of the air) is afforded by the violent motion communicated to a bullet ſhot out of a good wind-gun. For when this inſtrument is well charged, the ſtrongly-compreſt air being ſet at liberty, and forcibly endeavouring to expand itſelf to its wonted laxity, its corpuſcles give a multitude of impulſes to the bullet, all the while that it continues moving along the barrel, and by this means put it into ſo rapid a motion, that I found, by trial, the bullet would, in a moment, be flatted almoſt into the figure of an hemiſphere, by being ſhot off againſt a metalline plate. A wind-gun.

AND farther to ſhew, how ſwift that motion muſt have been, and with what celerity a vehement agitation may be communicated to the parts of a ſolid body, I ſhall add here, (though the phænomenon might be referred to the fifth chapter,) that, though the contact of the bullet and the metalline plate laſted probably but a phyſical moment; yet the minute parts of the bullet were put into ſo various and briſk an agitation, that making haſte to take it up before it ſhould cool, I found it too hot to be, with overmuch eaſe, held between my fingers.

CHAP. III.

OBSERVATION II.

We are too apt to think, that fluid bodies, becauſe of their ſoftneſs, cannot have by their bare motion, eſpecially if inſenſible, any ſenſible effect upon ſolid ones; though the fluid moves and acts as an intire body.

IT is not my purpoſe here to inſiſt on the efficacy of the motion of ſuch fluid bodies, as may have their motions diſcovered by the eye like ſtreaming water, or manifeſtly perceived by the touch, as are the winds, that beat upon us; ſince it were needleſs to give inſtances of ſuch obvious things, as the great effects of overflowing waters and violent winds; the latter of which, notwithſtanding the great tenuity and ſoftneſs of the air, and the effluvia, that ſwim in it, have been ſometimes able to blow down, not only timber-trees, but houſes and ſteeples, and other the firmeſt ſtructures. But the motions, I intend to ſpeak of in this chapter, are ſuch, as we do not immediately

ately either ſee or feel; and though theſe be exceeding rare, yet the operation of ſounds, even upon ſolid bodies, and that at a diſtance from the ſonorous ones, afford me ſome inſtances to my preſent purpoſe, which I ſhall now proceed to mention.

It has been frequently obſerved, that, upon the diſcharge of ordnance and other great guns, not only the ſound may be diſtinctly heard a great way off; but that, to a good diſtance, the tremulous motion of the air, that produces ſound, without producing any ſenſible wind, has been able ſenſibly to ſhake, and ſometimes violently to break, the glaſs windows of houſes, and other buildings, eſpecially when the windows ſtand in the way, wherein the propagation of the ſound is directly made. It is true, that theſe obſervations are moſt frequent, when the place, where the artillery is placed, ſtands upon the ſame piece of ground with the houſes, whoſe windows are ſhaken; and ſo it may be ſuſpected, that the ſhake is firſt communicated by the cannon to the earth or floor, on which they play, and is afterwards by that propagated through the intermediate parts of the ground to the foundations of the houſes, and ſo to the windows. And I readily grant, and may elſewhere ſhew, that a violent impulſe upon the ground may reach to a greater diſtance, than men uſually imagine: but in our preſent caſe I ſee no neceſſity of having recourſe to any thing but the wave-like motion of the air for the production of our phænomenon, ſince the like may be produced by local motion tranſmitted by fluids, as may appear by the following inſtances.

I was once invited by an engineer to ſee trial made of a ſtrange inſtrument he had to ſink ſhips, though great ones, in a few minutes; and though an unlucky accident kept me from arriving there, until near a quarter of an hour after the trial had been made on an old frigate with better ſucceſs, than my philanthropy allowed me to wiſh; yet cauſing myſelf to be rowed to the place, where the great veſſel was newly ſunk, the oddneſs of the effect, which was performed upon the water by a ſmall inſtrument outwardly applied, made me inquiſitive, what noiſe and commotion had been made; and I was informed, partly by the engineer himſelf, and partly by ſome acquaintances of mine, who among a great number of ſpectators ſtood aloof off, in ſhips and other veſſels lying at anchor, to ſee the event, that, upon the engineer's operating, the exploſion was ſo great, that it made a kind of ſtorm in the water round about, and did ſo rudely ſhake veſſels, that lay at no inconſiderable diſtance, as to make thoſe, that ſtood on them, to ſtagger.

In the late great ſea-fight between the Engliſh fleet, commanded by his royal highneſs the duke of *York*, and the dutch admiral *Opdam*, (who therein loſt the victory and his life,) though the engagement were made very many leagues from the *Hague*, yet the noiſe of the guns not only reached to that place, but had a notable effect there; of which when I enquired of the Engliſh embaſſador, that as yet reſided there, he was pleaſed to aſſure me, that it ſhook the windows of his houſe ſo violently, that not knowing what the cauſe was, he was ſurprized and much alarmed, apprehending, that ſome rude fellows were about to break his windows to affront him. And if there be a greater diſpoſition in ſome other bodies, than there is in glaſs-windows, to receive ſtrong impulſes from the air agitated by ſounds, theſe may be ſenſibly, though not viſibly, wrought upon, and that at a good diſtance, by the noiſe of a ſingle piece of ordnance; as may appear by that memorable circumſtance of an odd caſe about a gangrene mentioned by the experienced *Simon Pauli* in his ingenious tract *de Febribus malignis*, pag. 71. *Atqui æger ille Gallus brachio truncatus octiduum quidem ſuperfuit, ſed horrendis totius corporis convulſionibus correptus; qui quoque, (ut & illa addam obſervatione digniſſima,) dum in domini ſui ædibus ad plateam Kiödmoggerianam, Romane* Laniorum *appellares,*

pellares, decumberet, ac, me ac aliis aliquandiu ad lectum illius considentibus quidem, sed nobis non attendentibus, exploderentur tormenta bellica ex Regiis ac Prætoriis navibus, sinistrâ truncum dextri brachii fovens ac complectens, toties quoties exploderentur singula exclamabat, Au, au, me miserum! Jesu, Maria, contundor penitùs: adeò permolesta & intolerabilis illi erat tormentorum explosio, & quidem ex loco satis longinquo, terrâ non firmâ aut contiguâ, verùm super salo aut mari Balthico institutâ. " *Simon Pauli*, in his ingenious treatise of pestilen-
" tial fevers, *p.* 71. tells us of a sick *Frenchman*, who lived several days after his arm
" was cut off, though he was all the while most cruelly tortured by not ordinary con-
" vulsion fits: but what is most observable is this, that I and others sitting one day by
" his bed-side, but not taking notice, that the great guns were going off from the
" king's ships, he laying hold and cherishing the stump of his right arm, broke out
" at every shot into these pitiful words; *Jesus, Maria*, What do I not suffer! I am
" quite bruised: so troublesome, and insufferable to him was the shooting of the
" great guns, though at a great distance, they being fired not in a joining continent,
" but on the *Baltick-Sea*." By this it appears, that the guns, whose discharge produced these painful motions in the patient, rested upon a floating body. And I remember, that an illustrious commander of a very great man of war being asked by me, whether of the many wounded men he had in his ship in a very long sea-fight, none of them were affected by that noise of the enemy's cannon discharged in ships at a distance? he answered me, that some, whose bones were broken, would sadly complain of the torment they were put into by the shake they felt at the going off of the enemy's cannon, though they were too much accustomed to the report of great guns, to be, as it was a bare noise, offended by it. If after all this it be surmised, that these motions were not conveyed by the air, but propagated by the water, (and, in some cases, some part of the shore) from the ships, where the guns were fired, to the houses, where the windows were shaken, or the places, where the wounded men lay; I answer, that if this could be made probable, it would accommodate me with very eminent instances for the chapter of the propagable nature of motion: and though it be very difficult to find such examples of shakes excited by sounds, as are not liable to the mentioned objection, because the sonorous bodies here below do all either strike, or lean, upon such gross and visible bodies, as the earth and water; yet there is one kind of sound, that must be confessed to be propagated by the air, as being made in it; and that is thunder, whose noise does sometimes so vehemently affect the air, tho' without producing any sensible wind, that both others and I have observed it very sensibly to shake great and strong houses, notwithstanding the distance of the clouds, where the noises were first produced. And I remember, that having enquired of some sea-captains, that in stout vessels sailed to the *Indies*, whether they had not in those hot regions observed their ships, though very much less tall than houses, to be shaken by vehement thunders? I perceived, that some of them had not much heeded any such thing; but a couple of others told me they had observed it in their ships; and one of them told me, that once, when the claps of thunder were extraordinary great, some of them shook his ship so rudely, as to make the unwonted motions disorder his great guns. All which I the less wonder at, when calling to mind, what I have mentioned in the foregoing chapter and elsewhere of the power of the celerity of motion, I consider, that there is no celerity, that we know of here below, that is near so great, as that, wherewith a sound is propagated through the air. For, whereas the diligent *Mersennus* observes, that a bullet shot out of a cannon or a musket does not overpass two hundred and forty yards in a second, or sixtieth part of a minute; I have more than once diligently observed, that the motion of sound passes above four hundred yards in the same time of a second here in *England*; which I therefore add, because

Mersennus

Merſennus relates, that in *France* he obſerved a ſound to move in that time many yards more; which may poſſibly proceed from the differing conſiſtence of the Engliſh air and the French.

THE great loudneſs of theſe ſounds, and the vehement percuſſion, that the air receives in their formation, will probably make it be eaſily granted, that it was only the impetuoſity of the motion of the *Medium*, that gave the ſhake to the windows and other ſolid bodies, that I have been mentioning to have been made to tremble by the report of cannon or thunder. But yet I will not on this occaſion conceal, that perhaps it may without abſurdity be ſuſpected, that ſome of thoſe tremulous motions of ſolid bodies might either depend upon, or at leaſt be promoted by, ſome peculiar diſpoſition, that glaſs (which is endued with ſpringineſs,) and ſome other bodies, that perhaps are not quite devoid of that quality, may have to be moved by certain congruous ſounds (if I may ſo call them) more than they would by others, though perchance more loud: but though this ſurmiſe ſhould be admitted, yet it would not render the lately recited inſtances improper for the deſign of this diſcourſe, but only would make ſome of them fit to be referred to another chapter; to which I ſhall advance, as ſoon as I ſhall have annexed an odd obſervation of the experienced *Platerus*, which argues, that where there is a peculiar diſpoſition, even in a firm body, it may receive conſiderable impreſſions from ſo languid a motion (though in likelihood not peculiarly modified) of the air, as is not ſenſible to other bodies of the ſame kind.

Fœmina quædam (ſays he) *in ſubitaneum incidit morbum, viribus ſubitò proſtratis, ſe ſuffocari indeſinenter clamitans, etſi nec ſtertoris nec tuſſis aliqua eſſent indicia; maximè verò de aura quadam adveniente, ſi vel leviter aliquis adſtantium ſe moveret, quæ illam opprimeret, conquerebatur, ſéque ſuffocari, ſi quis propiùs accederet, clamitabat: vixdum biduum in ea anxietate perſeverans, expiravit.* To which he adds: *Vidi & alios ægros, de ſimili aura, quæ eos, ſi quis illis appropinquaret, in ſuffocationis periculum induceret, conquerentes; quod ſemper peſſimum eſſe ſignum deprehendi.* "*Platerus* in the firſt book of his obſervations, "*p.* 185. gives us this following account, *p.* 26. A woman being fallen ſick on a ſud-"den, complained continually of her being ſtrangled, though there was no great ap-"pearance thereof; this ſhe aſcribed chiefly to a certain air or wind, which ſhe was "ſo ſenſible of, that if any body happened to come near her, ſhe would immediately "complain of her being choaked, and died the ſecond day of this odd diſtemper. "To which he adds, I have known ſeveral others complain of a not unlike wind, and "that they were in danger of being choaked, if any body came near them; which I "conceived always to be a very ill ſign."

CHAP. IV.

OBSERVATION III.

Men undervalue the motions of bodies too ſmall to be viſible or ſenſible, notwithſtanding their numerouſneſs, which enables them to act in ſwarms.

MOST men, when they think at all of the effluvia of bodies and their motions, are wont to think of them, as if they were but much finer ſorts of duſt, (whoſe grains, by reaſon of their ſmallneſs, are inviſible,) which, by the various agitation of the air, are, as it were, by ſome faint wind blown againſt the ſurfaces of the bodies they chance to meet in their way, and that they are ſtopped in their progreſs without penetrating into the interior parts of the bodies they invade. And, according to this

notion, it is no wonder, that men ſhould not fancy, that ſuch minute bodies paſſing, as they ſuppoſe, no further than the ſurfaces of thoſe, on which they operate, ſhould have faint operations upon them.

But we may have other thoughts, if we well conſider, that the corpuſcles we ſpeak of, are, by their minuteneſs, aſſiſted, and oftentimes by their figure enabled, to pierce into the innermoſt receſſes of the body they invade, and diſtribute themſelves to all, or at leaſt to multitudes of the minute parts, whereof that body conſiſts. For this being granted, though we ſuppoſe each ſingle effluvium or particle to be very minute; yet, ſince we may ſuppoſe even ſolid bodies to be made up of particles, that are ſo too, and the number of invading particles to be not ſo much inferior to that of the invaded ones, or at leaſt to be exceedingly great, it need not ſeem incredible, that a multitude of little corpuſcles in motion (whoſe motion, may, for aught we know, be very ſwift) ſhould be able to have a conſiderable operation upon particles either quieſcent, or that have a motion too ſlow to be perceptible by ſenſe: which may perhaps be the better conceived by the help of this groſs example:

If you turn an ant-hill, well ſtocked with ants-eggs, upſide down, you may ſometimes ſee ſuch a heap of eggs mingled with the looſe earth, as a few of thoſe inſects, if they were yoked together, would not be able at once to draw after them; but if good numbers of them diſperſe themſelves and range up and down, and each lay hold of her own egg, and hurry it away, it is ſomewhat ſurpriſing to ſee (as I have with pleaſure done) how quickly the heap of eggs will be diſplaced, when almoſt every little egg has one of thoſe little inſects to deal with it.

And in thoſe caſes, wherein the invading fluid does not quite disjoin and carry off any great number of the parts of the body it invades, its operation may be illuſtrated by that of the wind upon a tree in autumn: for it finds or makes itſelf multitudes of paſſages, for the moſt part crooked, not only between the branches and twigs, but the leaves and fruits; and in its paſſing from the one ſide to the other of the tree, it does not only variouſly bend the more flexible boughs and twigs, and perhaps make them grate upon one another, but it breaks off ſome of the ſtalks of the fruit, and makes them fall to the ground, and withal carries off divers of the leaves, that grew the leaſt firmly on, and in its paſſage does, by its differing parts, act upon a multitude of leaves all at once, and variouſly alters their ſituation.

But to come to cloſer inſtances: ſuppoſe we caſt two lumps, the one of ſugar, the other of amber, into a glaſs of beer or water, they will both fall preſently to the bottom. And though perhaps the amber may be lighter than the ſugar, (for, I have found a notable difference in the ſpecific gravity of pieces of amber,) yet the aqueous particles are far from being able to diſplace the amber or any ſenſible part of it, or exerciſe any viſible operation upon it: but the ſame minute particles of the liquor being of a figure, that fits them to inſinuate themſelves every way into the pores of the ſugar, though the lump conſiſted of very numerous ſaccharine corpuſcles, yet the multitude of the aqueous particles, to which they are acceſſible, is able in no long time to diſperſe them all, and, carrying them along with themſelves, make the whole lump of ſugar in a ſhort time quite diſappear.

The point above diſcourſed of may be more nimbly exemplified in ſome chymical operations, and particularly in this. If, by a due degree of fire, you abſtract from running mercury four or five times its weight of good oil of vitriol, there will remain at the bottom a dry and brittle ſubſtance exceeding white; and if upon this heap of mercurial and ſaline bodies, which ſometimes may be coherent enough, you pour a good quantity of limpid water, and ſhake them together, you may ſee in a trice the multitude of little white grains, that make up the maſs, pervaded and manifeſtly al-

tered by the diſperſed corpuſcles of the water; as will plainly appear by the change of the calx or precipitate from a white maſs into one of a fine lemon colour.

But, to give inſtances in fluid bodies, (which I ſuppoſe you will think far the more difficult part of my taſk,) though you will eaſily grant, that the flame of ſpirit of wine, that will burn all away, is but a viſible aggregate of ſuch effluvia ſwiftly agitated, as without any ſenſible heat would of themſelves inviſibly exhale away; yet, if you be pleaſed to hold the blade of a knife, or a thin plate of copper, but for a very few minutes, in the flame of pure ſpirit of wine, you will quickly be able to diſcern by the great heat, that is, the various and vehement agitation of the minute corpuſcles of the metal, what a number of them muſt have been fiercely agitated by the pervaſion of the igneous particles, if we ſuppoſe, (what is highly probable,) that they did materially penetrate into the innermoſt parts of the metal; and whether we ſuppoſe this or no, it will, by our experiment, appear, that ſo fluid and yielding a body, as the flame of ſpirit of wine, is able, almoſt in a trice, to act very powerfully upon the hardeſt metals.

The power of extremely minute parts of a fluid body, even when but in a moderate number they are determined to conſpire to the ſame operation, may be eſtimated by the motions of animals, eſpecially of the larger and more bulky ſorts, as horſes, bulls, rhinoceroſes and elephants. For though the animal ſpirits be minute enough to be inviſible, and to flow through ſuch tender paſſages, that prying anatomiſts have not been able in diſſected nerves to diſcern ſo much as the channels, through which they paſs; yet thoſe inviſible ſpirits, conveyed (or impelled) from the brain to the nerves, ſerve to move in various manners the limbs, and even the unweildy bodies themſelves of the greateſt animals, and to carry them on in a progreſſive motion for many hours together, and perhaps enable them to ſpring into the air, and move through it by leaping; though divers of theſe animals weigh many hundred, and others ſeveral thouſand of pounds.

I will not here conſider, whether the following experiment may at all illuſtrate motions, that are produced by the fluid parts of animals in ſome of the conſiſtent ones: but I preſume it may confirm the obſervation maintained in this chapter, if I add, what I have tried of the conſiderable force of a number of aqueous particles, as flexible and as languid as they are thought to be, inſinuating themſelves into the pores or intervals of a rope, that was not thick. For in moiſt weather I ſometimes obſerved, that the aqueous and other humid particles ſwimming in the air, entering the pores of the hemp in great numbers, were able to make it ſhrink, though a weight of fifty, ſixty, or even more pounds of lead were tied at the end to hinder its contraction, as appeared by the weight's viſibly being raiſed in wet weather above the place it reſted at in dry.

But to return to what I was formerly ſpeaking of the determination of the motion of fluids; I ſhall on this occaſion obſerve, that though the wind or breath, that is blown out at a ſmall crooked pipe of metal or glaſs, ſuch as tradeſmen for its uſe call a blow-pipe, ſeems not to have any great celerity, eſpecially in compariſon of that of the parts of flame, and is itſelf of little force; yet, when by this wind the flame of a lamp or candle is directed ſo, as to beat with its point upon a body held at a convenient diſtance from the ſide of the flame, the burning fluid, determined, and perhaps excited by this wind, acquires ſo great a force, that, as we have often tried, it may be made in a few minutes to melt not only the more fuſible metals, but ſilver, or even copper itſelf; which yet may be kept for many hours unmelted in a crucible kept red-hot, or even in the flame of the lamp or candle unaſſiſted by the blaſt.

And if we can ſo contrive it, that a flame does not come to invade only the ſurface, that inveſts a body, but comes to be intermingled with the ſmaller (though not the ſmalleſt) parts it conſiſts of, as with its filings or its powder; the flame will then have a far more quick and powerful operation than the body expoſed to it. This I exemplify (in other papers,) and in this place it may ſuffice to obſerve, that, whereas a pound or two of tartar may coſt you ſome hours to calcine it to whiteneſs, if the flame have immediate acceſs only to the outward parts; you may calcine it in a very ſmall part of that time, if, mixing with its groſs powder an equal weight of good ſalt-petre, you fire the mixture, and keep it ſtirring, that the parts of the kindled nitre may have acceſs at once to very many parts of the tartar, and have opportunity to calcine them. And by ſomewhat a like artifice I elſewhere teach, how nitre itſelf may without tartar be ſpeedily reduced to a calcinatum not unlike that newly mentioned. But it may be ſaid, that ſome of the foregoing inſtances (for it cannot be truly ſaid of all) may indeed illuſtrate what we are diſcourſing of, but will not reach home to our purpoſe.

I shall therefore conſider the load-ſtone, which you acknowledge to act by the emiſſion of inſenſible particles. For though iron and ſteel be ſolid and ponderous bodies, and magnetical effluvia be corpuſcles ſo very minute, that they readily get in at the pores of all kinds of bodies, and even of glaſs itſelf; yet theſe magnetical effluvia entering the ſteel in ſwarms, do in a trice pervade it, and a multitude even of them acting upon the corpuſcles of the metal do operate ſo violently on them, that if the load-ſtone be vigorous enough, and well capped, it will attract a notable proportion of ſteel, and ſurmount the gravity of that ſolid metal, which I have found to exceed, when the ſtone has been very good and little, above fifty times the weight of the magnet, by whoſe effluvia it was ſupported: for to theſe I rather aſcribe magnetical attraction and ſuſtentation, than to the impulſe or preſſure of the ambient air, to which many corpuſcularians have recourſe; becauſe I have found by trial (which I elſewhere relate) that the preſſure of the ambient air is not abſolutely neceſſary to magnetical operations.

I remember, that to help ſome friends to conceive, how ſuch extremely-minute particles, as magnetical effluvia, may, by pervading a hard and ſolid body, ſuch as iron, put its inſenſible corpuſcles into motion, and thereby range them in a new manner, I took filings of ſteel or iron freſhly made, that the magnetical virtue might not be diminiſhed by any ruſt; and having laid them in a little heap upon a piece of paper held level, I applied to the lower ſide of the paper, juſt beneath the heap, the pole of a vigorous load ſtone, whoſe emiſſions traverſing the paper, and diffuſing themſelves through the incumbent metal, did in a trice manifeſtly alter the appearance of the heap; and though each of the filings might probably contain a multitude of ſuch martial corpuſcles, as ſteel may be divided into by oil of vitriol or ſpirit of ſalt, yet the magnetical effluvia immediately pervading our metalline heap did ſo remove a good part of the filings, that compoſed it, as to produce many erected aggregates, each of which conſiſted of ſeveral filings placed one above another, and appearing like little needles, or rather like the ends of needles broken off at ſome diſtance from the point: and as theſe little temporary needles ſtood all of them erected (though more or leſs, according to their diſtance from the pole of the magnet) upon the flat paper; ſo they would, without loſing their figure or connexion, be made, as it were, to run to and fro upon the paper, according as the load-ſtone, that was held underneath it, was moved this way and that way; and as ſoon as that was taken quite away, all this little ſtand of pikes (if I may ſo call it) would (almoſt in the twinkling of an eye) relapſe into a confuſed heap of filings.

There are two ways of explicating the turning of water into ice; one or other of which is approved almoſt by all the corpuſcularian philoſophers. The firſt is that of the Carteſians, who give an account of glaciation by the receſs of the leſs ſubtile particles of the ethereal matter, without which the finer parts were too ſmall and feeble to keep the eel-like particles of water flexible, and in the form of a liquor. The atomiſts on the other ſide aſcribe the freezing of water to the ingreſs of multitudes of frigorific corpuſcles, as they call them, which, entering the water in ſwarms, and diſperſing themſelves through it, crowd into the pores, and hinder the wonted motion of its parts, wedging themſelves (if I may ſo ſpeak) together with them into a compact body. But which ſoever of theſe two hypotheſes be pitched upon, the phænomenon itſelf will afford me a notable inſtance to my preſent purpoſe. For the particles of water, and much more the corpuſcles of cold, are confeſſed to be ſingly too ſmall to be viſible, and their motions are not ſaid to be ſwift, but may rather be judged to be ſlow enough; and yet thoſe minute aqueous, or more minute frigorific particles, becauſe of their number, produce in the glaciation of the liquor ſo forcible a motion outwards, as to make it break bottles, not only of glaſs and earth ſtrongly baked, but, as I have ſeveral times tried, of metal itſelf, that, being full of the liquor, were firmly ſtopped before the ſupervening of the cold. And the expanſive endeavour of freezing water is not only capable of doing this, but of performing ſo much greater things, which I elſewhere relate, that my trials have made me ſometimes doubt, whether we know any thing in nature, except kindled gunpowder, that bulk for bulk moves more forcibly, though the motion ſeems to be very ſlow.

Opinions of freezing

CHAP. V.

(Of the propagable nature of motion.)

Observation IV.

Men are not ſufficiently aware, how propagable local motion is, even through differing mediums and ſolid bodies.

THERE are four principal occaſions, on which I have obſerved, that men are wont to think the communicating of motion much more difficult, than indeed it is.

And firſt, there are many, that obſerving how uſually thoſe bodies, that hit againſt hard ones, rebound from them, eaſily perſuade themſelves, that motion can ſcarce be tranſmitted or diffuſed through ſolid bodies. But, though it be true, that oftentimes in ſuch caſes the progreſſive motion of the body or the ſolid, that is ſtruck or impelled, be either inconſiderable, or perhaps not ſo much as ſenſible; yet the impulſe may make a conſiderable impreſſion, and may be communicated to a great ſhare of the particles of that matter, whereof the ſolid maſs conſiſts; as we ſee in the ſtriking of a timber-beam at one end, the motion, though perhaps it were not ſtrong at the firſt, may become ſenſible at the other. Though bell-metal be ſo hard a body, that it is reckoned harder than iron itſelf, inſomuch that oftentimes it reſiſts even files of ſteel, which readily work on iron; yet this ſolidity hinders not, but that, as I have found, conveniently ſhaped veſſels of bell-metal, though thick, will be ſenſibly affected by a motion, that neither is ſtrong, nor touches them in more than a ſhort line, or perhaps than a phyſical point. The truth of this I have found by trial on more than one ſuch veſſels, and particularly on one, that was hemiſpherical, which being placed or held in

a convenient poſture, if I did but gently paſs the point of a pin for a little way along the brim of it, it would ſenſibly reſound, and that (to a very attentive ear) ſo long, and in ſuch a ringing manner, as made it highly probable, that the parts immediately touched (and not ſo much as ſcratched) by the point of a pin, were not only put into a vibrating motion themſelves, but were enabled to communicate it to thoſe, that were next them, and they to thoſe, that were contiguous to them; and ſo the tremulous motion was propagated quite round the bell, and made divers ſucceſſive circulations before it quite ceaſed to be audible. And if inſtead of drawing a line on the brim of the veſſel, I ſtruck it, though but faintly, with the point of a pin, though the part immediately touched would be but a phyſical point, yet the motion would be, like the former, propagated ſeveral times quite round; as was argued by the ringing and duration of the produced ſound, though this metalline veſſel were ſeven inches in diameter, and of a conſiderable thickneſs. Nor was a ſolidity like that of braſs requiſite to produce theſe effects; for I found them to inſue much after the ſame manner, when I employed only a ſhort and ſlender thread of glaſs, which, though little, if at all, thicker than a pin, was yet hollow quite through. Now, if it be true, as it is highly probable, that ſound, as it belongs to the air, conſiſts in an undulating motion of the air, and ſo in our caſe requires a vibrating motion in the ſonorous body to impart that motion to the air: we muſt grant in our inſtances a wonderful propagableneſs of motion, even when it is not violent, in ſolid bodies themſelves; ſince the point of a pin, gently ſtriking a part, no bigger than itſelf, of a maſs of very ſolid metal, could thereby communicate a ſenſible motion, and that ſeveral times circulated, to millions of parts equal to it in bulk, and much exceeding it in hardneſs. And ſince the effect was more conſiderable, when the trial was made in a much greater, than in a ſmaller veſſel; it is probable, that, if I had had the opportunity of experimenting on a large and well hung bell, the phænomenon would have been more notable; as it alſo ſeemed to be on our veſſel, if, inſtead of ſtriking it with the point of a pin, we caſt, though but faintly, againſt the lower part of it a grain of ſhot, leſs than a ſmall pin's head, or let a little grain fall from about one foot high, upon the inſide of the inverted hemiſphere. And to ſhew, that even ſoft and yielding bodies, and but faintly moved, are not to be excluded from a power of putting ſuch hard ones into motion; I ſhall add, that I found almoſt the like effects to thoſe above-mentioned, by paſſing the pulp of my finger a little way along the lower part of the veſſel. Nay, that fluid bodies themſelves may communicate ſuch an inteſtine and propagable motion to hard and ſolid ones, I may have hereafter an occaſion to ſhew by the effects of a ſmall flame and the ſun beams on glaſs and ſteel. And I ſhall here on this occaſion add this word about the propagation of motion produced in ſolid bodies by heat, that it much depends upon the particular textures of the bodies; for I found, that when I heated a piece of glaſs or of a fire-ſtone, I could without inconvenience hold my naked hand upon parts, that were very near (ſuppoſe within an inch off) the ignited portions of them: but, if we take a rod of iron, for inſtance, and heat one end red-hot, the heat of that end will be ſo propagated towards the other, that it will offend one's hand at ſeveral times the diſtance, at which one might conveniently hold the rod, if it were of glaſs.

In many buildings it may be obſerved, (and is thought a ſign of the firm coheſion of their parts), that a ſtamp of one's foot, nay, or bear treading, or ſome ſuch other leſs briſk impulſe, made in one room, will have a ſenſible effect in all or moſt of the others. And it often happens, that by the haſty ſhutting of a door, the whole houſe is made to tremble; whence we may argue, that, even among ſolid bodies, motion made in one place may be readily propagated to many others: and if, as to the latter of the inſtances, the ſudden impulſe and compreſſion of the air, made by the door

ſuppoſed

ſuppoſed to be haſtily ſhut, have any conſiderable ſhare in the effect, the phænomenon will ſerve to ſhew the efficacy even of ſuch a motion of a fluid body, as we cannot directly feel upon divers large and firmly connected ſolid bodies.

A (highly probable) cauſe of earthquakes.

In earthquakes the tremulous motion ſometimes extends ſo very far, that though it ſeems highly probable, that the ſhake, that is given to one part of the earth by the firing and exploſion of ſubterraneal exhalations, (if that be the true and only cauſe of earthquakes) is not capable of reaching near ſo far as divers earthquakes have done, but that the fire paſſes through ſome little ſubterraneal clefts, or channels, or hidden conveyances, from one great cavity or mine to another; yet it is not improbable, but that the vehemently tremulous motion does oftentimes reach a very great way beyond the places, where the exploſions were made; ſince, though *Seneca* would confine the extent of earthquakes to two hundred miles, yet obſervations made in this and the laſt century warrant us to allow them a far greater ſpread. The learned *Joſephus Acoſta* affirms, that in the kingdom of *Peru*, in the year 1586, an earthquake reached along the ſhore of the pacific ſea 160 leagues; and adds, that ſometimes it has in thoſe parts run on from ſouth to north 300 leagues. And in the beginning of this our age (*anno dom.* 1601) good writers relate a much larger earthquake to have happened, ſince it reached from *Aſia* to that ſea, that waſhes the *French* ſhores, and, beſides ſome *Aſiatic* regions, ſhook *Hungary*, *Germany*, *Italy*, and *France*, and conſequently a great part of *Europe*. And if that part of the narrative be certain, which relates, that this laſted not much above a quarter of an hour, it will be the more likely, that this earthquake ſhook great tracts of land beyond thoſe places, to which the fired matter, paſſing from one cavity to another, could reach in ſo ſhort a time: as you will the more eaſily gueſs, if you try, as I have done, that in trains of gunpowder itſelf the fire does not run on near ſo ſwiftly as one would imagine. But though I have been in more earthquakes than one; yet, ſince they were too ſudden and too ſhort to afford me any conſiderable obſervation, I ſhall ſay no more of them; but proceed to take notice, that oftentimes the motion of a coach or cart, that paſſed at a good diſtance from the place I was in, has made the buildings ſo ſenſibly ſhake, that I could not but wonder, that ſo great a portion of ſo firm and ſluggiſh a body, as the earth, could, by a cauſe, that ſeemed very diſproportionate to ſuch an effect, be made to tremble itſelf, and manifeſtly to ſhake firm buildings, that were founded on it. And this obſervation made me the more inclinable to give credit to their relations, who tell us, that in a calm night, the march of a troop of horſe may be felt by attentive ſcouts watching at a great diſtance off, by the ſhake, that the ground receives from the trampling of the horſes; though I formerly ſuſpected much, and do yet a little, that the impulſe of the air conveyed along the reſiſting ſurface of the ground might mainly contribute to the effect, that is aſcribed only to the motion of the ſoil.

Natur. quæſt. Lib. IV. *Cap.* 25. *Lib.* III. *Cap.* 26.

Before I advance to the ſecond member of this chapter, it may not be impertinent to note, that in peculiarly diſpoſed bodies, and eſpecially in organical ones, a very languid motion may have a far greater effect, than it could produce by a bare propagation of itſelf. For it may ſo determine the motion of the ſpirits or other active parts of the body it works on, as to make multitudes of them act as if they conſpired to perform the ſame motions. As when a tickliſh man, by having the pulp of one's finger paſſed gently along the ſole of his foot or the palm of his hand, has divers muſcles and other parts of his body and face put into preternatural or unuſual motions. And moſt men, by being lightly tickled with the end of a feather or ſtraw within their noſtrils, have their heads and many parts of their bodies put into that violent commotion, wherein ſneezing conſiſts. And I remember, that having for ſome time been, by a diſtemper, (from which God was graciouſly pleaſed a while

after to free me,) quite deprived of the uſe of my hands; it more than once happened to me, that ſitting alone in a coach, if the wind chanced to blow a ſingle hair upon my face in the ſummer time, the tickling or itching, that it produced, was ſo uneaſy to me, until by calling out to a footman I could get it removed, that, though I could well bear it as long as I was wont to do, when, having the uſe of my hands, I could relieve myſelf at pleaſure; yet if I were forced to endure the itching too long, before any came to ſuccour me, the uneaſineſs was ſo great, as to make me apprehend falling preſently either into convulſions or a ſwoon. But it is time to proceed to the ſecond member of this chapter.

2. OTHERS there are, that cannot believe, that local motion, eſpecially if it be languid, can be propagated through differing mediums, each of which, ſave that wherein the motion is begun, muſt, they think, either repel, or check and dead it. To theſe I ſhall recommend the conſideration of an experiment, I remember I made before ſome learned men in our pneumatick engine: for having cauſed a large thick glaſs receiver to be ſo blown, that it had a glaſs button in the inſide of that part, which upon the engine was to be placed upwards, I cauſed a watch to be ſuſpended by a little ſilver chain faſtened to that button by as ſlender and ſoft a body, as I thought would be ſtrong enough to ſupport my watch; and then, the glaſs being cemented on cloſe to the receiver, to prevent a commerce between the cavity of it and the air, the watch, that hung freely near the middle of the cavity of the receiver, made itſelf to be heard by thoſe attentive liſtners, that would hold their ears directly over the ſuſpended watch, whoſe motions were thereby argued to have been propagated either through the included air, or along the ſtring, to the concave part of the glaſs, and through the whole thickneſs of the glaſs to the convex part, and thence through the interpoſed air to the ear. And this mention of watches minds me of what I often obſerved in a ſmall ſtriking watch, that I have worn in my pocket; for when it ſtruck the hours, and in ſome poſtures, when the balance did but move, I could plainly feel the briſker motions of the bell, and ſenſibly the languid ones of the balance, through the ſeveral linings of my breeches, and ſome other interpoſing ſoft and yielding bodies; and this, though the watch (as I ſaid) was ſmall, and the balance included in a double caſe, and though the outwardmoſt were of (what they call) ſhagreen, and the innermoſt of gold; which I therefore mention, becauſe that cloſeſt of metals is obſerved more to dead ſounds and motions, than harder metals, as ſilver, copper and iron.

THAT motion may be propagated through differing mediums, may ſeem the more probable by the ſhakings, that are often felt by men lying on beds, that ſtand in rooms cloſe ſhut, when loud claps of thunder are produced (perhaps at a great diſtance off) in the clouds. And whether it will be fit to add to this inſtance that, which you have lately met with in the third chapter, of a wounded Frenchman at *Copenhagen*, I leave you to conſider."

I KNOW not, whether it will be very proper to take notice, on this occaſion, of an odd phænomenon recited by the experienced *Agricola*, in theſe words: *Si animal dejicitur in autrum Viburgenſe, quod eſt in Carelia, regione Scandiæ, erumpit, ut perhibent, ſonus intolerabilis magno cum flatu: ſi leve pondus in ſpecum Dalmatiæ, quamvis, inquit Plinius tranquillo die, turbini ſimilis emicat procella.* "If you throw down an animal into the "hole of *Viburg*, which is in *Carelia*, a country in *Scandia*, it is reported, that there "breaketh immediately forth a great and inſufferable ſound, together with a ſtrong "wind: if a ſmall weight be thrown into the gap of *Dalmatia*, though, ſays *Pli*-"*nius*, in a calm day, there is a ſtorm immediately raiſed, not unlike that, which is "occaſioned by a whirlwind." *De nat. rerum quæ eſt. e terra lib 4. cap. 7.*

3. As

3. As thoſe, of whom I took notice at the beginning of this chapter, are backward to allow, that motion may be conſiderably propagated through ſolid bodies; ſo on the contrary, there are others, that are indiſpoſed to think, that it is near ſo propagable, as indeed it is through fluid bodies; becauſe they preſume, that the eaſy ceſſion of the parts of fluids will dead the impulſe received by thoſe of them, that are firſt acted on by the impelling body. And

4. THERE is yet another ſort of naturaliſts, who, though they may be brought to grant, that motion may be propagated even through a ſoft and yielding medium, cannot believe, that it ſhould through ſuch a medium be propagated to any conſiderable diſtance; being perhaps induced to this opinion by obſerving, that though a body ſomewhat broad as well as ſolid, as the palm of one's hand, or a battledore, be moved through the air ſwiftly enough to make a wind; yet that wind will not be ſtrong enough to be felt any more than a very little way off. Wherefore, becauſe the inſtances, to which I aſſign the remaining part of this chapter, may be for the moſt part applicable to the removal of both theſe prejudices; it may, for brevity ſake, be expedient to conſider them both together.

Des Cartes judgment of light.

IF luminous bodies act on our eyes, not by a ſubſtantial diffuſion of extremely minute particles, as the atomiſts would have it, but by a propagated pulſion of ſome ſubtile matter contiguous to the ſhining body, (as the Carteſians, and many other philoſophers maintain) it will be manifeſt, that a body leſs than a ſmall pin's head may give a briſk motion to a proportion of fluid matter, many millions of times greater than itſelf; ſince in a dark night a ſingle ſpark of fire may be ſeen in different places, whoſe diſtance from it exceeds many thouſand times the ſpark's diameter: not to mention the great remove, at which the flame of a ſmall taper may not only be ſeen, but appear greater than near at hand. And if we compare the diameter of that bright planet Venus, which yet ſhines but with a borrowed and reflected light, with its diſtance from the earth, we may eaſily conclude, that the fixed ſtars, which probably are ſo many ſuns, that ſhine by their own native light, muſt impel a ſtupendous proportion of ætherial matter, to be able at that immenſe diſtance to make ſuch vivid impreſſions, as they do, upon our eyes. But to deſcend to inſtances leſs remote and diſputable, I ſhall, in order to the removal of the two lately mentioned prejudices, proceed to conſider; that, though it be true, that fluid bodies do eaſily yield to ſolid ones, that impel them, and thereby oftentimes quickly dead the motion of thoſe ſolids; yet the motion being loſt only in regard of the ſolid body, is not loſt, but tranſmitted and diffuſed in reference to the fluid: as when a log of wood, or any ſuch body ſpecifically lighter than water, is let fall in the middle of a pond, though its progreſs downwards be checked, and it be brought to reſt quietly on the ſurface of the water, yet its motion is not loſt, but communicated to the parts of the water it firſt ſtrikes againſt, and by thoſe to others, till at length the curls or waves produced on the ſurface of the water ſpread themſelves, till they arrive at the brinks, and would perhaps be farther expanded, if theſe did not hinder their progreſs. From which inſtance we may learn, that, though the nature of fluid bodies, as ſuch, requires, that their parts be actually diſtinct and ſeparately moved, yet the particular corpuſcles, that compoſe them, being (at leaſt here below) touched by divers others, the new motion, that is produced in ſome of them by an impellent ſolid, muſt needs make them impel the contiguous corpuſcles, and theſe thoſe that chance to lye next to them; and ſo the impulſe may be propagated to a diſtance which you will the more eaſily believe may be great, if you conſider with me, both that in a fluid body the corpuſcles, being already in the various motion requiſite to fluidity, yield more eaſily to the impellent, and alſo that being fully, or very near it, counterpoiſed by others of

A probability, that the fixed ſtars are ſo many ſuns.

the

the ſame fluid, a ſcarce imaginably little force may ſuffice to impel them; inſomuch that, though the braſs ſcale of a balance, of divers inches in diameter, may well be ſuppoſed to outweigh many myriads of ſuch particles as compoſe water, wine, *&c.* yet, (as I elſewhere more fully relate) when ſuch a ſcale was duly counterpoiſed with another like it, I could eaſily put it into various motions only with the inviſible effluvia of no great piece of amber. And if we conſider that obvious inſtance of the ſwelling circles made by caſting a ſtone into a pond, or other ſtagnant water, we ſhall be the more eaſily perſuaded, that, even in a heavy fluid, a motion may reach a far greater way, than men are uſually aware of, beyond the parts on which it was firſt impreſſed.

On this occaſion I muſt not omit a ſtrange obſervation given me by a very experienced navigator, that much frequents the coaſt of *Groenland*, and other arctick regions, to fiſh for whales: for this perſon being diſcourſed with by me about the effects of the breaking of thoſe vaſt piles of ice, that are to be met with in thoſe parts, aſſured me, that not only he had often heard the ice make, in breaking, a terribler noiſe than the loudeſt claps of thunder with us; but that ſometimes, when the ſea-water had, as it were, undermined the foundation of the mountainous piece of ice, he has known it at length ſuddenly fall into the ſubjacent ſea, with ſo much violence as to make a ſtorm at a great diſtance off; inſomuch that once, when he lay two leagues off the place, where this ſtupendous maſs of ice fell, it made the waves go ſo high, as to waſh clear over the ſtern of the ſhip, with danger enough to ſome of his men, and to ſink ſeveral of his ſhallops, that were riding by, though ſcarce any ſmall veſſels in the world uſe to be ſo fitted for rough ſeas, as thoſe about *Groenland*.

And whereas, though the air be a much thinner fluid, we are apt to think it indiſpoſed to propagate motion far, give me leave to tell you, that we take wrong meaſures, if we think, that (for inſtance) the undulating motion, into which the air is put by the action of ſonorous bodies, reaches but a little way, as we are apt to preſume it does, becauſe we judge of it by the effect it has on our ears, when the ſound is made in diſadvantageous places. For one, that, for inſtance, hears a lute or a viol played on in a room furniſhed with hangings, will be apt to think the ſound faint and languid, in compariſon of what it would appear to him, if the ſame inſtrument were played on after the ſame manner in an arched room without hangings; theſe ſoft and yielding bodies being apt to dead the ſound, which the figure and hardneſs of the vaulted room would reflect. And ſo, when a man ſpeaks aloud in the free air, we are not wont to take any notice of a progreſs made by the motion of the air beyond the place we are in, when our ears receive the ſound; but if the place happen to be furniſhed with echo, though at many times that diſtance from the ſpeaker, we may then eaſily take notice, that the motion of the air was carried on, and that with good vigour, to a far greater diſtance, than elſe we ſhould have obſerved. And I have often thought, that, even by the better ſort of our echoing places, we are not informed to near how great a ſphere the motion, which the air is put into by ſounds, may extend itſelf, where its diffuſion and vigour are not hindered nor weakened by bodies, either placed too near, or indiſpoſed to promote its operation.

What has been lately ſaid of the great diffuſion of ſounds, if themſelves be loud and great, will appear highly probable, by what is related by the learned *Fromundus*, who being profeſſor of philoſophy at *Louvain*, in the year 1627, had opportunity enough to know the truth of what he relates; namely, that at the famous ſiege of *Oſtend* in *Flanders*, the thunder of the great ordnance was heard at above thirty Dutch leagues, which, according to the vulgar reckoning, amounts to a hundred and twenty of our Engliſh miles; and that is yet, as he truly obſerves, more ſtrange, and makes *From. Meteor. lib. 2. art. 9.*

more for our preſent purpoſe, which he adds concerning the diffuſion of the ſound of a drum, which, he ſays, was, upon a time, heard at ſea twelve leagues off.

But to return to what I was ſaying of echos, to confirm my conjecture about them, I ſhall think it needleſs to offer you any other argument, than that, which you will draw yourſelf from the notable relation I met with in the learned *Varenius*, of an obſervation made by *David Frælichius*, who, in the company of a couple of ſtudents, had the curioſity (in the month of *June*) to viſit the mountain *Carpathus*, eſteemed the higheſt of all the Hungarian hills, and ſaid to be much more ſteep and difficultly acceſſible, than any of the Alps themſelves. *Frælichius* then (in my author) having related with what difficulty he and his companions aſcended above that region of the air, where they met with clouds and vehement winds, adds this memorable obſervation, for whoſe ſake I mention the ſtory: *Exploſi* (ſays he) *in ea ſummitate ſclopetum, quod non majorem ſonitum primò præ ſe tulit, quam ſi tigillum vel bacillum confregiſſem; poſt intervallum autem temporis murmur prolixum invaluit, inferioreſque montis partes, convalles, et ſylvas opplevit. Deſcendendo per nives annoſas intra convalles, cùm iterum ſclopetum exonerarem, major & horribilior fragor quàm ex tormento capaciſſimo inde exoriebatur: hinc verebar, nè totus mons concuſſus mecum corrueret; durávitque hic ſonus per ſemiquadrantem horæ, uſque dum abſtruſiſſimas cavernas penetraſſet, ad quas aer undique multiplicatus reſiliit. Et talia quidem objecta concava in ſummitate ſe non illico offerebant, idcirco ferè inſenſibiliter primùm ſonus repercutiebatur, donec deſcendendo antris et convallibus vicinior factus ad eas fortiùs impegit.* Geograph. general. lib. 1. c. 19.

" I diſcharged a piſtol, being upon the top of the hill, which at firſt made
" no greater noiſe than that, which uſually happens at the breaking of a ſmall rod;
" but after a little while the noiſe became ſtronger, and filled the lower parts of the
" hill, the vallies, and neighbouring woods. Now coming down lower through
" ſnow, that had lain there ſeveral years, and having diſcharged again the piſtol, the
" noiſe became, on a ſudden, louder, than that of the greateſt guns: which gave me
" ſome grounds to fear, that the whole hill, being thus ſhaken, ſhould at length
" ſubſide: this ſound laſted half a quarter of an hour, till it had penetrated into the
" remoteſt grotto's, whence the parts of the air thruſting one another had been
" ſtrongly reverberated; and becauſe no ſuch concavities were in the top of the hill,
" the ſound was firſt inſenſibly reverberated, till coming lower and nearer the grotto's
" and vallies, it was ſtrongly daſhed againſt them."

CHAP. VI.

OBSERVATION V.

Men uſually think not, what the modification of the inviſible motion of fluids may perform on the diſpoſed bodies of animals.

In this obſervation I expreſsly mention the diſpoſed bodies of animals, to intimate, that there is a peculiar aptitude required in thoſe animals, or ſome particular parts of them, that are to be ſenſibly affected by ſuch motions, as we are treating of, which would otherwiſe be too languid to have any ſenſible operation on them.

It ſeems the leſs ſtrange to me, that continuing ſounds, and other ſomewhat durable impulſes of the air or other fluids, ſhould have a manifeſt operation upon ſolid bodies, when I conſider the multitude of ſtrokes, that may in a very ſhort, and perhaps ſcarce obſervable time, be ſuppoſed to be given by the parts of the fluid to the conſiſtent body; for though each of theſe ſingle would perhaps be too languid to have any ſenſible effect at all; it being opportunely and frequently repeated by the ſucceſſive parts of

of the fluid, as by ſo many little ſwimming hammers or flying bullets, they may well have a notable effect upon the parts of a body expoſed to their action: as may be argued from the great ſwing, that may be given to pendulums, by a very languid force, if it ſucceſſively ſtrike the ſwinging body, when having finiſhed its excurſion, it is ready to return towards the perpendicular; as alſo from the tremulous motion, that is imparted even to the metalline ſtring of a muſical inſtrument, by the congruous motion the air is put into by another trembling ſtring, (as there may be hereafter occaſion to declare.)

I REMEMBER *Scaliger* tells a pleaſant ſtory of a knight of *Gaſcony*, whom the ſound of a bagpipe would force preſently to make water; adding, that a perſon diſobliged by this man, and reſolving to be merrily revenged on him, watched a time when he ſate at a feaſt, ſo as he could not well get out, and brought a bagpiper to play unawares behind him; which he did ſo unluckily, that the muſick had preſently its wonted effect upon the poor knight, to his great confuſion, and the laughter of the company. On which occaſion I ſhall add, that I know a very ingenious gentleman, who has confeſſed to me, that the noiſe of a running tap is wont to have almoſt the like operation upon him.

IT is a common obſervation, that the noiſe, that an ungreaſed cart-wheel makes in grating againſt the axletree, and the ſcraping of a knife upon a plate of ſilver or pewter, and ſome other briſk and acute ſounds, do ſo affect divers parts of the head, as to produce that effect, that is commonly called ſetting the teeth on edge; which, whether it proceed from any commerce between the auditory nerves, and thoſe that are inſervient to the motion we have mentioned, I leave anatomiſts to conſider. But theſe effects of acute ſounds are much leſs conſiderable than that, which I elſewhere relate of an ingenious domeſtick of mine, who ſeveral times complained, that the tearing of brown paper made his gums bleed; which argued, that the ſound had an operation not only upon the nervous and membranous parts, but the blood and humours themſelves.

SIR HENRY BLOUNT, in his voyage to the *Levant*, giving an account of what he obſerved in *Egypt*, has, among other remarkable things, this paſſage: many rarities of living creatures I ſaw in *Grand Cairo*, but the moſt ingenious was a neſt of four-legged ſerpents, of two feet long, black and ugly, kept by a Frenchman, who, when he came to handle them, they would not endure him, but ran and hid in their hole; then would he take his cittern and play upon it; they hearing his muſick, came all crawling to his feet, and began to climb up him, till he gave over playing; then away they ran.

THIS recalls to my mind, what ſome men of repute, and particularly the learned *Kircherus*, relate concerning a great fiſh, in or about the ſtreights, that ſever *Sicily* from *Italy*, which is ſaid to be much affected with a peculiar kind of tune (harſh enough to human ears) by which the mariners are wont to allure it to follow their veſſels. And it may much ſtrengthen the concluſion maintained in this chapter, if there be any certainty in the famous tradition, that the lion is terrified, and made to run away by the crowing of a cock: I ſay *if*, becauſe though I doubt not but ſome peculiar kinds of ſounds, as well as of other ſenſible objects, may be particularly and exceedingly ungrateful to the ſenſories of this or that peculiar kind of animals, and conſequently to the ears of lions; yet a late French traveller into the *Levant* gives me cauſe much to queſtion the matter of fact, affirming, that rowing along the brink of *Tigris* or *Euphrates*, (for I do not punctually remember which) they were, for many hours in the night, terrified by lions, that attended them along the brink of the river, and would not at all be frighted by the frequent crowing of the cocks, that chanced to be

Lions frighted by the crowing of cocks, a vulgar error.

be in the paſſengers boat: of which unconcernedneſs of the lions our obſerving traveller took much more notice, than the lions appeared to do of the crowing of the cocks. I might, on this occaſion, ſay ſomething of the received tradition, that many ſleeping perſons will be more eaſily waked by being called upon by their own uſual names, than by other names, though uttered with a louder voice: but this it may ſuffice to have mentioned; nor will I here inſiſt on that more certain example of the operation of a ſound, which is afforded by the ſtarting of men or greater animals, upon a ſurpriſing, though not vehement noiſe; though this oftentimes puts ſo many of the ſpirits and muſcles into motion, that the whole bulk of the animal is ſuddenly raiſed from the ground, which perhaps it could not be by the bare counterpoiſe of ſome hundreds of pounds: this I ſay, I will not in this place inſiſt on, becauſe the phænomenon ſeems to depend rather upon the loudneſs or acuteneſs of the ſound, than upon any determinate modification of it, particularly relating to the animal itſelf.

But the eminenteſt inſtance of the efficacy of peculiarly modified ſounds upon diſpoſed bodies, is afforded by what happens to thoſe, which are bit by a tarantula: for though the bitten perſon will calmly hear divers other tunes, yet when a peculiarly congruous one comes to be played, it will ſet him a dancing with ſo much vigour, as the ſpectators cannot but wonder at, and the dancing will ſometimes continue many hours, if the muſick do ſo, and not otherwiſe. I know there are ſome, that queſtion the truth of the things related of theſe Tarantati, (as the Italians call them) and I eaſily grant, that ſome fictions may have been ſuffered to paſs under the countenance of ſo ſtrange a truth: but beſides the affirmations of ſome learned men, (as well phyſicians as others) my doubts have been much removed by the accounts I have received from an ingenious acquaintance of mine own, who at *Tarentum* itſelf, whence the inſect takes its name, and elſewhere, ſaw many bitten perſons in their dances, ſome in publick and ſome in private places, and amongſt the reſt a phyſician, on whom the tune, that fitted his diſtemper, had the ſame operation as on the other patients. And the learned *Epiphanius Ferdinandus*, who practiſed phyſick in *Apulia* and *Calabria* for many years, not only delivers, upon his own perſonal obſervation, ſeveral narratives of the effects of muſick upon the Tarantati, but invites any, that may doubt of the truth of ſuch narratives, to repair to him at a fit ſeaſon, undertaking to convince them by ocular demonſtration.

See *Sandys's* travels.

I know a very honeſt and ſober muſician, who has divers times affirmed to me, that he could at pleaſure, by playing a certain tune, (which he acquainted me with, and which did not move others) make a perſon (whom he named to me) weep, whether ſhe would or no. And I might add, that when I have been taking phyſick, or am any thing feveriſh, the repetition of two verſes of *Lucan* ſeldom fails (as I have often tried) of producing in me a chilneſs, almoſt like that, but fainter, that begins the fit of an ague. But on this inſtance I look not, as a ſtrong proof of the phyſical efficacy of ſounds; becauſe thoſe two verſes having been emphatically read, when divers years ago I lay ſick of a ſlow fever, and could not reſt, they made ſo ſtrong an impreſſion on me, that whenever I am under a diſcompoſure any thing near like that, that then troubled me, thoſe verſes revive, as it were, in my brain and ſome other parts, that diſpoſition, or rather indiſpoſition, with which my firſt hearing of thoſe verſes was accompanied.

It may be the leſs admired, that the vibrating motion of the air, that produces ſounds, ſhould have ſuch effects upon diſpoſed organical bodies; ſince light itſelf, which either conſiſts of briſkly moving effluvia, far more ſubtile than aerial corpuſcles, or is propagated by the pulſe of a far more ſubtile body than air, may have a notable operation upon diſpoſed bodies: for we commonly obſerve, that the ſun-beams, by beating

beating upon the face or eyes of ſome, that come ſuddenly out of a ſhaded place into the light, preſently make them ſneeze; which, you know, is not done without a vehement motion of divers parts of the body. And though colour be but a modification of light; yet, beſides that it was antiently a practice, as the hiſtory of the *Macchabees* informs us, to ſhew red objects to elephants, to make them more fierce, it is a familiar obſervation, that red cloaths do offend and irritate turky-cocks. And that is more remarkable, which is related by the very learned phyſician *Valeſius*, of a perſon, that he knew, who, if he looked upon red objects, would not only have his eyes offended, but was ſubject to an effuſion of humours in the neighbouring parts.

CHAP. VII.

OBSERVATION VI.

Men ſuſpect not, what efficacy the inviſible motions of fluids may have, even upon inorganical bodies, upon the ſcore of ſome determinate congruity or relation betwixt a peculiar texture of the one, and the peculiar modification of the other's motion.

THOUGH the experiments delivered in the foregoing chapter have, I preſume, ſufficiently manifeſted, that the modification given to the motions of the air by ſonorous bodies may have conſiderable effects upon animals, in whoſe organized bodies the curiouſly contrived parts have an admirable connexion with, and relation to one another, and to the whole ſymmetrical fabrick they make up; yet, I fear, it will ſcarce ſeem credible, that ſonorous motions of the air, not very loud, ſhould find, even in bodies inanimate and inorganical, ſuch congruous textures and other diſpoſitions to admit their action, that even more languid ſounds, peculiarly modified, may ſenſibly operate upon them, and much more than ſounds, that are louder and more vehement, but not ſo happily modified. To make this good by particular experiments, I ſhall begin with that, which, though the effect may ſeem inferior to that of moſt of the others, I judge fitteſt to manifeſt, that the produced motion depends upon the determinate modification of that of the impellent fluid.

THAT a certain impulſe of air, made by one of the uniſon-ſtrings of a muſical inſtrument, may ſuffice to produce a viſible motion in another, is now become a known experiment; of the cauſe and ſome unobſerved phænomena of which I elſewhere more fully diſcourſe. But, that it may not be ſuſpected in this caſe, that the ſhake of the untouched ſtring is communicated to it by the propagated motion of the inſtrument itſelf, to which the ſtring, that is ſtruck, is alſo faſtened; I ſhall add, that, according to what I elſewhere relate, I found by trial purpoſely made, that a ſtring of wire, (which you will grant to be a more ſolid body, than an ordinary gut-ſtring) may be, without an other ſtring, brought to tremble by a determinate ſound made at a diſtance, which produced but ſuch an impulſe of the air, as could neither be ſeen nor felt by the byſtanders, nor would communicate any ſenſible motion to the neighbouring ſtrings. It is true, that in this caſe the ſtring, in which the trembling was produced, was a ſingle, long, ſlender and ſpringy body, faſtened at both ends to a ſtable one; and therefore it may ſeem altogether groundleſs to expect, that any thing like this effect ſhould be by the ſame cauſe produced in bodies, that do not appear ſo qualified. But, as we elſewhere ſhew, that a certain degree or meaſure of tenſion is in order to this phænomenon the principal qualification, without which all the other would be unavailable; perhaps it will not be abſurd to enquire, whether,

in bodies of a very differing appearance from ſtrings, the various textures, connexions and complications, that nature or art, or both, may make of the parts, may not bring them to a ſtate equivalent to the tenſions of the ſtrings of muſical inſtruments, whereby divers of the mentioned parts may be ſtretched in the manner requiſite to diſpoſe them to receive a vibrating motion from ſome peculiar ſounds; and whether theſe trembling parts may not be numerous enough to affect their neighbours, and make, in the body they belong to, a tremulous motion diſcernable, though not by the eye, yet by ſome other ſenſe. This conjecture, or inquiry, you will, I hope, have the leſs unfavourable thoughts of, when you ſhall have conſidered the following experiments.

I REMEMBER, that many years ago I found by trial, that, if a ſomewhat large and almoſt hemiſpherical glaſs, though not very thin, were conveniently placed, a determinate ſound, made at a convenient diſtance from the concave ſurface of the glaſs, would make it ſenſibly ring, as a bell does a while after it has been ſtruck: but this noiſe was the effect of a determinate ſound; for, though the voice were raiſed to a higher tone, or if the ſound were made louder, the ſame effect would not enſue. I remember alſo, that, ſome years after, I obſerved, that large empty drinking glaſſes of fine white metal had each of them its determinate tenſion, or ſome diſpoſition, that was equivalent, as to our purpoſe. For, cauſing the ſtrings of a muſical inſtrument to be variouſly ſcrewed up, and let down, and briſkly ſtruck, we found, as I expected, that the motion of one ſtring, when it was ſtretched to a certain note or tone, would make one of the glaſſes ring, and not the other; nor would the ſound of the ſame ſtring, tuned to another note, ſenſibly affect the firſt glaſs, though perhaps it might have its operation upon another. And this circumſtance is not, on this occaſion, to be omitted, that, after we had found the tone proper to one of the glaſſes, and ſo tuned the ſtring, that, (I ſay) when that was ſtruck, the glaſs would reſound. Having afterwards broken off a part of the foot of the glaſs, yet not ſo much, but that it continued to ſtand upright, the ſame ſound of the ſtring would no longer be anſwered by the veſſel, but we were obliged to alter the tenſion of the ſtring, to produce the former effect. The learned *Kircherus*, as I have been informed, ſomewhere mentions a correſpondence between ſome liquors and ſome determinate ſounds; which I ſuppoſe may be true, though the trial did not ſucceed with me, perhaps for want of ſuch accommodations for ſo nice an experiment, as I could have wiſhed, but could not procure: but if you can, you will oblige me to make the trials ſo, as to ſatisfy yourſelf and me, whether the agitation of the liquor be cauſed immediately by the motion of the air, or be communicated by the intervention of the tremblings the veſſel.

AN artiſt, famous for his ſkill in making organs, anſwered me, that, at ſome ſtops of the organs, ſome ſeats in the church would tremble. But becauſe I ſuſpected by his relation, that the greatneſs of the ſound chiefly effected it, becauſe when that pipe, which they call the open *diapaſon*, ſounds, the chair or ſeat, on which the organiſt ſits, and perhaps the neighbouring part of the organ trembles; I ſhall add, that I have divers times obſerved certain ſounds of an excellent organ to make not only the ſeat I ſate on in the church tremble under me, but produce an odd tremulous motion in the upper part of my hat, that I could plainly feel with my hands. And that, which makes me apt to believe, that this effect depends upon the determinate tone, rather than upon the loudneſs of the ſound, is, that I have oftentimes felt, and diligently obſerved, ſuch a kind of motion in the upper part of my hat, upon the pronouncing of ſome words in ordinary diſcourſe; in which caſe the effect could not with

probability be referred to the greatneſs of the ſound, but its peculiar fitneſs to communicate ſuch a motion to a body ſo diſpoſed.

Nor is it only in ſuch ſmall and yielding bodies, as hats and ſtrings, that ſounds, that are not boiſterous, may produce ſenſible effects; for, if they be congruous to the texture of the body they are to work on, they may excite motions in it, though it be either ſolid or very bulky: of which I ſhall here ſubjoin a couple of inſtances.

An ancient muſician affirmed to me, that, playing on a baſe viol in the chamber of one of his ſcholars, when he came to ſtrike a certain note on a particular ſtring, he heard an odd kind of jarring noiſe, which he thought at firſt had either been caſual, or proceeded from ſome fault in the ſtring; but having afterwards frequent occaſion to play in that ſame room, he plainly found, that the noiſe he marvelled at was made by the tremulous motion of a caſement of a window, which would be made to tremble by a determinate ſound of a particular ſtring, and not by other notes, whether higher or lower.

To this firſt inſtance I ſhall add the ſecond, which, I confeſs, I was not forward to believe, till trial had convinced me of the truth; and I ſcrupled it the rather, becauſe, if the reflection of determinate ſounds ſhould appear to proceed from the peculiar kind of tremulous motion, into which the parts of the reſonant body are put, it may incline men to ſo great a paradox, as to think, that ſuch a motion of the air, as our bodies do not feel, may produce a trembling in ſo ſolid a body, as a ſtone-wall of a great thickneſs. The experiment or obſervation itſelf I ſhall give you in the ſame words I ſet it down ſome hours after I made it, which were theſe.

Yesterday I went to ſatisfy myſelf of the truth of what had been told me by an ancient muſician, to whom I had been relating, what I had obſerved of the effects of ſome determinate ſounds even upon ſolid bodies, and of whom I inquired, if he had met with any thing of the like nature: taking him along with me, I found, that though the place be but an arch, yet it would not anſwer to all notes indifferently, when we ſtood in a certain place, but to a determinate note, (which he afterwards told me was *Ce fa ut* a little flatted,) to which note it anſwered very reſonantly, and not ſenſibly to others, which we made trial of, whether higher or lower than it: and (which added to the ſtrangeneſs) when I made him raiſe his voice to an eighth; as conſonant as thoſe two ſounds are wont to be in all other caſes, the vaulted arch did not appear to us affected with the note. The muſician added, that he had tried in moſt arches all about the city, and could not find ſuch a peculiarity in them, as being to be made reſonant by all notes or ſounds indifferently, that were ſtrong enough; and alſo, that as this arch for this hundred years has been obſerved to have this property, ſo an ancient and experienced builder informed him, that any vault, that were exquiſitely built, would peculiarly anſwer to ſome determinate note or other.

CHAP. VIII.

Observation VII.

Men look upon divers bodies, as having their parts in a ſtate of abſolute reſt, when indeed they are in a forced ſtate, as of tenſion, compreſſion, &c.

This obſervation will probably ſeem paradoxical; for when an intire body, eſpecially if it be of a ſolid conſiſtence, and ſeem to be of an homogeneous or uniform matter, appears to be moveleſs, we are wont to take it for granted, that the parts, which that body is made up of, are perfectly at reſt alſo. But yet this will ſcarce

ſcarce be thought a reaſonable ſuppoſition, if we do but rightly conſider ſome obvious phænomena, which may teach us, that whilſt a whole body, or the ſuperficies, that includes it, retains its figure, dimenſions and diſtance from other ſtable bodies, that are near it, the corpuſcles, that compoſe it, may have various and briſk motions and endeavours among themſelves. As when a bar of iron or ſilver, having been well hammered, is newly taken off of the anvil, though the eye can diſcern no motion in it, yet the touch will readily perceive it to be very hot; and, if you ſpit upon it, the briſk agitation of the inſenſible parts will become viſible in that, which they will produce in the liquor. Beſides, when the lath of a croſs-bow ſtands bent, though a man do neither by the eye nor the touch perceive any motion in the ſpringy parts; yet, if the ſtring be cut or broken, the ſudden and vehement motion of the lath, tending to reſtore it to the figure it had before it was bent, diſcovers a ſpringineſs; whence we conclude it was before in a ſtate of violent compreſſion. And though the ſtring of a bent bow do likewiſe appear to be in a ſtate of reſt; yet, if you cut it aſunder, the newly made extreams willl fly from one another ſuddenly and forcibly enough to manifeſt, that they were before in a violent ſtate of tenſion. And on this occaſion I could add divers inſtances taken not only from the works of art, but thoſe of nature too, if they did not belong to another paper: but one ſort of obſervations it will be proper to ſet down in this place; becauſe in thoſe already mentioned, the bow and ſtring were brought into a violent ſtate by the meer and immediate force of man. I ſhall therefore add, that there are divers bodies, in which, though no ſuch kind of force appears to have antecedently acted on them, we may yet take notice of a ſtate of violent compreſſion or extenſion, and a ſtrong endeavour or tendency of the parts, that to the eye or the touch ſeem at reſt, to ſhrink, or to fly out; and this endeavour may in ſome caſes be more laſting and more forcible, than one would eaſily ſuſpect or believe. But examples of this kind you muſt not expect that I ſhould give you out of claſſick authors, ſince in them it is like you have not met with either an inſtance or a conjecture to this purpoſe; but ſome few things, that I tried myſelf, and ſome others, that I learnt by inquiry from ſome tradeſmen, whom I judged likelieſt to inform me, I ſhall briefly acquaint you with.

I HAVE ſometimes obſerved myſelf, and have had the obſervation confirmed to me by the ingeniouſer traders in glaſs, that a glaſs, that ſeemed to have been well baked, or nealed, (as they call it,) would ſometimes, many days or weeks, or perhaps months, after it is taken from the fire, crack of its own accord; which ſeems for the moſt part to happen upon the ſcore of the ſtrong, but unequal, ſhrinking of the parts of the glaſs. And the glaſs-men will tell you, that if they take their glaſſes too haſtily from the fire, not allowing them leiſure to cool by degrees, they will be very apt to crack. But I remember, that, to ſatisfy ſome ingenious men, I deviſed a way of exhibiting a much more quick and remarkable phænomenon of that kind. Having made then, by a way I elſewhere teach, a flat lump of metalline glaſs, two or three or four times as thick, as an ordinary drinking glaſs, I obſerved, as I expected, that though it had been melted in a very gentle fire, its very fuſible nature needing no other; and though it were removed but very little from the fire, it was ſo diſpoſed to ſhrink upon a ſmall degree of refrigeration, or rather abatement of heat, that, before it was ſenſibly cold, it would crack with a noiſe in ſo vehement a manner, that, notwithſtanding the ponderouſneſs of the matter, which had been purpoſely laid upon a level, parts of a conſiderable bulk, weighing perhaps ſome drams, would fly to a not inconſiderable diſtance from one another. And this experiment I took pleaſure to make more than once. And if you will be content with an inſtance, which, though otherwiſe much inferior, may not be unwelcome, for its being eaſily and readily made, I

ſhall

ſhall offer you one, that I have often repeated. Take a piece of copper, (if the plate be thick, it is ſo much the better,) and having throughly brought it to a red or white heat among kindled coals, take it from the fire, and when it begins to cool a little, hold it over a ſheet or two of white paper, and you will perceive good ſtore of flakes to fly off, not without ſome little noiſe, one after the other, and ſometimes perhaps as far, as the farthermoſt edges of the paper; which flakes or ſcales ſeem, by their brittleneſs and colour, to be but parts of the ſurface of the metal vitrified by the vehement action of the fire, and afterwards by a too haſty refrigeration ſhrinking ſo violently, as to crack and leap from one another, like the contiguous parts of the ſtring of a viol or other muſical inſtrument, that breaks by the moiſture of the air. And on this occaſion I ſhall add, that having afterwards inquired of an expert artificer, that made metalline concaves, about the ſhrinking of his mixtures of metals, he confeſſed to me, that he uſually obſerved them to ſhrink upon refrigeration. And the like I myſelf have obſerved in iron of a great thickneſs, and purpoſely fitted to a hollow body of metal, which it would not enter when it was ignited, though it would when it was cold. But to ſhew you by a notable inſtance or two, both that metals may ſhrink, and that they may do ſo with a very conſiderable force, I ſhall add, that I found by inquiry, that the lately mentioned artificer, after he had made ſome large concaves of an unfit mixture of metals, and having removed them from the fire, had been very careful to keep the cold air from them, leſt they ſhould cool too haſtily; obſerved yet, to his great loſs, that, when they came to be further refrigerated, they would (perhaps after three hours) crack with a great noiſe, though this metalline mixture were perchance harder than iron, and three or four times as thick as common looking-glaſſes. But the misfortune of another tradeſman afforded me yet a more conſiderable phænomenon. For this excellent artificer, whom I often employ, and with whom I was a while ſince diſcourſing of theſe matters, complained to me, that having lately caſt a kind of bell-metal upon a very ſtrong ſolid inſtrument of iron of a conſiderable ſuperficial area, though the metal were ſuffered in a warm room to cool, from about eight o'clock on Saturday night till about ten or twelve on Monday morning, and were then (which is to be noted) conſiderably hot to the touch; yet it cooled ſo far, that, ſhrinking from the iron, that would not ſhrink with it, the bell-metal cracked, in divers places, with noiſes loud as the report of a piſtol, though the metal, he affirmed to me, was an inch and an half, or two inches thick. And the ſame perſon ſhewed me a large cylinder of iron, about which, for a certain purpoſe, a coat of bell-metal had been caſt ſome days before; on which (bell-metal) there was a crack near one end made by the coldneſs of the iron, though the thickneſs of the bell-metal, as near as I could meaſure it, exceeded an inch, and (as the workman affirmed) an inch and a quarter.

Nor is it only in ſuch mixtures as bell-metal, which, though very hard, may be very brittle, but even in a metal, that is malleable when cold, that the like phænomenon may be met with, as I have been aſſured by another ingenious artificer, of whom I inquired, whether he had taken notice of the ſhrinking of metals; who affirmed to me, that having had occaſion to caſt about a cylinder of iron a ring or hoop of braſs, he found, to his trouble, that, when the metal began to cool, the parts ſhrunk from one to another ſo, as to leave a gaping crack, which he was fain to fill up with ſoder quite croſs the breadth of the ring, though this were above an inch thick.

I should not, *Pyrophilus*, have in this chapter entertained you with more experiments of others, than of my own, if I had the conveniency of living near founders of metals, as the tradeſmen had, whoſe obſervations I have recited, and whoſe ſincerity

in them I had no cauſe to queſtion; and both their experiments and mine ſeem to teach, that a body may be brought into a ſtate of tenſion, as well by being expanded and ſtretched by the action of the fire upon the minute parts, as by the action of an external agent upon the intire body. And, to ſpeak more generally, the ſtate of violent contraction and compreſſion may not unfitly be illuſtrated by a bow, that is bent. For, as the bow itſelf is brought to a ſtate of compreſſion by the force of the archer, that bent it; ſo by the elaſtical force of the bent bow the ſtring is brought into a violent ſtate of tenſion, as may be made evident by the cutting off the ſtring in the middle; for then both the bow will fly ſuddenly outwards, and the parts of the ſtring will ſwiftly and violently ſhrink from one another. And, according to this doctrine, the effect of other bodies upon ſuch, as are thus brought into, what men call a preternatural ſtate, is not to be judged barely according to uſual meaſures, but with reſpect to this latent diſpoſition of the patient: as, for inſtance, though the ſtring of a violin not ſcrewed up will not be hardened by the vapours, that imbue the air in moiſt weather; yet a neighbouring ſtring of the ſame inſtrument, though perhaps much ſtronger, being ſcrewed up, and thereby ſtretched, will be ſo affected with thoſe vapours, as to break with noiſe and violence. So when one part of a piece of glaſs is made as hot as can be, without appearing diſcoloured to the eye, though a drop or two of cold water have no effect upon the other part of the ſame glaſs, yet if it touch the heated part, whoſe wonted extenſion (as I have elſewhere proved) is altered by the fire, that vehemently agitates the component particles, the cracking of the glaſs will almoſt always preſently enſue.

If againſt theſe inſtances it be alledged, that it is poſſible to aſſign another cauſe of the ſeemingly ſpontaneous breaking of the bodies mentioned in this chapter, than that which I have propoſed, it will not much concern this diſcourſe to examine the allegation; for, whatever the latent cauſe of the phænomena may be, the manifeſt circumſtances of them ſuffice to ſhew, that bodies, which as to ſenſe, are in a natural ſtate of reſt, may be in a violent one, as of tenſion, and may have, either upon the ſcore of the contexture of the parts among themſelves, or upon that of ſome interfluent ſubtile matter, or ſome other phyſical agent, a ſtrong endeavour to fly off or recede from one another; and that, in divers bodies, the cauſe of this endeavour may act more vigorouſly, than one would eaſily believe: and this ſuffices to ſerve the turn of this diſcourſe; for I preſume, that a perſon of your principles will allow, that local motion muſt be produced by local motion, and conſequently, that, without a very ſtrong, though inviſible and unheeded one, ſuch hard and ſolid bodies, as thick pieces of metal, could not be made to crack.

I know not, whether I may on this occaſion acquaint you with an odd relation I had from a very honeſt and credible, as well as experienced artiſt, whom I, for thoſe reaſons, have ſeveral times made choice to deal with about precious ſtones, and other things belonging to the jewellers and goldſmiths trades. For, conſidering with him one day a large lump of matter, which contained ſeveral ſtones, that he took for coarſe agats, and which were joined together by a cement, that in moſt places was harder, than moſt ordinary ſtones, I perceived, that there remained divers pretty large cavities in this cement, which ſeemed to have contained ſuch ſtones as thoſe, that yet made parts of the lump; upon which occaſion he affirmed to me, that ſeveral of the ſtones grew whilſt they were lodged in thoſe cavities. And when I told him, that though I had been long of an opinion, that ſtones may receive an increment after their firſt formation, yet I did not ſee, how any ſuch thing appeared by thoſe we were looking upon; he gave me in many words an account of his aſſertion, which I reduced to this; that the ſtones he ſpoke of, did, after they were

firſt formed, really tend to expand themſelves by virtue of ſome principle of growth, which he could not intelligibly deſcribe; but that theſe ſtones being lodged in a cement extremely hard, and therefore not capable of being forced to give way, their expanſive endeavour was rendered ineffectual, but not deſtroyed: ſo that when afterwards theſe ſtones came to be taken out of the cement, wherein they were bedded, and to whoſe ſides it is like they were not exquiſitely congruous, the compreſſed ſtones, having their ſides now no longer wedged in by the harder cement, quickly expanded themſelves, as if it were by an internal and violently compreſſed ſpring, and would preſently burſt aſunder, ſome into two, and ſome into more pieces; of which he preſented many to his friends, but yet had reſerved ſome, whereof he preſented me one, that I have yet by me, together with ſome of the maſs, whoſe cement I find to bear a better poliſh than marble, and to be very much harder than it. And, in anſwer to ſome queſtions of mine, he told me, that he had taken up theſe ſtones himſelf, naming the place to me, which was not very far off, and that he obſerved all that he told me himſelf, and more than once or twice; and that I needed not ſuſpect, as I ſeemed to do, that it was the ſtrokes employed to force the ſtones out of their beds, that made them break: for, beſides that many of them, which (it ſeems) were not compreſſed enough, did not break, ſeveral of thoſe, that did, were taken out, without offering them any ſuch violence, as that their burſting could with any probability be imputed to it.

CHAP. IX.

OBSERVATION VIII.

One main cauſe, why ſuch motions, as we ſpeak of, are overlooked, is, that we are ſcarce wont to take notice but of thoſe motions of ſolid bodies, wherein one whole body drives away another, or at leaſt knocks viſibly againſt it; whereas many effects proceed from the inteſtine motions produced by the external agent in and among the parts of the ſame body.

THIS obſervation is like to be much more readily underſtood, than granted; and therefore I ſhall offer by way of proof the following experiments.

WE cauſed in a large braſs ſtop-cock the moveable part to be nimbly turned to and fro in the contiguous cavity of that part, that was made to receive it, in that part of the inſtrument, that is wont to be kept fixed. And though this motion of the key was made only by the bare hand, yet in a ſhort time the mutual attrition of the contiguous parts of the inſtrument made ſo briſk an agitation in the other parts, that the incaleſcence made the metal itſelf to ſwell; in ſo much that the key could no more be turned, but remained fixed, as if it had been wedged in; ſo that, to make it work as before, it was neceſſary by cooling it to make it ſhrink a little, and ſo take off the mutual preſſure of the key, and the other part of the ſtop-cock. Nor is this to be looked on as a caſual experiment; for, beſides that it was made more than once, and is very analogous to ſome other trials of mine; I found, that a maker of ſuch inſtruments complained to me, that he was ſeveral times forced to intermit his work, and plunge his inſtrument in cold water, before he could, by grinding, adjuſt the key to the cavity it ought to fit.

I PRESUME I need not take notice to you, that this experiment confirms what I elſewhere mention of the dilatation of metals themſelves by heat; and therefore I proceed to the next inſtance.

THIS is afforded by the known experiment of paſſing one's wetted finger upon the orifice of a drinking glaſs almoſt filled with water. For, though the eye does not immediately diſcern any motion, that, by reaſon of the preſſure of the finger, is made by one part of the glaſs upon another; yet, that a vibrating motion is thereby produced, may be argued by the dancing of the water, eſpecially that, which is contiguous to the preſſed ſides of the glaſs, by which it is oftentimes ſo agitated, that numerous drops are made to leap quite over, and others are toſſed up to a good height into the air. And that there may be conſiderable motions in the ſides of the glaſs, whilſt it does not break in pieces, we may probably gueſs by this; that in drinking-glaſſes artificially cut by a ſpiral line, both I and others have often found by trial, that a glaſs being dexterouſly inverted and ſhaken, the parts will vibrate up and down ſo manifeſtly, as ſometimes to lengthen the glaſs, by my eſtimate, a quarter of an inch or more; and yet, the glaſs being ſet again upon its foot, it appeared, that it had not been hereby at all injured.

THAT two pieces of iron or ſteel, by being ſtrongly rubbed againſt one another, will at length acquire a temporary heat, is not hard to be believed; but that an edged tool of hardened ſteel ſhould, by having its edge rubbed againſt, have a manifeſt and permanent change made in its texture, you did not perhaps ſuſpect: and yet, having had the curioſity to cauſe ſome metals, and particularly iron and ſteel, to be turned by an excellent artificer; I learned partly by his experience, and partly by my own, that the edge of the ſteel-tool, with which he by degrees ſhaved off the protuberant parts of the metal, would be ſo heated and agitated, that, in no long time, if care were not taken to prevent it, the tool would be brought to look of bluiſh and yellowiſh colours; and, permanently loſing its former temper, would become ſo ſoft, as to be uſeleſs for its former work, unleſs it were again artificially hardened: and therefore, to prevent the trouble of tempering his tools again, this artiſt, from time to time, dipt it, when it began to grow too hot, into a certain liquor, which he affirms, upon much experience, to have a peculiar fitneſs for that purpoſe.

NOR is it always neceſſary, that the body, that makes the parts of an inanimate body work conſiderably on one another, ſhould be either very hard, or impetuouſly moved. For I remember, that having once by me ſome ſhort bars of fine tin, I reſolved to try whether, meerly with my naked hands, (which you know are none of the ſtrongeſt or hardeſt,) I could not procure a conſiderable internal commotion among the parts; and accordingly, laying hold on the two ends of the bar with my two hands, I ſlowly bent the bar towards me and from me two or three times; and having by this means broke or cracked it in the midſt, I perceived, as I expected, that the middle parts had conſiderably heated each other.

WHAT uſe may be made of this experiment, in the ſearch of the hidden cauſe of elaſticity, would be leſs properly conſidered in this place, than in another. But ſince I have named that quality, I ſhall take this riſe to intimate, that if the reſtitution of a ſpringy body, forcibly bent, proceed only (as ſome learned moderns would have it) from the endeavour of the compreſſed parts themſelves to recover their former ſtate, one may not impertinently take notice of the elaſticity, that iron, ſilver and braſs acquire by hammering, among the inſtances that ſhew, what in ſome caſes may be done by a motion, wherein the parts of the ſame body are, by an almoſt unheeded force, put to act upon one another. But if ſpringineſs depend chiefly upon the pervaſion of a ſubtile matter, as the *Carteſians* would have it, then the inſtances will properly belong to another ſubject.

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§ The foregoing examples may alſo ſuffice to make out (what I am unwilling to refer to another head) this ſubordinate obſervation; that men are more uſually, than juſtly, prepoſſeſſed with an opinion, that nothing conſiderable is to be expected from the motion of a body againſt another, unleſs the former do make a manifeſt percuſſion or truſion of the latter. But, becauſe this prepoſſeſſion eſpecially prevails in caſes, where the body, that is by friction or attrition to affect the other, is itſelf ſoft or yielding, I ſhall on this occaſion add a few inſtances to remove this prejudice.

An artiſt eminent for grinding of optical glaſſes, confeſſed to me, that ſometimes, when he went about to poliſh his broader glaſſes, though but upon a piece of leather ſprinkled with puttee, that friction did ſo heat or otherwiſe agitate the parts of the glaſs, as, to his great loſs, to make it crack from the edge to the middle; which ſeemed the more ſtrange, becauſe we ſee, what intenſe degrees of heat glaſſes will endure without cracking, if the fire be but gradually applied, as this artiſt's glaſſes muſt have been gradually heated.

But I think it worth inquiry, whether in this caſe the whole work be performed by meer heat; and whether there intervene not a peculiar kind of motion, into which ſome bodies are diſpoſed to be put by a peculiar kind of friction, which ſeems fitted to produce in manifeſtly ſpringy bodies, and perhaps in ſome others, (of which divers may be ſpringy, that are not commonly taken to be ſo,) ſuch a vibrating or reciprocal motion, as may have ſome notable effects, that are not wont to be produced by moderate heats, nor always by intenſe ones themſelves. The trembling of the parts of a drinking-glaſs, and the viſible vibration of the long and great ſtrings of a baſe-viol, upon peculiar ſounds, may give ſome countenance to this conjecture; and that in ſome bodies there may be ſuch a tremulous motion produced, by rubbing them upon ſo ſoft a thing as wool, or upon a piece of cloth, I tried by this experiment:

We caſt into a hollow veſſel, very ſmooth within, and of an almoſt hemiſpherical figure, ſeveral ounces of good melted brimſtone; and having ſuffered it to cool, and taken it out, the convex ſurface, as had been deſired, came off well poliſhed: then this conveniently ſhaped lump, which had (if I well remember) four or five inches in diameter, being briſkly rubbed in the ſame line forwards and backwards, upon a cuſhion or ſome ſuch woollen thing, in a place free from other noiſes, I could, by holding my ear to it, and attentively liſtening, plainly hear a crackling noiſe made by the agitated parts, which continued a briſk, and, as I ſuppoſed, a vibrating motion for ſome time after the friction was ended.

That there may be a conſiderable commotion produced among the internal parts of bodies, by rubbing them even againſt ſoft bodies, I have divers times obſerved, by the ſulphureous ſteams, that I could ſmell, if, after having a little rubbed a lump of good ſulphur upon my cloaths, I preſently held it to my noſe: which brings into my mind, that I have had the like effect from much harder and cloſer bodies than ſulphur, when they were rubbed upon bodies, that were ſo too; for having purpoſely taken hard ſtones cut out of men's bladders, and rubbed a couple of them a little againſt one another, they quickly afforded, as I expected, a rank ſmell of ſtale urine.

That diamonds themſelves will, by rubbing upon woollen clothes, be made electrical, ſeems to argue, that even their parts are ſet a moving: and that the commotion reaches to the internal parts, I am the more apt to think, becauſe I have a diamond, that, if I rub it well and luckily againſt my cloaths, will, for a little while, ſhine or glimmer in the dark; which is the ſame phænomenon, that I elſewhere relate

myſelf to have produced in the king's larger diamond, by giving it one briſk ſtroke with the point of a bodkin, where the light, that preſently appeared in the gem, ſeemed not referrible to any thing ſo likely, as the ſudden commotion made in the internal parts of that peculiarly conſtituted ſtone.

WHAT a peculiar modification of motion, diſtinct from its degrees of impetus, may do in fluid bodies, we have formerly in this eſſay taken notice of: but, perhaps, it may be worth while to inquire, what kinds there are of it, and what effects they may have in the parts of ſolid bodies themſelves. For I have obſerved, that though thoſe ſtones, that the Italian glaſs-men uſe, are very hard, and, if I miſremember not, have ſeveral times afforded me ſparks of fire by colliſion; yet, by rubbing them a little one againſt another, I found, that ſuch an agitation was made in their parts, as to make them throw out ſtore of fœtid exhalations: and it is poſſibly to the ſtony ingredient that glaſs owes the quality I have obſerved in it, and elſewhere mentioned, of emitting offenſive ſteams. And it is remarkable to our preſent purpoſe, that though ſo vehement an agitation of the parts, as is given to glaſs by heat, when it is made almoſt red-hot in the fire, does not make it ſenſibly emit odours; yet barely by dexterouſly rubbing two ſolid pieces of glaſs againſt one another, one may, in a minute of an hour, make thoſe fixed bodies emit ſuch copious ſteams, as I found, not only ſenſibly, but rankly, fœtid; though one would think thoſe ſtinking exhalations very indiſpoſed to be forced off, ſince they were not expelled by the vehement fire, that the glaſs long endured in the furnace, where it was kept melted.

THERE are few things, that ſhew better, both how the parts of inorganical bodies communicate their vibrating motions to one another, and how briſk thoſe motions are, than that, which happens upon the ſtriking of a large bell with a clapper or a hammer. For though the ſtroke be immediately made but upon one part, yet the motion thereby produced is propagated to the oppoſite, and the ſucceſſive vibrations of the ſmall parts do, even in ſo ſolid and cloſe a body as bell-metal, run many times round; as may appear by the durableneſs of the ringing noiſe, which ſeems plainly to proceed from the circularly ſucceſſive vibrations of the parts, which, unleſs they briſkly tremble themſelves, can ſcarcely be conceived to be fitted to give the air that tremulous motion, whoſe effect on the ear, when the firſt and loud noiſe made by the percuſſion is paſt, we call ringing. And this motion of the parts of the ſounding bell may be further argued by this; that if the finger, or ſome other ſoft body, be laid upon it, the ſound will be checked or deaded, and much more, if a broad ſtring, though of a ſoft ſubſtance, be tied about it. And not only an attentive ear may often make us gueſs, that the ringing ſound is produced by a motion propagated circularly in the bell, but this vibrating motion may ſometimes be alſo felt by the tremulous motion communicated by the trembling parts of the bell to the finger, that is warily applied to it. That this motion paſſes in a round from one ſide of the bell to the other, ſeems manifeſt by the great difference of ſound, eſpecially in regard of ringing, that may be obſerved in a ſound bell, and in a cracked one; where yet all the matter and the former figure are preſerved, only the intireneſs or continuity, which is neceſſary to the circulation (if I may ſo call it) of the tremulous motion, is at the crack ſtopt or hindered. And that the motion of the parts is very briſk, may be gueſſed partly by what has been ſaid already; but much more, if that be true, which, not only is traditionally reported by many, but has been affirmed to me by ſeveral artificers, that deal in bells, who averred, as an experienced thing, that if a conveniently ſized bell were bound about, any thing hard, with a broad ſtring, and then ſtruck with the uſual force, that it would otherwiſe bear very well; that percuſſion would break it, giving a diſorderly check to the briſk motion of the parts of

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the bell, whereof ſome happening to be much more (and otherwiſe) agitated than others, the force of their motion ſurmounts that of their coheſion, and ſo produces a crack.

But, in regard great bells are not eaſy to be procured, nor to be managed, when one has acceſs to them, I ſhall add, that I took the bell of a large watch, or very ſmall clock, made of fine bell-metal, which had no handle or other thing put to it, ſave a little bodkin or ſkewer of wood, whoſe point we thruſt into the hole, that is uſually left in the middle of the baſis; and this ſharp piece of wood ſerving for a handle to keep the bell ſteady enough, we placed in the cavity of it, near the edges, (for that circumſtance muſt not be omitted,) ſome black mineral ſand, or, in want of that, ſome ſmall filings of ſteel or copper, or ſome other ſuch minute and ſolid powder, which yet muſt not be too ſmall; and then ſtriking moderately with the key againſt the ſide of the bell, we obſerved, (as we expected,) that, whilſt it continued briſkly ringing, it made many of the filings to dance up and down, and ſometimes to leap up, almoſt like the drops of water formerly mentioned to ſkip when the brim of the glaſs was circularly preſſed by the wetted finger: which prompts me to add, that, having put a middle-ſized drop of water (for in this caſe the quantity is a conſiderable circumſtance) near the lower edge of the bell, it was eaſy to make it viſibly tremble, and be, as it were, covered over with little waves, by a ſomewhat briſk ſtroke of the key on the oppoſite ſide. And this effect was more conſpicuous, when a very large drop of water was placed near the edge on the convex ſide of a hand-bell, whoſe clapper was kept from any where touching the inſide of it. And to obviate their jealouſy, that, not having ſeen the manner of the above-mentioned motion of the ſand, might ſuſpect, that it was produced by the impulſe, which the bell, as an intire body, received from the percuſſion made by the key, we ſeveral times forbore putting in the filings, till after the ſtroke had been given; which ſatisfied the ſpectators, that the dancing and leaping of the minute bodies proceeded from the ſame briſk vibrations of the ſmall parts of the bell, which, at the ſame time ſtriking alſo the air, produced a ringing ſound, which might very well, as it did, out-laſt the ſkipping of the filings; the exceedingly minute particles of the air, being much more eaſily agitable, than the comparative groſs and heavy corpuſcles of the powder. And this ſucceſs our experiment had in a bell, that little exceeded an inch and half in diameter.

And here, *Pyrophilus*, I ſhall put an end to this rhapſody of obſervations, hoping, that among ſo many of them, ſome or other will be able to engage you, if not to conclude, yet at leaſt to ſuſpect, that ſuch local motions, as are wont either to be paſt by unobſerved, or be thought not worth the obſerving, may have a notable operation, though not upon the generality of bodies, yet upon ſuch as are peculiarly diſpoſed to admit it, and ſo may have a conſiderable ſhare in the production of divers difficult phænomena of nature, that are wont to be referred to leſs genuine, as well as leſs intelligible cauſes.

A SHORT SUPPLEMENT TO THE ESSAY OF THE GREAT EFFECTS

Of even LANGUID and UNHEEDED LOCAL MOTION.

THAT I may not be altogether wanting to the expectation, that may have been raiſed by a paſſage in the advertiſement prefixed to the foregoing eſſay, I ſhall here ſubjoin ſome particulars, which perhaps will not be unwelcome to the readers, that occurred to my remembrance, whilſt I was, with a tranſient eye, reviewing the heads of the paſt diſcourſe: but theſe paralipomena or ſupplements will be but few, not only becauſe of my want of leiſure to review the tract they belong to deliberately, but alſo becauſe ſome inſtances, that might be here ſubjoined, may be more opportunely brought in in other papers.

To the third CHAPTER.

THAT the motion of the air, that accompanies ſounds, may be propagated to great diſtances, and yet make conſiderable impreſſions on the bodies it finds there diſpoſed to admit its action, may be notably confirmed by a phænomenon I have met with in the learned mathematician *Borellus*, who relates it upon his own knowledge, and not undeſervedly magnifies it; which I ſhall therefore recite in his own words. *Aderam* (ſays he) *Tauromenii Siciliæ, quando Etna mons eruptionem quandam effecerat propè Ennam, urbem fere* 30. *milliaria à Tauromenio diſtantem, tunc vicibus interpolatis eruptiones ingentes ignis vorago efficiebat, grandi ſono & ſtrepitu, & tunc omnia Tauromenii ædificia tremore concutiebantur, in quo circumſtantiam notatu digniſſimam obſervavi; ſcilicet, quod domus & ædificia, quæ directè expoſita erant proſpectui ejuſdem voraginis, vehementiſſimè concutiebantur; reliquæ verò domus, quæ conſpectu voraginis privabantur, ſatis lentè & leniter tremorem efficiebant.* Upon which matter of fact he thus argues: *Profectò, ſi hujuſmodi tremor factus ſuiſſet à concuſſione et reſilitione ſoli Tauromenitani, omnes domus æquè concuſſæ fuiſſent, & æquali tremore agitatæ, ita ut non poſſit conſpectus voraginis tam inſignem et evidentem inæqualitatem tremoris procreare; igitur neceſſariò à tremore ejuſdem aëris incuſſo in parietibus domorum liberè percuſſiones excipientium, agitatio illa efficiebatur. Videas hinc,* (infers he) *quanta ſoni ad* 30 *milliarium diſtantiam efficacia ſit.* "*Borel. de vi percuſſionis prop.* CXI. has theſe obſervable words: I was at *Tauro-*

Borellus *de vi Percuſſionis. prop.* CXI.

" *menium*

" *menium* in *Sicily*, when the mountain of *Ætna* broke out near *Enna*, a town diſtant " about thirty miles from *Tauromenium*; whilſt the gap did ſend out now and " then, with a great noiſe, fire and flame, all the houſes of *Tauromenium* were ſenſibly " ſhaken; and it was obſervable that ſuch houſes, as looked directly towards the " gap, were moſt of all agitated; thoſe that looked otherwiſe ſhaking more ſlowly. " Upon which matter of fact he argues thus: had this trembling been occaſioned by " the ſhaking of the ground of *Tauromenium*, all the houſes had been equally ſhaken, " ſince this inequality of motion could not be aſcribed to their different ſituation: " hence then we muſt needs conclude, that this agitation was produced by the im- " preſſion of the air upon the walls of the houſes, which demonſtrates to us the great " efficacy of a ſound, though at thirty miles diſtance."

To the fifth CHAPTER.

THAT motion may be propagated far, through bodies of differing natures, may be inferred from what is mentioned in this chapter, eſpecially about earthquakes: but becauſe it may reaſonably be ſuſpected, that the active matter, which produces thoſe ſtupendous motions, is diſperſed into divers places, and may be of conſiderable extent; I ſhall here ſubjoin, out of the eloquent *Famianus Strada*, an inſtance, which is much the moſt memorable to my purpoſe, that I remember to have met with in hiſtory, to manifeſt to how great an extent a motion excited in a very narrow compaſs, perhaps but a very few fathom ſquare, may be propagated through differing mediums, and one of them as ſolid as earth. This famous hiſtorian then having deſcribed a ſtupendous work, that had been with great ſkill and care made by the prince of *Parma*, to keep the city of *Antwerp*, which he cloſely beſieged, from being relieved by the river *Scheldt*, (which, though not broad, is deep) proceeds to relate, that an engineer, who was a great maſter in his art, having undertaken to deſtroy this great work with a veſſel (which I think we may call a floating mine) fraught with gunpowder, fireworks, *&c.* performed it with ſo tragical a ſucceſs, that ſome Spaniſh officers, that were preſent, reckoned eight hundred to have been killed outright, beſides a great number, that were wounded and maimed. But that part of the narrative, which comes home to our preſent purpoſe, is delivered in theſe words:

ON a ſudden the fatal ſhip burſt, with ſuch a horrid craſh, as if the very ſky had rent aſunder, Heaven and Earth had charged one another, and the whole machine of the earth itſelf had quaked; for the ſtorm of ſtones, chains and bullets being caſt out with thunder and lightning, there followed ſuch a ſlaughter, as no man, but that actually it happened, could have imagined. The caſtle, on which the infernal ſhip fell, the pile-work of the bridge to *St. Mary*'s fort, that part of the naval bridge next the caſtle, ſoldiers, mariners, commanders, a great number of cannons, armour, and arms; all theſe this furious whirlwind ſwept away together, toſſed in the air, and diſperſed as wind doth leaves of trees. The *Scheldt*, prodigiouſly gaping, was firſt ſeen to diſcover its bottom, then ſwelling above the banks, was even with the rampiers, and overflowed *St. Mary*'s fort above a foot. The motion of the panting earth [*N. B.*] extended its force and fear above nine miles. [If he means the miles of that country, or Dutch leagues, they amount to thirty-ſix Engliſh miles.] There we found ſtones, and that very great ones, as, grave-ſtones, and the like, a mile off the river, ſtruck into the ground, in ſome places, four palms. Famian. Strad. *de Bello Belg. Dec. 2. lib. 6.*

To the ſixth CHAPTER.

OBSERVATION I.

WHAT is delivered in this chapter about the operation of ſounds and animals, particularly that which is mentioned (p. 19.) about the effect of muſick upon ſerpents at *Grand Cairo*, may be not only confirmed, but exceeded by a ſtrange relation, that I had from a perſon of unſuſpected credit; which narrative having appeared to me ſo conſiderable, as well to deſerve a place among my *Adverſaria*, I ſhall ſubjoin that part of it, which concerns our preſent ſubject, in the words, wherein I find it ſet down.

Sir *J. C.* a very candid and judicious traveller, favouring me yeſterday with a viſit, told me, among other remarkable things relating to the *Eaſt-Indies*, (which countries he had curiouſly viſited) that he, with divers European merchants, had ſeen (and that, if I miſtake not, ſeveral times) an Indian, who, by many, was thought to be a magician, that kept tame ſerpents of a great bulk; and that when the owner of them played upon a muſical inſtrument, theſe ſerpents would raiſe themſelves upright into the air, leaving upon the ground but three or four inches of their tail, upon which they leaned for their ſupport. He added, that at the ſame time, that they erected their bodies, they alſo ſtretched and lengthened them in a ſtrange and frightful manner; and whilſt they were thus ſlender, they were taller than he, or any man of ordinary ſtature. But that, which appeared to him the moſt wonderful and ſurpriſing, was, that they manifeſtly ſeemed to be very much affected with the muſick they heard; inſomuch that ſome parts of the tune would make them move to and fro with a ſurpriſing agility, and ſome other parts of it would caſt them into a poſture, wherein they ſeemd to be half aſleep, and, as it were, to melt away with pleaſure.

To the ſixth CHAPTER, p. 20.

OBSERVATION II.

BEcauſe the truth, even of the principal effects of the biting of the tarantula, has of late been publickly called in queſtion, I was glad to meet with an ingenious traveller, that in *Calabria* or *Apulia* was himſelf bitten by one of thoſe venomous inſects; and though it were but ſlightly, yet the effects he felt in his own body, and thoſe greater ones he ſaw produced in other perſons, that were more unhappily bitten, brought credit to the main of what ſober writers affirm of the ſymptoms and cure of that poiſon. And the learned, *&c.*

To the ſeventh CHAPTER, p. 21.

MUCH of what is delivered in this chapter, and elſewhere, about the operation of air or inviſible fluids (whoſe motions affect not the touch) upon congruous ſolids, may be confirmed by that notable experiment, which has been publiſhed in an elegant diſcourſe by the learned *Morhofius*; about a Dutch wine-ſeller in *Amſterdam*, by name *Nicolaus Petterus*, who having found the tone or note peculiarly belonging to a large bellied drinking-glaſs, ſuch as the Dutch call Romer, and many here call Rheniſh wine-glaſſes, would, by accommodating his voice exactly to that tone, and yet making it loud and laſting, make the veſſel, though not viſibly touched, firſt tremble and then burſt, which it would not do, if the voice were, though but a little, too low or too high. This notable experiment has been ſeen by many virtuoſi, both before

before and ſince he publiſhed it. And the very ingenious writer, as he paſſed through *London*, not only related it to me, but very civilly offered me farther ſatisfaction, if I could furniſh him with a Romer, which I was very ſorry, that where we then were, was not to be procured.

To the eighth CHAPTER.

OBSERVATION I.

IT may add probability to ſome things delivered in this chapter, and in divers other paſſages of this treatiſe, if I here recount a ſtrange phænomenon, that came into my memory, whilſt I was running over thoſe parts of this diſcourſe.

THE phænomenon, in ſhort, was this: having met with divers pieces of tranſparent glaſs, which I had reaſon to think to be of a texture or temper very differing from ordinary glaſs, I thought fit to try, whether ſome of them were not far more ſpringy and brittle than their thickneſs would make one expect. And accordingly, though I found ſeveral, wherein the experiment would not ſucceed, eſpecially if their figure were not convenient, yet with ſome others I had very good ſucceſs, and particularly with ſome, that were ſhaped almoſt like the ſharper end of the neck of a retort: for though theſe pieces of glaſs were much thicker than ſuch necks are wont to be, being perhaps ſix or ſeven times as thick, as common drinking-glaſſes; yet I more than once made the trial ſucceed ſo well, that, by obliquely ſcratching them, or tickling them, if I may ſo ſpeak, on the inſide with the head or point of a pin, they would forcibly burſt into many pieces in my hand. In which ſurpriſing phænomenon, the matter of the glaſs ſeemed to contribute ſomething to this odd effect of ſo languid a motion, but much leſs than the texture, or tenſion, it obtained by the peculiar way of ordering it in the fire and the air.

To the eighth CHAPTER.

OBSERVATION II.

TO ſhew, that the ſuſpicion I mention myſelf, a little before the end of this chapter, to have had, that the breaking of the ſtones there ſpoken of might poſſibly be produced or promoted by ſome impreſſions, remaining after the ſtrokes employed to force the ſtones off their beds, was not altogether without ground;

I SHALL here obſerve, that it need not ſeem incredible, that faint ſtrokes and attritions may leave more laſting and operative motions among the inſenſible parts, even of compact and ſolid bodies, than one would readily imagine: for I have ſeveral times found, ſometimes by obſervations deſignedly made, and ſometimes by undeſigned accidents, that, having cauſed ſomewhat thin veſſels of glaſs, eſpecially urinals, to be diligently made clean with ſand mixed with water, to looſen or grate off the foulneſs, that adhered to the ſides of the veſſel; though the veſſels, after having been thus made clean, did not appear to have received the leaſt injury, and would continue very intire perhaps for ſeveral hours, yet after that time they would, of themſelves, break with noiſe, and thereby become unſerviceable for the future. But though this happened to many urinals, yet becauſe to more others it did not, it ſeemed probable, that the diſſilition depended chiefly upon the peculiar texture of the glaſs in this or that veſſel; whether acquired by a mixture of the ingredients, that was not uniform enough, or made in a due proportion, or elſe by the too haſty refrigeration of the veſſel, eſpecially if it chanced, as is not very unuſual, to be cooled more haſtily in one part than another.

To the ninth CHAPTER, p. 27.

OBSERVATION I.

BEcauſe there are divers gems, particularly thoſe tranſparent ones, that are red or blue, that are much harder than iron or ſteel, it may much ſtrengthen the proof or our eighth obſervation, if I here relate, that a jeweller to a great princeſs anſwered me, that when he poliſhed ſapphirs, rubies, and ſome ſorts of other hard gems, upon his mill, they would ſeem, when attrition had made them very hot, to be all on fire, like ſo many little coals; and that each of them had the light it afforded tinged with a colour proper to the ſtone; ſo that the ruby gave a red light, the ſapphir a blue, *&c.* And I remember, that inquiring of a ſkilful cutter of diamonds and poliſher of gems, whoſe cuſtomer I had been, about ſome conjectures I had concerning things belonging to his profeſſion, he anſwered me, that ſometimes, when he poliſhed certain ſtones, eſpecially rubies, that were pretty large, and perhaps not thick, he could plainly perceive, that the ſtone gaped at and near the edge, as if it were begun to be cracked; which ſign admoniſhed him to make haſte to ſlacken the motion of the mill, leſt the ſtone ſhould abſolutely burſt; which if it did not, he could not perceive any flaw in it, when it was thoroughly cold; but, which was ſtrange, it appeared as entire as ever. He added, in confirmation of what he had ſaid of the intenſe heat, that gems would ſometimes acquire, by attrition, whilſt they were in poliſhing, that having lately given by this means too great a degree of heat to an oriental topaz, (which ſort of that gem is very hard) it cracked upon the mill, inſomuch that one part of it quite ſeparated from the reſt, and ſpoiled the ſtone in the capacity of a gem; as a proof whereof he had laid it aſide for me, and would needs make me accept it as a curious, though not an uſeful, thing.

To the ninth CHAPTER.

OBSERVATION II.

TO confirm, what has been ſaid in the eighth obſervation to ſhew, that ſlow and inſenſible inteſtine motions of the parts of a body, that ſeem quieſcent, may be very operative, chance afforded me a notable inſtance, which was this. I had, to preſerve a liquor, from which I expected a curious experiment, incloſed it in a ſtrong vial, to whoſe neck a thick glaſs ſtopple was but too exquiſitely adapted. This veſſel I ſet upon the edge of a window, in a high and ſecure place, that it might not be moved. There it continued many months, or, if I miſremember not, above a year; and the liquor was of ſuch a nature, that if any body had, though but for a few moments, taken out the ſtopple, I could eaſily diſcover it. But, after all this while, one day, that I was ſitting in my cloſet, at a good diſtance from the place, in which the vial ſtood, I heard a loud and briſk noiſe, almoſt like the report of a piſtol, and then perceived that ſomething came rolling to my feet: I haſtily took it up, and found it to be the thicker and larger part of the ſtopple of my vial, which of itſelf had flown off, leaving the remaining part ſo cloſely and ſtrongly adjuſted to the neck, which ſerved it for a kind of ſocket, that I could by no means pull it out thence. At this accident I was not a little ſurprized, conſidering the thickneſs of the ſolid glaſs, and that it had ſtood ſo long unmoved, and that the bigger and heavier part of the ſtopple broke off from the other with ſuch violence, and was carried from it by inviſible motors to ſo great a diſtance: which ſeemed the more ſtrange, becauſe there was no ſhaking nor treading in the room, that could put the parts of the glaſs into motion, there being nobody preſent but myſelf, who was ſitting quietly and ſtudying.

To

To the ninth CHAPTER.

OBSERVATION III.

TO confirm what I have in the eighth obſervation and elſewhere delivered about the latent motion of parts, that may be in a body not only quieſcent but ſolid, I ſhall here add a ſtrange inſtance, which was afforded me by a diamond, belonging to an ingenious merchant of that ſort of gems, who brought many fine ones out of the *Eaſt-Indies*. For having, at the diamond-mine itſelf, purchaſed, amongſt other ſtones that grew there, a rough diamond, that he valued at about a hundred pounds, and had well conſidered when he bought it; coming to look over his purchaſe again once more, about ten days or a fortnight after, he was much ſurpriſed to find, to his great loſs, that this diamond had of itſelf cracked in ſeveral places, and ſo became of little or no value, but as it was a rarity: and indeed I could not without wonder ſee ſo fair and hard a ſtone ſo oddly ſpoiled with clefts, that ſeemed to penetrate ſo very deep, that it was gueſſed it would not be very difficult to pull the parts of the ſtone aſunder. And on this occaſion he told me, that he had admired this accident at firſt, much more than he did afterwards; for complaining of it to divers merchants and jewellers, that he met with in thoſe parts; he was told, that though it ſeldom happen, yet it was no ſuch wonderful accident, the like misfortune having befallen others as well as him.

A N

AN EXPERIMENTAL DISCOURSE Of ſome UNHEEDED CAUSES OF THE INSALUBRITY and SALUBRITY of the AIR:

BEING

A Part of an intended NATURAL HISTORY of AIR.

The PREFACE.

HAVING heretofore had occaſion to draw together, under certain heads, divers unpubliſhed obſervations and experiments of my own, and ſome of other men by way of memorials for a natural hiſtory of the air; I thought fit, by more largely treating of two or three of the ſubjects diſtinctly mentioned in my ſcheme of titles, to give a ſamplar or ſpecimen of what may be done upon the other heads of the deſigned hiſtory. Upon this account I treated ſomewhat largely of the ſalubrity and inſalubrity of the air, as a ſubject, which for the importance of it to men's healths and lives, I thought deſerved to be attentively conſidered, and have its cauſes diligently inquired into. And having obſerved, that among the ſix principal cauſes of the healthfulneſs and inſalubrity of the air; namely, the climate, the ſoil, the ſituation of the place, the ſeaſons of the year, the reigning winds and contingencies (whether more or leſs frequent) and eſpecially ſubterraneal ſteams: having I ſay obſerved, that among theſe cauſes there was one, *viz.* the laſt named, about which I thought I could offer ſomething, that I had not met with in the books of phyſicians, that treat of it; I was thereby invited to ſet down my thoughts and obſervations by way of conjectures, which I was made to believe would appear uncommon, and would not prove uſeleſs. Theſe obſervations and reflections I referred, for clearneſs and diſtinction's ſake, to four propoſitions: but when I had gone through the three firſt, and made ſome progreſs in the fourth, being hindred by divers avocations to make an end of it, I laid by the whole diſcourſe in a place, which I thought a ſafe one; but when afterwards I had ſome opportunity to diſpatch what remained, I found all the diligence I uſed to retrieve the entire manuſcript unſucceſsful. At this ſurprizing accident I confeſs I was ſomewhat troubled; becauſe, whatever may be thought of the diſcurſive part of thoſe papers, the hiſtorical part contained divers matters of fact, that I did not meet with in books, nor can now diſtinctly remember, and will not perhaps be lighted on by even phyſicians, or ſuch naturaliſts, as derive their knowledge only from them. It is upon this conſideration, that having afterwards met with many papers, that belonged to moſt parts of the unhappy diſcourſe, I thought fit to put them together in the beſt order I could, that I might not loſe what might give ſome light to ſo important a ſubject as the theory of diſeaſes. And this courſe I the rather pitched upon, becauſe, before the papers about the ſalubrity of the air, I miſſed two other of my

manuſcripts, whereof the former contained a collection of medicinal things, and the ſecond a defence of the mechanical way of philoſophizing about natural things, as it reſpects religion. And I remembered, that having formerly loſt a manuſcript I was much concerned for, I purpoſely made a noiſe of it; whence I ſuppoſed the plagiary would conclude himſelf unable to make it paſs for his: and in effect the book was in a while after privately brought back; ſo that I found it laid in a bye-place, where I had before as fruitleſsly as carefully ſought it.

An Experimental Discourse of ſome unheeded Causes of the Insalubrity and Salubrity of the AIR, &c.

THE ſixth and laſt thing, upon which the ſalubrity and inſalubrity of the air depends, is the impregnation it receives from ſubterraneal effluvia. And though this be a cauſe not wont to be much heeded by phyſicians themſelves; yet I take it to be oftentimes one of the moſt conſiderable in its effects.

The effluvia, that paſs into the air, may be diſtinguiſhed into ſeveral ſorts, according to their reſpective natures, as has been elſewhere ſhewn: wherefore I ſhall now only take notice of the differences that may be taken from place and time; upon which account we may conſider, that ſome of them ariſe from the cruſt (if I may ſo call it) or more ſuperficial parts of the earth; and others have a deeper original, aſcending out of the lower parts, and, as it were, bowels of the terraqueous globe. And to this difference taken from place I muſt add another, perhaps no leſs conſiderable, afforded by time; which difference relates chiefly to the ſecond ſort of ſteams newly mentioned.

Of the ſubterraneal effluvia, ſome are almoſt conſtantly or daily ſent up into the air, and thoſe I therefore call ordinary emiſſions; and others aſcend into the air but at times, which are not ſeldom diſtant enough from one another, and thoſe I call extraordinary emiſſions; whether they come at ſtated times, and ſo deſerve the title of periodical, or elſe uncertainly, ſometimes with far greater, ſometimes with far ſmaller intervals, and ſo may be called fortuitous or irregular. But though I thought it might render what I am about to ſay more clear, if I made and premiſed the two foregoing diſtinctions, yet becauſe in many caſes nature does not appear ſollicitous to obſerve them, but at the ſame time imbues the air with ſteams referrible to divers members of theſe diſtinctions; I ſhall ſeveral times, though not always, take the liberty to imitate her, and conſider the effluvia of the terraqueous globe in the more general notion, that they are ſo.

I know it is frequently obſerved, and uſually granted, that marriſh grounds and wet ſoils are wont to be unhealthful, becauſe of the moiſt and crude vapours, that the ſtagnating waters ſend up too copiouſly into the air. And on the other ſide, dry ſoils are, becauſe of their being ſuch, generally looked upon as healthy. Nor do I deny, that theſe obſervations do moſt commonly hold true. But yet I think, that beſides what can be juſtly aſcribed to the moiſt vapours, or dry exhalations, we have been ſpeaking of; in many places the healthfulneſs and inſalubrity of the air may be aſcribed to other ſorts of effluvia from the ſoil, than thoſe, that act merely, or perhaps principally, as theſe are either moiſt or dry.

Proposition I.

TO deliver my thoughts about this matter ſomewhat more diſtinctly, I ſhall lay them down in the four enſuing obſervations or propoſitions, whereof the firſt ſhall be this: It ſeems probable, that in divers places the ſalubrity or inſalubrity of the air,

air, conſidered in the general, may be in good part due to ſubterraneal expirations, eſpecially to thoſe, that I lately called ordinary emiſſions. For in ſome places the air is obſerved to be much more healthy, than the manifeſt qualities of it would make one expect: and in divers of theſe caſes I ſee no cauſe, to which ſuch a happy conſtitution may more probably be aſcribed, than to friendly effluvia ſent up from the ſoil into the air; which particles, either by promoting tranſpiration (that great inſtrument of health and recovery;) or by hindering the production, or checking the activity of morbific ferments; or by mortifying or diſabling ſome noxious particles, that would otherwiſe infeſt the air; or by other ways, that I ſhall not now ſtay to enumerate; may not a little contribute to keep the bodies of thoſe, that live in that air, in that regular and deſireable ſtate we call health. I know indeed, that it is generally thought, and often true, that mineral bodies do ſend up exhalations, hurtful not only to plants, but to men; but when we mean ſubterraneal things indefinitely, though men are wont to look upon them but ſlightly, under a general confuſed notion, we employ a word more comprehenſive, than moſt men are aware of, there being a great variety, (as well as multitude of bodies, that nature has lodged in her dark ſtore-houſes under the ſurface of the earth: and of theſe differing ſorts of bodies, though it is probable, that the greateſt part are ſuch, whoſe effluvia are unhealthful to men, yet there may be others, whoſe emanations may be friendly to him. I have known it obſerved, that over ſome tin-mines in the weſtern parts of *England*, not only trees, but far more tender plants, as graſs, are wont to proſper and flouriſh; and (if I much miſremember not) I have ſeen verdant trees growing juſt over a vein of another ſort of mineral, that lay near the ſurface of the earth: and it is likewiſe obſervable about thoſe, that conſtantly dig in thoſe tin-mines, that they do not lead a ſhort and ſickly life, as in many others, but arrive at a great and vigorous age. And an ancient poſſeſſor of ſome of theſe mines being aſked by me, whether amongſt the otherwiſe differing exhalations, that aſcended into the air, he did not find a difference as to ſmell, bad or good: he anſwered, that though moſt of thoſe viſible fumes had a ſmell, that participated enough of ſulphur or bitumen to be offenſive, yet ſome others were ſo far from being ungrateful, that they were well ſcented. And, on this occaſion, I remember, that not long ſince a friend of mine and another virtuoſo being partners in a chargeable attempt to diſcover a mine, in digging deep for it, they accidentally broke into a vaſt ſubterraneal cavern, into which becauſe the diggers would not venture to deſcend, one of theſe curious gentlemen cauſed himſelf to be let down, and there found the air very temperate and refreſhing, and that he long breathed it with delight; and on the floor, or ſoil (which reached farther than he could diſcover) he found many and various minerals, moſt of them embryonated, or imperfectly formed, and ſtore of a kind of mineral earth, whoſe ſmell was fragrant and very pleaſant, both in his judgment and that of ſome ladies. And though, when ſome of theſe minerals were brought to me, a ſmall lump of this earth, that was among them, had been kept ſo long in the air, as to ſpend moſt of its odoriferous particles, yet the ſmell it ſtill retained was, though but faint, yet pleaſing.

That from foſſiles that lie hid under the ſurface of the earth, and have a conſiderably large ſpread, there may aſcend ſtore of wholeſome effluvia into the air, ſeemed to me the more probable by what I noted at my laſt being in *Ireland*; where, being invited by a brother of mine to paſs ſome time in a country houſe of his, to which there belonged a very large ſheep-walk, that produced ſhort, but excellent graſs; I learned (and was eaſily perſuaded by ſome things I took notice of) that this place was juſtly reputed very healthful: and this ſalubrity of the air, together with the ſweetneſs of the graſs, ſome circumſtances invited me to aſcribe to this; that the ſoil was ſuſtained by a

large tract of limeſtone, which I ſuppoſed to emit continual exhalations into the air; which conjecture will perhaps with the leſs ſcruple be aſſented to, if I add, that it has been long and generally obſerved, that, as far as the limeſtone extends, that tract of ground makes the ſnow, that falls on it, thaw or melt much ſooner, than it does on the neighbouring lands.

AFTER I had made this obſervation, I mentioned it in diſcourſe to an inquiſitive perſon, that had ſeen and been employed about ſeveral mines; and I aſked him, whether he had met with any thing of this kind: to which he anſwered me, that in *Derbyſhire*, at a place, which he named to me, he and others had obſerved, that a large tract of limeſtone land was ſo warm (as they ſpeak) as to diſſolve the ſnow, that fell on it, very much ſooner, than another great ſcope of land, which was divided from it but by a glin, where the ſoil did not cover limeſtone, but freeſtone.

AFTERWARDS diſcourſing of this ſubject with an ingenious perſon, that had viſited the Hungarian and Bohemian mines; he told me, that during his ſtay among the former, he often walked abroad with the overſeer of them, a famous and experienced mineraliſt, who delighted to breathe the freſh morning air upon ſome hills abounding with minerals; that his guide made him obſerve, that when they were over a tract of land, that afforded much of that noble ore (which by a German name he called *Rot-gulden ertz*) he found the ſmell to be pleaſing, and the air refreſhing: and whereas, in paſſing over ſome mines, he found himſelf moleſted by offenſive fumes, he felt no ſuch effect, when he was upon that ſcope of ground, under which there lay veins of cinnabar, or, if you pleaſe, a mine of quick-ſilver ore: and his antient guide told him, that next the *Rot-gulden ertz* before-mentioned, the ſoil containing theſe cinnabarine veins, was that, whoſe incumbent air was the moſt eligible for pleaſantneſs and ſalubrity. And I the leſs wonder, that in ſome places the ſubjacent foſſiles ſhould impregnate the air with wholeſome effluvia, becauſe I remember I had the curioſity to ride many miles, (though in the depth of winter,) to ſee a ſcope of ground, that was famous for a good pottery; where, beſides many other mineral earths, that I took notice of, there was a pit or groove, that reached, if I miſtake not, fifteen or twenty feet beneath the ſurface of the ground; whence they dug up a kind of white clay ſo richly impregnated with ſubtile and noble parts, that it afforded a chymiſt or two of my acquaintance (for I had myſelf no opportunity to diſtill it) good ſtore of a ſubtile ſpirit of a volatile and ſaline nature, which, upon trial, they highly extolled for its cordial and other virtues in phyſic: and which, by ſome peculiar mechanical trials I have made with it, I concluded to abound with a volatile ſalt, not unlike that of urine or hartſhorn. And ſince by this inſtance we ſee, that ſome unſuſpected foſſiles may be enriched with medicinal and fugitive ſalts and ſpirits; it may reaſonably be ſuppoſed, that theſe aſcending into the incumbent air may highly conduce to the ſalubrity of it. And the curioſity I have had to examine chymically ſome boles, and other bodies, which are wont to be unregardedly comprized under the confuſed notion of earths, makes me ſuſpect, that there may be far more ſpecies of ſalubrious foſſiles, than many have yet taken notice of.

BUT peradventure you will much the more eaſily admit in general, that ſubterraneal tracts of great extent may for a very long time ſend up into the air copious expirations, not diſcernible by any of our ſenſes, nor commonly ſuſpected to be found in that body, if you pleaſe to conſider with me (what I do not remember to have been taken notice of to this purpoſe) that the common air we live in, and breathe, does always abound, and for many ages has been impregnated, with the copious magnetical effluvia of the earth; which our induſtrious *Gilbert*, and after him ſome learned Jeſuits and others, have proved to be a great, though faint magnet; and whoſe ema-

nations, as they conſtantly ſteam through the air, I have elſewhere by particular experiments ſhewn to be capable of paſſing through the pores of glaſs itſelf, and acting almoſt inſtantaneouſly, and yet manifeſtly, upon bodies hermetically ſealed up in it. But though from what has been ſaid it may be inferred, that it is not improbable the ſalubrity of the air in ſome places may be chiefly, or at leaſt in part, due to the wholeſome expirations of ſubterraneal bodies; yet, generally ſpeaking, the air is depraved, in far more places than it is improved, by being impregnated with mineral expirations. And indeed, beſides that among the minerals unknown unto us, there are many more that are noxious, than that are wholeſome; the power of the former to do miſchief is wont to be far more efficacious, than that of the latter to do good; as we may gueſs by the ſmall benefit men receive in point of health by the effluvia of any mineral, or other foſſile, known unto us, in compariſon of the great and ſudden miſchief, that is often done by the expirations of orpiment, ſandarach, and white arſenick; for that ſold in ſhops is factitious, being made of orpiment ſublimed with ſalt, yet it is found natural in ſome Hungarian and other mines. On which occaſion I remember, that the ingenious perſon lately mentioned to have with his guide taken the air upon the hills of that mineral country, anſwered me, that, when his guide and he walked over ſome veins of theſe noxious minerals, he met with ſeveral odorous ſteams, which, though differing from one another, agreed in this, that they were all offenſive to him; and particularly ſome of them by their unwelcome ſharpneſs, and others by giving him a troubleſome difficulty of reſpiration. I will not here urge thoſe ſulphureous ſteams, that ſo ſuddenly deprive dogs of ſenſe and motion, in the Neapolitan *Grotta di Cani*: becauſe there the exhalations are too much included, and, as it were, pent up: but it is very proper to alledge for my preſent purpoſe the *Aorni* or *Averni*, which are mentioned by good authors to be found, ſome in *Hungary*, and ſome in other countries; for in theſe places there aſcend out of the earth ſuch noxious and plentiful exhalations, as kill thoſe animals, that draw in the air they infect; and ſome of them are able to precipitate even the birds, that fly over the caverns, that emit them. But there are a multitude of places, where it is not ſo manifeſt, that hurtful exhalations aſcend into the air, and yet they really do ſo; there being in many places whole tracts of land, that near the ſurface of the earth abound with marchaſitical minerals, as theſe do with a ſharp vitriolate ſalt, which, together with the ill-conditioned ſulphur, that they alſo plentifully contain, aſcend into the air, and render it corroſive. On which occaſion I remember, that, for curioſity's ſake, I took ſome Engliſh ſhining marchaſite, and cauſed a pound of it to be diſtilled in an earthen veſſel with a good fire; by which means, notwithſtanding its dryneſs, I obtained two or three ſpoonfuls of a limpid liquor, that ſmelled very ſtrongly, like that, which the Helmontians call *gas ſulphuris*; and which appeared manifeſtly to be of an acid nature, both by the taſte, and by it's readily corroding and diſſolving unbeaten coral, even in the cold, to mention here no other tryals, that I made with it. And the mineral afforded me, together with this liquor, about an ounce and three quarters of inflammable ſulphur, part whereof aſcending (as may be gueſſed) in the form of very agile corpuſcles, theſe faſtened themſelves all about to the inſide of the receiver, and there compoſed divers thin coats, or films, as it were, of ſulphureous matter ſticking to one another; which at their firſt taking off, and for ſome time after, might be bent or folded like leaves of paper, but afterwards harden in the air. Mineraliſts, and ſome other good authors, mention divers places, as abounding with marchaſitical foſſiles; but I am apt to think they are far more common, than is vulgarly taken notice of; for I have met with them, where one would little expect them. And though in *England* all our vitriol (which is now plentifully vended into foreign parts) be made of vitriolate ſtones, or bodies, that paſs for ſtones; yet that is not true, which our mineraliſts are

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wont thence to conclude, that there is no other vitriolate or marchaſitical matter in *England:* for a famous dealer in foſſiles having found a mine, which he knew not what to make of, and therefore carefully concealed, addreſſed himſelf to me, becauſe, he ſaid, he knew I would not betray or ſupplant him; and having at his deſire taken a private view of what he had diſcovered, I preſently found it to be a vein, that lay at ſome depth under ground, and ran along (how far I know not) like a vein of metalline ore, (and for ſuch, upon that account, he miſtook it) conſiſting of a black and heavy ſtuff, which, upon a few eaſy trials, I quickly found to be of a vitriolate nature; inſomuch that, ſomewhat to my wonder, I was able to make it yield in a few hours ſtore of pure vitriol, without any troubleſome or artificial preparation.

PROPOSITION II.

It is probable, that in divers places ſome endemical diſeaſes do mainly, or at leaſt in part, depend upon ſubterraneal ſteams.

UNDER the name of endemical diſeaſes, I do not compriſe thoſe only, that are very peculiar to this or that country; as the plica is ſaid to be to *Poland*, (whence it receives its name of *Polonica*;) or an odd kind of cholick in one part of *France*, (from which it is called *la Colique de Poictou*;) but alſo thoſe, that are more rife in ſome countries, than in moſt others; ſuch as agues in *Kent*, and in that part of *Eſſex* they call the *Hundreds*; the conſumption (though that be an ambiguous name) in *England*, whence foreign phyſicians call it the *Tabes Anglica*; and fluxes of the belly in *Ireland*, where they are ſo rife, as commonly to paſs under the name of the country diſeaſe.

THAT theſe endemical, or (if we may ſo call them) topical diſtempers, do in many places proceed from ſome exceſſive heat, moiſture, or other manifeſt quality of the air; from bad diet, vulgar intemperance, and other cauſes, that have little or no connexion with ſubterraneal reeks, I readily grant: but, that in ſome places the endemical diſeaſe may either be principally cauſed, or much fomented, by noxious effluvia, I am inclined to ſuſpect upon the following grounds.

1. THERE are ſome places, in which the endemical diſeaſe cannot be probably imputed to any manifeſt cauſe; as he may perceive, that ſhall conſider, how often it happens that the cauſes, which are aſſigned of ſuch diſeaſes, if they were the true ones, muſt produce the like diſtempers in many other places, where yet it is notorious, that they are not endemical.

2. THAT ſubterraneal bodies may ſend up copious ſteams, of different kinds, into the air, has been already made out.

3. IT has been alſo ſhewn, that the matters, that ſend up theſe effluvia, may be of a large extent. And, I remember, on this occaſion, that I have ſometimes obſerved, and that in more countries than one, a whole tract of land, that abounded with minerals of one kind; and within no great diſtance, as perhaps a mile or a league, another large tract of land, whoſe ſubterraneal part abounded with minerals of a very differing ſort.

4. WE have alſo above declared, and it is highly probable from the nature of the thing itſelf, that thoſe copious ſteams (ſaline, ſulphureous, arſenical, antimonial, *&c.*) that impregnate the air, may very much conduce to make it hurtful to a human body, in the way requiſite to produce this or that determinate diſeaſe; as I not long ſince related from the chymiſt, that viſited the Hungarian mines, that in ſome places he found the reeks aſcending from them into the air (though in an elevated place, and expoſed to the winds) make him, as it were aſthmatical, and give him a

troubleſome difficulty of reſpiration. And here let me add an obſervation, which perhaps will not be thought fit to be ſlighted by phyſicians; namely, that ſome parts of the ſubſtance of the air (for I ſpeak not of its heat, coldneſs, or other ſuch qualities) do not only affect human bodies, or at leaſt many individuals among them, as they are taken in by reſpiration, but as they outwardly touch the ſkin; and the ſkin being (as I have elſewhere ſhewn) full of pores, and thoſe perhaps of different ſizes and figures, thoſe corpuſcles, that get in at them, may have their operation, even upon the moſt inward parts of the body. To make this more clear and probable, becauſe it is a thing of importance, I deſire theſe things may be obſerved.

1. THAT when I ſpeak of the air, I do not in this place underſtand that air, which I elſewhere teach to be more ſtrictly and properly ſo called, and to conſiſt of ſpringy particles; but the air in its more vulgar and lax ſignification, as it ſignifies the atmoſphere, which abounds with vapours, and exhalations, and, in a word, with corpuſcles of all ſorts, except the larger ſort of ſpringy ones; and many of them may be ſo ſmall, and ſo ſolid, or ſo conveniently ſhaped, as to get entrance at ſome of the numerous orifices of the minute or miliary glandules of the ſkin, or at other pores of it. Thus, though paper be not pervious to the uncompreſſed elaſtical parts of the air, yet it may be eaſily penetrated by other corpuſcles of the atmoſphere; for I remember I have, for curioſity's ſake, prepared a dry body, out of a ſubſtance belonging to the animal kingdom, which, being lapped up in paper, would, without wetting or diſcolouring, or any way ſenſibly altering it, paſs in a trice through the pores of it in ſuch plenty, as to have not only a viſible, but a manifeſt operation on bodies placed at ſome diſtance from it. And though a bladder almoſt full of air, having its neck well tied, be held near the fire in various poſtures, the elaſtical air, though rarefied, or attenuated by the heat, will rather burſt the bladder, (as I have more than once found) than get out at the pores; yet we have often made a certain ſubſtance, belonging to the mineral kingdom, that, if a bladder were wet or moiſt, (as the ſkins of living men are wont to be, would readily pervade it) and have a ſenſible operation, even upon ſolid bodies placed within it. This experiment (that I can repeat when I will) is therefore the more conſiderable to our preſent purpoſe, becauſe in the bladder of a dead animal, the poroſity may be well ſuppoſed to be much leſs, than it was in the animal when alive; in which ſtate the parts of the human body are much more perſpirable, than one would eaſily believe; partly becauſe of the heat, that is continually diffuſed from the heart, and partly becauſe of the copious ſteams, that are in perpetual motion, and keep the parts warm, moiſt and ſupple: and it is not to be pretermitted in our preſent inſtance, that the bladder of urine conſiſts not of a ſingle membrane, and is probably of a ſtronger texture, by reaſon of the ſubtile ſalt liquor it is inſtituted to contain, than many other membranes of the body, or the epidermis. And this is the firſt thing I would have noted.

THE next is, that whereas in the inſtances newly recited, and ſome others, that are by and by to be mentioned, the effects were produced when the ambient air, impregnated with mineral corpuſcles, had but a very ſhort time (perhaps not many minutes) to work upon the body expoſed to it; in thoſe countries, that are very ſubject to endemical diſeaſes, the inhabitants are wont to live all the year long, and perhaps during their whole life, expoſed to the action of the vitiated air: and how much a far ſhorter time will ſerve, to make the corpuſcles, that rove in the air, penetrate into bodies of no very cloſe contexture, may be gueſſed by the breaking even of the bigger ſtrings of lutes and viols, by the numerous (though inviſible) vapours, that get into them in rainy weather; and much more by the effects of ſuch vapours, when inſinuating themſelves in ſwarms into the pores of a rope, they ſhorten it ſo forcibly, as to enable

enable it, by ſhrinking itſelf, to lift up and keep ſuſpended conſiderable weights, as I have elſewhere ſhewn by trials purpoſely made. Theſe things may render it probable, that, though in a ſmall compaſs of time the noxious effluvia, that rove in the air, may be too thinly diſperſed in it, to inſinuate themſelves in any conſiderable number at the pores of the ſkin; yet, by reaſon of the continual contact of the air, (eſpecially as to the face, hands, and ſome other parts) which may laſt day and night for many months, or perhaps years, there may be opportunity for a conſiderable number of morbific particles to inſinuate themſelves into the cutaneous pores.

3. AND thus having once got entrance, they may by the capillary veſſels, that reach to, or terminate at the ſkin, paſs on to ſomewhat larger veſſels; and ſo may get into the maſs of blood, and by its circulation be carried to all the parts of the body; and ſo be enabled both to deprave the blood, and other juices themſelves, and to gain acceſs to any determinate parts of the body, which their peculiar ſhapes, figures, &c. qualify them to produce ſome particular diſtemper in. This whole doctrine may be made more probable, by what experience ſhews of the virtues of certain plaiſters, eſpecially mercurial ones, in diſtempers, that are not at all, or at leaſt are not chiefly cutaneous; and (which comes more home to our argument) of the efficacy of periapta, and appenſa, ſuch as piony-root, blood-ſtone, lapis nephriticus, quick-ſilver in a quill, a dried toad in a ceſnet bag, &c. whereof though many anſwer not the characters, that are wont to be given of them, yet ſome of them experience has convinced me to be of greater efficacy than I expected. And much more activity may be preſumed to be in divers noxious effluvia from ſubterraneal bodies; as may be gathered from the effects of the mercurial girdles, that ſome unwary perſons wear to cure the itch; and from what I elſewhere relate of the fits of the cholick, often produced in a friend of mine by the effluvia of maſſes of loadſtone. And this laſt example may ſerve for a proof of another part of our hypotheſis, by ſhewing, that mineral effluvia may not only be noxious in a general way, but may produce this or that determinate diſeaſe. That arſenical appenſa, though much extolled by divers phyſicians themſelves, and ſold dear by empiricks, as (if worn near the heart) wonderful amulets againſt the plague, have (eſpecially in ſome perſons and circumſtances) produced ſome of the noxious effects of arſenical poiſons, and particularly cauſed in ſome, great faintneſs and diſpiritedneſs, I find by the teſtimony of divers eminent phyſicians. To which I ſhall add a remarkable one, which may probably be referred partly to this third obſervation, as well as to what I lately delivered about the bad effects of mineral exhalations breathed in with the air they vitiated; and I the rather mention this caſe, becauſe it is not only an odd one, but is a conſiderable argument to ſhew, that noxious mineral expirations may manifeſtly produce a determinate diſtemper in unlikely parts of the body. The obſervation is this; I knew, and on ſome occaſions employed, a chymical laborant, that fancied that he could make a rare medicine out of red arſenick, (as ſome call what others ſtile ſandarach,) which is thought to differ little from common orpiment, ſaving its being much higher coloured; this laborant then working long and aſſiduouſly upon this mineral, and rubbing it frequently in a mortar, came divers times to me, and complained of a diſſaffection he thence contracted in the organs of reſpiration; for which I gave him ſomething, that happened to relieve him; which encouraged him to complain to me of another diſtemper, that, though not ſo dangerous, did often very much moleſt him; which was, that when he was very aſſiduous in the preparation of his ſandarach, it would give him great pains, and (if I miſremember not) ſome tumours too, in his teſticles; and this, for aught I know, happened to him as long as he was earneſt about that proceſs; for the medicines, that had relieved him in his other diſtemper, did not remove this; and I having,

ing occaſion to go for a while into the country, found him gone at my return. It may ſtrengthen the conjecture lately propoſed of the poſſible inſinuation of effluvia, that rove in the air, at the pores of the ſkin, if I add, that I have had the curioſity to enquire of more than one traveller, that had viſited the famous *Pico* of *Teneriff* (at whoſe upper part there are found ſcattered parcels of ſulphur, and divers manifeſt tokens of a vulcano) whether the ſulphureous ſteams (that I ſuppoſed to be copious near the top of the mountain) did not work upon the ſilver money they had in their pockets, and diſcolour it; to which he anſwered, that it was no uncommon obſervation to find, at men's return from viſiting the top of the hill, that the money they carried about them was blackened, and that he himſelf had particularly obſerved it to be ſo; which might eaſily gain credit with me, who have divers times made a preparation of ſulphur, which, even in the cold, ſends out exhalations ſo penetrant, that having, for trial's ſake, put ſome pieces of coin (which ought not to be golden) into a leather purſe, they were able, and that not in very many minutes, to diſcolour manifeſtly the money, in ſpite of the interpoſition of the purſe, that contained it. But I had a more conſiderable inſtance of the efficacy of the ſulphureous expirations of the *Pico* of *Teneriff*, by a ſober perſon, that is one of the chief directors of the famous *Eaſt-India* Company of *London*; who being queſtioned by me about ſome circumſtances of his journey to viſit the top of that ſtupendous mountain, anſwered me, that among other effects the ſulphureous air had upon him, (who is of a very fine complexion) he found, at his return to the bottom, that his light-coloured hair had manifeſtly changed colour, and was in many places grown forked at the ends. Theſe obſervations may make it probable, that mineral exhalations may not only affect human bodies, as they are drawn into the lungs with the air they ſwim in, but as they inſinuate themſelves into the pores of the ſkin.

One conſiderable objection I foreſee may be made, againſt the propoſition I have been all this while endeavouring to render probable; namely, that it is ſcarce conceivable, that in ſo many ages as endemical diſeaſes have afflicted ſome countries, the ſubterraneal matter, to which I do in great part impute ſome of them, ſhould not be waſted and ſpent. I might perhaps, on this occaſion, move a doubt, whether we have had ſuch continued accounts of the temperature of the air of all the countries, where diſeaſes are now endemical, as to know, that they have been always ſo; and that ſome of thoſe diſeaſes have not been worn out here or there, and ſome other have not of later ages begun to appear in this or that place: but contenting myſelf at preſent to have hinted this queſtion, I ſhall not ſtay to diſcuſs it, but proceed to offer three things, by way of direct anſwer to the objection.

1. And firſt, I think it very poſſible, that divers ſubterraneal bodies, that emit effluvia, may have in them a kind of propagative, or ſelf-multiplying power. I will not here examine, whether this proceeds from ſome ſeminal principle, which many chymiſts and others aſcribe to metals, and even to ſtones, or (which is perhaps more likely) to ſomething analogous to a ferment, ſuch as in vegetables enables a little ſour dough to extend itſelf through the whole maſs; or ſuch as, when an apple or pear is bruiſed in one part, makes the putrified part, by degrees, to tranſmute the ſound into its own likeneſs; or elſe ſome maturative power, whereby an inanimate body may gradually admit of ſuch a change, or acquire ſuch qualities, as may be, in men's eſtimate, perfective of it, and perhaps give it a new denomination; as ananas in the Indies, and medlars, and ſome other fruits here in Europe do, after they are gathered, acquire (as it were, ſpontaneouſly) in proceſs of time, a conſiſtence and ſweetneſs, and ſometimes colour and odour, and in ſhort ſuch a ſtate, as by one word we call maturity or ripeneſs; and ſo ſome metalline ores, and ſome mineral earths themſelves, have been obſerved by mineralogiſts, to acquire, in tract of time, ſuch a change, as to af-

ford ſome metal, or other body, which either it did not afford before, or at leaſt did not afford ſo copiouſly, or ſo well qualified. This I have purpoſely made out in another paper; and the obſervation particularly holds as to nitre, which is thought to be the moſt catholick foſſile we have, and to be at leaſt one of thoſe foſſiles, that do the moſt plentifully emit effluvia into the air.

2. WHEN I conſider, that even in thoſe mines, that are accounted deep ones, the ſpades of men are not wont to reach to the ten thouſandth part of the thickneſs of the earth between its ſurface and its centre, which yet is but its ſemi-diameter; I cannot but confeſs, that we know very little of the nature or conſtitution of the lower part of the terreſtrial globe; ſince we know little or nothing experimentally, of what lies beneath that, comparatively, very thin cruſt or ſcurf, (if I may ſo call it) that human induſtry has been hitherto confined to. And upon this account, I do not think it abſurd to ſuſpect, that from the lower ſubterraneal regions there may be, either continually, or periodically, emitted into the regions of mines (if I may ſo call it) great ſtore and variety of mineral exhalations, which may continually repair the loſs of thoſe, that, from time to time, aſcend out of the foſſile region (as I may alſo call that of mines) into the atmoſphere. But the things I could alledge to countenance this conjecture, muſt not be inſiſted on in this place; therefore I proceed to conſider,

3. THAT bodies ſo heavy, and conſequently ſo abundant in parts of ſolid matter crouded together, as minerals and other foſſils are wont to be, may well be ſuppoſed capable, without deſtructively waſting themſelves, to emit ſtore of ſuch minute particles, as effluvia, for an exceeding long time. This will be eaſily granted by him, that ſhall conſider the particulars laid together in a ſmall tract, that I purpoſely writ, about the admirable ſubtilty of effluvia; and it will be the more eaſily believed, if it be conſidered, how long ſome load-ſtones, ſevered from their mine, have been kept in the air, without any notable, or perhaps ſo much as ſenſible diminution, of their virtue. And this brings into my mind what an eminent phyſician, who was ſkilled in perfumes, affirmed to me about the durableneſs of an effluviating power, that was not natural to a metal, but adventitious, and introduced by art; for he aſſured me, that he had a ſilver watch-caſe, that had been ſo well perfumed, that, though he uſually wore the watch in his pocket, it continued to be well ſcented ſixteen years. The ſame perſon had a way of perfuming factitious marble quite through, whoſe grateful ſcent he affirmed would laſt exceedingly; and of this perfumed marble he preſented me a ball, which having been ſome months after gotten from me by a great lady, I was diſabled from obſerving the durableneſs of the fragrancy.

I MIGHT perhaps be thought wanting to my cauſe, if, before I diſmiſs the propoſition I have been all this while diſcourſing of, I ſhould not obſerve, that ſubterraneal effluvia may contribute to endemical diſeaſes, not only as they vitiate the air that men breathe in, or are immediately touched by; but as they may impregnate or deprave the aliments, that men feed upon. For firſt, they do mingle themſelves with the water, which either men drink itelf alone, (as is the cuſtom with many nations, and of ſome men in moſt nations;) or make of it their beer, ale, or other factitious drinks, prepared of water and barley, oats, rice, &c. That divers ſprings and other waters are imbued with mineral corpuſcles, may be judged by ſome of the medicinal ſprings: for, though divers *acidulæ* and *thermæ* afford good ſtore of palpable ſulphur or ſalt, yet all do not; and having purpoſely examined a famous one, I could, with a pair of nice ſcales, ſcarce diſcover any ſenſible difference at all between the medicinal water and the common water, that was to be met with thereabouts: and that, which impregnated this, and which I found by trial on myſelf, and ſome other bodies, enabled it to work very manifeſtly like a mineral water, was a ſort of corpuſcles ſo minute

nute and ſubtle, that if the bottles were not kept well ſtopped, they would, in a ſhort time, vaniſh, and leave the liquor diſpirited. Experience has aſſured me, that there are ways of making common water violently and hurtfully operative upon human bodies, though its ſenſible qualities would not make one ſuſpect any change in it; but the ill uſe that bad men may make of ſuch liquors, makes me forbear to expreſs myſelf more clearly; nor is it neceſſary that I ſhould add any thing to confirm the propoſed conjecture, ſave what may be inferred from theſe two particulars: the firſt whereof is the ſcarce at all ſenſible change, that may be made in water, and ſome other liquors, that are made ſtrongly emetick by *crocus metallorum*, and by antimony vitrified without addition: and the ſecond may be taken from thoſe *Averni*, whence there continually aſcend ſuch pernicious exhalations, as in ſome places intoxicate or kill even the birds, that fly over thoſe poiſonous vents; for if ſuch exhalations, or even far leſs deadly ones, ſhould (as they may be reaſonably ſuppoſed ſometimes to do) meet with either running or ſtagnant waters in their aſcent, there is little doubt to be made, but they will impregnate them, and make them noxious. And, on this occaſion, we may pertinently recall to mind, what I have formerly delivered about a place upon the borders of *Lancaſhire*, where the water and mud of a ditch is ſo copiouſly impregnated with ſubterraneal exhalations, (whether they be bituminous, ſulphureous, or of ſome unknown kind) that they may eaſily be fired at the ſurface of the water or earth, and made to burn like a candle, as an ingenious man did, at my requeſt, ſucceſsfully try.

But there is another account, upon which the effluvia of the lower parts of the earth may have a greater ſtroke in producing of endemical diſeaſes; namely, as they mingle with the water, and other liquors, that are neceſſary to the nutrition and growth of plants; and, by depraving thoſe juices, make the vegetables, that are nouriſhed by them, unhealthy for the men that eat them, or make drinks of them. And theſe noxious exhalations may be ſuppoſed in many places to impregnate the juices of the earth much more copiouſly, than they do the running or ſtagnant waters lately ſpoken of; becauſe the difficulty of pervading the earth in their aſcent may ſo long check them, as to make them very numerous in a ſmall ſpace, and perhaps make them convene into bodies ſo far of a ſaline nature, as to be diſſoluble either in common water, or ſome other ſubterraneal liquor; by whoſe help, as by vehicles, they may inſinuate themſelves into the roots of plants, and be thence conveyed to other parts. Divers things might be alledged to keep this conjecture from being improbable, if I had leiſure to inſiſt on them; but I ſhall now only mention two things, that on this occaſion, come into my mind; the firſt whereof is, that inquiring of a famous chymiſt, who lived in a country abounding with mines of vitriol, whether he did not obſerve, that the oaks growing over them were more ſolid or heavy, than thoſe trees are elſewhere wont to be; he anſwered me, that he did, and that the difference was remarkable: the other is, that the parts of ſome minerals, (probably by reaſon of the ſmallneſs and ſolidity of the corpuſcles they conſiſt of) are capable of inſinuating themſelves very plentifully into the pores of growing vegetables, without being really ſubdued by what philoſophers are pleaſed to call the concocting faculty of the plant; and, inſtead of being aſſimilated by the vegetable, they retain their own mineral nature; and upon the receſs or evaporation of the juice, that ſerved them for a vehicle, may ſometimes diſcover their being mineral, even to an unaſſiſted eye; for I remember I have ſeen a piece of a vine, that grew not far from *Paris*, which being broken, I perceived a multitude of the internal pores of the root, and, if I miſtake not, part of the trunk alſo, to be ſtuffed with corpuſcles of a marchaſitical nature,

as

as manifeſtly appeared by their colour, and their ſhining lũſtre, and alſo by their weight.

THERE goes a tradition among learned men, that the leaves of vines, that grow in ſome places of Hungary, whoſe mines afford gold, are, as it were, gilt on the lower ſide, by aſcending exhalations of a golden nature. Whether this be true or no, I ſhall not take upon me to determine; but I remember, that having made enquiry about the truth of it, of a very ingenious traveller, whoſe curioſity led him to viſit heedfully thoſe famous mines; he told me, that he did not remember he had obſerved what is reported about the leaves of the vine; but he knew very well, that at *Tockay*, (a place that affords the famouſeſt wine of *Hungary*, and indeed the beſt I have drunk) very many of the kernels of the grapes would appear gilt over, as it were, with leaf gold. To what has been already diſcourſed, may be added, that ſince men are not wont to feed upon either beaſts, or birds of prey, as carnivorous animals uſually are, but upon ſuch as live upon graſs or ſeeds, or other vegetable ſubſtances, and drink nothing but fair water; the noxious exhalations, that make vegetables and water unwholſome, may, by their means, have a very bad influence upon ſheep, cows, deer, pigeons, and other animals, that feed upon ſuch depraved vegetables, and drink ſuch noxious waters; and conſequently may be very hurtful to thoſe men, that feed upon ſuch animals, and may, by the depraved aliment they afford, determine them to an endemical diſeaſe, ſuch as that vitiated nutriment is fitted to produce.

PERHAPS it will not ſeem improper to add, on this occaſion, that it is poſſible, that in certain places the latent minerals may be of ſuch a nature, as that their effluvia may, inſtead of promoting, hinder the production of ſome particular diſeaſe, whether epidemical or endemical, in the bodies of them, that inhabit thoſe places. For, as phyſicians obſerve, that the more manifeſt morbifick cauſes of ſome ſickneſſes are quite contrary to thoſe of others; ſo I think it not improbable, that there may alſo be a mutual contrariety between thoſe latent morbifick cauſes, that are ſent up by ſubterraneal agents: and therefore it need to be no wonder, if ſome of theſe ſhould either diſable thoſe, to which they are hoſtile, or ſhould at leaſt work in human bodies a great indiſpoſition to admit their hurtful operations; which methinks thoſe phyſicians and chymiſts ſhould eaſily grant, who, with a boldneſs that I do not applaud, preſcribe amulets, wherein arſenick, or ſome other poiſonous drug is employed, as preſervatives from the plague; againſt which I doubt the chief ſuccours they afford, proceed from the confidence or fearleſneſs they give thoſe, that wear them. But to return to our ſubterraneal effluvia; ſince there are divers whole countries, or leſſer places, that are either altogether, or in great part, free from this or that particular diſeaſe; as in ſeveral parts of *Scotland* agues, eſpecially, if I miſtake not, quartans are very unfrequent; inſomuch that a learned phyſician anſwered me, that in divers years practice he met not with above three or four; and in ſeveral large regions of the *Eaſt-Indies*, notwithſtanding the exceſſive heat of the climate, the plague is very rare: ſince (I ſay) theſe things are ſo, it ſeems not altogether improbable, that the ſubterraneal ſteams may contribute to this advantage, by impregnating both the air, the earth and the water, with corpuſcles endowed with qualities unfriendly to theſe diſeaſes; which ſeems to be ſomewhat the more credible, becauſe it has been obſerved, that ſome vaſt tracts of land will neither breed nor maintain venomous creatures, as is undoubtedly believed of the whole kingdom of *Ireland*, where I confeſs I neither did ſee any alive, nor met with any other that did; for as to ſpiders, though they breed in that country, where I have ſeen many of them, and ſometimes even upon Iriſh wood, yet they are unanimouſly believed not to be poiſonous there. And ſome writers tell us, how truly I know not, of ſome other countries, to which they affirm the

like privilege to belong. But there is one inſtance afforded us by *Beguinus*, who travelled much to viſit mines, which, if it be ſtrictly true, is very notable for my preſent purpoſe. *Dignum admiratione eſt*, ſays he, *quod quamvis in vicinia Hydriæ comitatus Gloricienſis, ubi reperitur copiosè ☿, ſingulis ferè annis lues peſtifera graſſatur, illa tamen ſemper immunis ab hac manere ſoleat, idque viri provectæ ætatis ſe obſervaſſe, et à majoribus ſuis accepiſſe, mihi ſanctè confirmarunt.* "It is worthy our admiration, (ſays "*Beguinus*) that though in the county of *Gloricia*, where a great quantity of mercury "is found, the peſt almoſt every year raged, yet it is always free from the plague. And "this was confirmed to me by perſons of a very great age, who ſaid they had re-"ceived it from their anceſtors." To which I ſhould add the teſtimony of the learned *Michael Mayerus*, who pronounces the mercury to be an *alexipharmacum* againſt divers diſeaſes, and particularly the plague, if I did not ſuſpect, by his way of mentioning this laſt diſeaſe, that he borrowed his encomium of mercury from *Beguinus*. But however, what has been related has invited me to conſider, whether there may not be ſome virtue, as well as ſome danger, in amulets of quickſilver, that are by many extolled againſt the plague: but this only upon the bye.

Proposition III.

It is likely, that divers epidemical diſeaſes are, in great part, produced by ſubterraneal effluvia.

I AM very well aware, that divers diſeaſes, that extraordinarily invade great numbers of people at the ſame time; (and were therefore by the Greeks called epidemical) may be rationally referred to manifeſt intemperateneſſes of the air, in point of heat, cold, moiſture, or ſome other obvious quality; and therefore the propoſition ſpeaks but of ſome epidemical diſeaſes, and imputes thoſe it ſpeaks of to ſubterraneal effluvia, not as total, but as partial, and ſometimes as principal agents in the production of them.

In favour of the propoſed conjecture thus explained, I ſhall offer two things to conſideration.

1. And firſt, it ſeems not very improbable, that divers of thoſe morbifick exceſſes (eſpecially if they be ſudden) that are obſerved in the air, may proceed from the unuſually copious aſcent of hurtful exhalations, that mingle with the air, and diffuſe themſelves through it. We are greater ſtrangers, than we commonly take notice of, to the ſubterraneal part of the globe we inhabit: and if I had leiſure, and thought it neceſſary, I could ſhew, that there are a great many odd and ſurpriſing things to be met with in the ſtructure and diſpoſition even of thoſe parts of the earth that lye but a little way beneath the ſurface of it, and partly have been, and partly may eaſily enough be, actually penetrated by the induſtrious labours of men. And as for the deeper ſubterraneal regions, we are ſo much more unacquainted with them, that we are ſcarce fit ſo much as to conjecture, how far they extend, or what kind of materials they contain; and what is the groſs, and (if I may ſo ſpeak) the mechanical fabrick of the greater maſſes, whether ſolid or fluid, they conſiſt of; and leaſt of all can we determine, what motions, whether periodical, or others, theſe maſſes, or other portions of deeply lodged matter, may have.

On ſuch grounds as theſe I conceive it poſſible, that among the many and various effluviating bodies, that the terreſtrial globe may conceal in its bowels, there may be ſome, whoſe reeks, aſcending plentifully into the air, may occaſion in it an exceſs of heat, cold, moiſture, thickneſs, or ſome other manifeſt quality. So that ſometimes (not to ſay many times) even thoſe manifeſt intemperateneſſes of the air, to which an epide-

epidemical diſeaſe is wont to be wholly imputed, (though perhaps not very juſtly) may in part proceed from ſubterraneal bodies; for I elſewhere ſhew, that theſe, by their conflicts, or mutual actions on one another, may excite great and ſudden heats, and on that account ſend up ſuch copious ſteams into the atmoſphere, as may produce there ſudden and exceſſive heats, lightnings, thunders, *&c.* And I ſhall now add (what perhaps will appear ſomewhat ſtrange) that I think ſudden and unſeaſonable refrigerations of the air may proceed from the action of ſubterraneal bodies upon one another: for trial purpoſely made has informed me, that there are certain minerals, whereof ſome may be employed in their crude ſimplicity, and the other requires but a ſlight preparation, ſuch as it may have in the bowels of the earth; which minerals being put together, will produce, by their re-action, an intenſe degree of cold, not only as to ſenſe, but when examined by a ſealed weather-glaſs.

THE changes of the air, that produce epidemical diſeaſes, are ſometimes ſo great and ſudden, that they cannot, in my opinion, with probability be imputed to the action of the ſun or the moon (which are cauſes that act in too general, and too uniform a way, to have thoſe particular and anomalous effects attributed to them) as probably as they may be to ſubterraneal bodies, that often act with more ſuddenneſs and impetuoſity, and without any regularity, at leaſt that is known to us. The difference we find in ſeaſons, that bear the ſame name, and ſhould be alike in temperature, is oftentimes very great, and ſometimes alſo very laſting. It is proverbially ſaid in *England*, that *a peck of March duſt is worth a king's ranſom*; ſo unfrequent is dry weather, during that month, in our climate. And yet in ſome years, and particularly the laſt, it was a rare thing to have a ſhower either in *March*, *April*, or *May*. Sometimes in the month laſt-named, there are heats greater, than in the dog days of that ſame year; though uſually here in *England*, divers mornings of that month are cold, and ſome of them froſty: and now and then I have obſerved in the ſame months and days, at no great diſtance from one another, that the weather has been ſultry hot, and has alſo produced a great ſnow. We have ſeen ſummers like that, which is remembered for the ſiege of *Colcheſter*, that for almoſt the whole ſeaſon were more dark and rainy, than ſeveral winters have been obſerved to be. To which purpoſe I remember, that when I was about to write the hiſtory of cold, I was fain to watch a whole winter to find two or three froſty days, to make an experiment or two I had need of, that required not a cold, that was either laſting or very intenſe. But inſtances of this kind are ſo obvious to thoſe, that are at all heedful obſervers, that I may ſafely paſs them by, and inculcate, that the ſun, being in the ſame ſigns, at the ſame times of the year, it does not appear, how he ſhould produce ſo great a diſparity of the temperature of the air in ſeaſons of the ſame denomination; (as the winters or the ſummers of differing, and yet perhaps immediately conſecutive years.) And therefore I do not ſo much wonder, that many learned writers fly to aſtrology for an account of theſe irregular phænomena, and aſcribe them to the influences of certain ſtars; notwithſtanding what divers eminent philoſophers, and ſome great aſtronomers too, have ſaid to prove the vanity of judiciary aſtrology.

I SHALL not now ſtay to diſcuſs the queſtion, whether the ſtars have any influence diſtinct from their light and heat, becauſe, my opinion about it being ſomewhat peculiar, I have diſcourſed of it in a paper by itſelf. But this I ſhall now ſay, that the fixed ſtars being but general, and (if I may ſo ſpeak) indefinite agents, almoſt unimaginably remote from us, it is nothing near ſo likely, that ſuch effects, as (beſides that they happen very ſuddenly and irregularly) are oftentimes confined to a town, or ſome other narrow compaſs, ſhould be produced by certain ſtars; as that they ſhould be ſo by ſubterraneal bodies, which are near at hand, of very various natures, and ſub-

ject to many irregular and differing motions, commixtures, re-actions, and other alterations. I have known a great cold in a day or two, invade multitudes in the ſame city with violent, and, as to many perſons, fatal ſymptoms; when I could not judge, (as others alſo did not) that the bare coldneſs of the air could ſo ſuddenly produce a diſeaſe ſo epidemical and hurtful: and it appeared the more probable, that the cauſe came from under ground, by reaſon that it began with a very troubleſome fog.

That there may be many ſubterraneal bodies, which by their commixtures may produce a ſudden heat, will be eaſily granted by thoſe that know, (what I elſewhere purpoſely make out) that there are ſubterraneal menſtruums, and are acquainted with chymical operations, ſuch as the great effervеſcence made, when oil of vitriol is put upon filings of iron, or ſpirit of nitre upon butter of antimony: to which I might add many other of the like kind that I have tried; as when ſpirit of nitre is put upon filings either of iron, copper or tin, or upon crude quickſilver; which I ſhall content myſelf to have named, becauſe I have another inſtance, that comes cloſer to our preſent purpoſe. For whereas I have ſhewn above, that there is in many places great ſtore of marcaſitical matter beneath the ſurface of the earth, and ſometimes very near it; I ſhall now add, that I have purpoſely tried, that putting a little ſpirit drawn from nitre, (with which ſalt the earth in many places abounds) or a little oil of vitriol, upon powdered marcaſites (which, being hard ſtones, are more difficultly wrought upon, than many other ſubterraneal marcaſitical bodies of a looſer texture) there preſently enſued a ſtrong re-action between the liquid and the ſolid bodies, whereby was produced much heat, not without viſible fumes, and ſtrongly ſcented, though not viſible, exhalations. And ſuch kind of odoriferous effluvia were emitted upon the putting a little ſpirit of ſalt upon our powdered marcaſites. And becauſe ſulphur is a mineral, that (either pure, or copiouſly mixed with others) is to be plentifully met with in the bowels of the earth, and in many places burns there; I ſhall add, that I have found acid ſpirit of ſulphur (made the common way) to work ſenſibly upon marcaſitical matter hard enough coagulated. An experienced German chymiſt relates, that in ſome parts of his country he met with vitriol ſtones, or marcaſites, that, by the action of mere common water reſting a competent time upon them, will grow ſo hot, as to enable the liquor to retain a ſenſible heat, when it had paſſed a pretty way from them. And, as I elſewhere ſhew, that many accidents may occaſion the breaking out of waters, or the change of their courſe in ſubterraneal places; ſo that common water may produce in a very ſhort time conſiderable degrees of heat in mineral bodies, may appear by mixing with two or three pounds of fine powder of common brimſtone, a convenient quantity, (for now I remember not well how much I took) of filings of iron; for this mixture being thoroughly drenched with common water, did in a ſhort time grow intenſely hot, and ſend up ſuch a thick ſmoke, as good quicklime is wont to do, whilſt men ſlack it with water.

It is obſervable to our preſent purpoſe, what account was given me by a domeſtic of mine, that lived in the north part of *England*, of a certain mineral groove, which he had often occaſion to reſort to: for when I aſked, whether the damp, that place was moleſted with, did frequently recur; he anſwered me, that at the time he was there, it would annoy the workmen, (if they did not take good care of themſelves) more than once in one day. And by inquiries, that I made of others, that were converſant in mines, I learned, that in divers places they were moleſted with damps, that came not at ſtated periods, but irregularly; ſometimes with much greater, and ſometimes with far leſſer intervals between them; the times of their duration being alſo not ſeldom unequal. So that, ſuppoſing ſuch noxious effluvia to be plentifully emitted from the lower parts of the ſoil, it need be no wonder, that an epidemical diſeaſe ſhould

ſhould be rife in this or that particular town or part of a country, without ſpreading much farther; and that it ſhould begin ſuddenly in places, where it was not expected: for beſides that theſe ſwarms of effluvia, being produced by caſual concourſes of circumſtances, may oftentimes be excited, and invade this or that place, without giving the inhabitants any warning; beſides this, I ſay, it is not always neceſſary, that theſe noxious effluvia ſhould be generated juſt under the places they moleſt, ſince the motion of the air, eſpecially when the wind ſits favourably, may ſuffice to carry them to the town or other place, that feels their ill effects: and yet they may ſeem to be almoſt confined to thoſe places; ſometimes becauſe the neighbouring places are not inhabited enough to make their ill qualities taken notice of; but more frequently, becauſe, by being diffuſed through a greater tract of air, they are more and more diſperſed in their paſſage, and thereby ſo diluted (if I may ſo ſpeak) and weakened, as not to be able to do any notorious miſchief.

AND here I conſider too, that it is not always neceſſary, that the harm, that is done by theſe morbid conſtitutions of the air, ſhould proceed only or preciſely from theſe ſubterraneal exhalations we are ſpeaking of, by virtue only of their own qualities, which they bring with them from under ground. For it is very poſſible, that theſe effluvia may be in their own nature either innocent enough, or at leaſt not conſiderably hurtful, and yet may become very noxious, if they chance to find the air already imbued with certain corpuſcles fit to aſſociate with them: for though theſe ſorts of particles were perhaps neither of them apart conſiderably hurtful, yet there may from their combinations reſult corpuſcles of a new and very morbifick nature.

THIS may be ſomewhat illuſtrated by conſidering, that the ſpirituous ſteams of ſalt-petre are not wont ſenſibly to work on gold, nor yet the ſpirituous parts, that the fire raiſes from ſal-armoniac; and yet when theſe two ſorts of particles convene, there reſults from their coalitions certain corpuſcles of a new nature, that compoſe the liquor chymiſts call *aqua regis*, which by its fretting quality corrodes and diſſolves gold. By analogy to this we may conceive, that ſometimes the ſubterraneal effluvia may find the air already impregnated with ſuch corpuſcles, that, by aſſociating themſelves therewith, they may compoſe corpuſcles far more capable, than themſelves were whilſt apart, of having ill effects upon the maſs of blood, or ſome determinate parts of human bodies, and conſequently of producing diſeaſes there.

AND this inſtance may appear the more appoſite; becauſe it may be ſaid, that as though ſilver and gold, and diamonds and rubies, *&c.* be put together, and *aqua regis* be poured upon them, it will leave all the reſt uncoroded, and fall only upon the gold; ſo the newly-produced corpuſcles, that I have been ſpeaking of, whether breathed in with the air in reſpiration, or carried up and down by the blood, or other liquors of the body, may paſs by other parts of it without doing them any ſenſible harm, and attacking this or that determinate part, produce there ſome diſeaſe, ſuch as the fabrick and ſituation of that part peculiarly diſpoſe it to be affected with.

AND I ſhall add on this occaſion, that in our hypotheſis we may render a probable reaſon, why in ſome epidemical diſeaſes ſome perſons may eſcape much better than others, that ſeem likely to be, at beſt, as obnoxious to them, without a recourſe to the peculiar conſtitutions of the bodies of differing perſons; for it may be conjectured, that the noxious corpuſcles, that infeſt the air, may (eſpecially in windy weather) be very unequally diſperſed through the air, and many fly in far greater or leſſer numbers within equal ſpaces of air; and conſequently the perſons, that have the ill luck to be in the way of the more numerous ſwarms of morbifick corpuſcles, may be much more

more prejudiced by them, than others, though of weaker conſtitutions, who happen to be attacked but by few of them.

On which occaſion I remember, that a great many trees in ſome land, that belongs to me, having been ſuddenly much endamaged by a wind, that was not able to do it by its bare ſtrength; I had the curioſity to view ſomewhat heedfully a tree, that ſtood in the garden, and perceived, that all the conſiderable miſchief was done to that ſide of the tree, which reſpected the corner whence the hurtful wind blew, the leaves of the other ſide continuing freſh and verdant, as being by the other part of the ſame tree fenced from the wind: and it was farther obſerved, that even the expoſed ſide of the tree was not every where endamaged; for there were divers parts where the leaves continued ſound and green, though neighbouring leaves, were ſome more, ſome leſs (for all that were prejudiced were not totally) blaſted: the ſound leaves and the diſcoloured being ſo oddly mingled, that I conjectured the cauſe of the miſchief to have been this; that ſome arſenical, or other corroſive or poiſonous exhalations, being ſuddenly emitted from the ſubterraneal parts into the air, were by the wind they chanced to meet with there, hurried along with it, and blown againſt the bodies, that ſtood in its way, moving in the air like hail-ſhot diſcharged out of a gun, here in a cloſer, and there in a more ſcattering order; ſo that as more or fewer of them happened to fall upon the ſame branch or leaf, they left more or leſs marks of their paſſage, by deſtroying the texture and colour in the leaves, or parts of them they chanced to beat upon. And this may poſſibly be the cauſe of ſome of thoſe ſudden and ſometimes fatal effects, that I have known in ſome places the people talk much of, complaining, that ſuch a one had his eyes, or his face, or only one ſide of it, blaſted by a malignant wind; of which I thought I ſaw an example in a domeſtick of my own, whilſt in ſuch a wind he was riding after me, who (thanks be to God) had no ſuch miſchief done me.

But the vulgar have entertained ſuch ſtrange conceits and ſtories about theſe blaſtings, on which account ſome of them ſay, that men are planet-ſtruck, that the fabulous things mingled with thoſe, that are poſſible, have made intelligent perſons to reject them all.

One thing more I ſhall take notice of in favour of our hypotheſis; which is, that it well agrees with what has been obſerved, not without ſome wonder, of the very ſhort duration of ſome epidemical diſeaſes in certain times and places. For this may proceed from hence; either that all the morbific expirations aſcended into the air almoſt at once, or at leaſt within a ſhort time, and ſo were eaſily ſpent, that is, by diffuſion or diſperſion, ſo weakened, as to be diſabled from doing much miſchief; or elſe the ſubterraneal commotion, that produced them, may paſs on from one place to another, and ſo ceaſe to afford the air incumbent on the firſt place the ſupplies neceſſary to keep it impregnated with noxious exhalations: and it agrees well with this conjecture, that ſometimes we may obſerve certain epidemical diſeaſes to have, as it were, a progreſſive motion, and leaving one town free, paſs on to another. Of which ſome obſervations, that I have made, incline me to think, that if phyſicians would heedfully mind it, they might take notice of ſeveral inſtances.

One thing more may be added, as conſonant to our hypotheſis; namely, that ſometimes an epidemical diſeaſe ceaſes in this or that place, almoſt as ſudden as it invaded, or at leaſt in a much ſhorter time, than phyſicians expected. For according to our hypotheſis it may well happen, that after ſome ſort of exhalations, whoſe peculiar qualities make them morbifick, have depraved the air incumbent on a particular place; there may, by a new or farther commotion of ſubterraneal bodies, be ſent up into the air ſtore of expirations of another kind, which meeting with thoſe, that for-

merly impregnated it, may either precipitate them, and ſo free the air from them; or by other operations on them, and ſometimes even by coalitions with them, ſo alter their nature, as to diſable them from doing any farther miſchief.

THIS I ſhall illuſtrate, if not confirm, by that very remarkable phænomenon, that is yearly obſerved at *Grand Cairo* in *Ægypt*; for, (though I know not, whether or no the corpuſcles, that produce it, ariſe from under ground, the affirmative part of the queſtion being not improbable) it appears, that by the intermixture of adventitious corpuſcles with the formerly peſtilential air, it is ſo altered and corrected, that within one day or two, if not within a leſſer compaſs of time, there is a ſtop put to the progreſs of the plague, that in the favourable time of year, namely, about the middle of ſummer, ſcarce ever miſſes of raging in that populous city: and, which is more admirable, theſe ſanative corpuſcles (if I may ſo call them) operate ſo powerfully, that of thoſe, that are already ſeized by that fataleſt of diſeaſes, the plague, few or none die of it, after once theſe antidotal particles have ſufficiently impregnated the air. I confeſs ſo great and ſudden a change is very wonderful, and I ſhould ſcarce think it credible, if I had not had the means and curioſity to inquire about it of divers perſons, ſome of them very intelligent, that either curiouſly viſited, or alſo made ſome conſiderable ſtay, in that great city, and found them agree in the main about the truth of the matter of fact: which is much confirmed to me by ſo eminent a teſtimony, as that of the learned *Proſper Alpinus*, who for ſeveral years practiſed phyſick in *Grand Cairo*, and as an eye-witneſs delivers what he relates more authentically, as well as more particularly, than any I have met with: and, though he endeavours to give ſeveral reaſons of this ſtrange and ſudden ceſſation of the malignity of the plague, yet I doubt they are not ſufficient for ſo wonderful an effect, unleſs we take in ſome new exhalations, that then impregnate and correct the air.

AND we ſhall ſcarce doubt of the great intereſt theſe have in the effect produced, if we give credit to what the recenteſt writer I have met with of voyages into *Ægypt*, has lately publiſhed about the annual peſtilence at *Grand Cairo*, a city he much frequented. This author, in the account he gives of the preſent ſtate of *Ægypt*, relates, that a little after the middle of our *June* (and uſually upon the very ſeventeenth day) there begin to fall towards the laſt quarter of the night, near the morning, certain drops of a kind of dew, which cauſes the river to be fruitful, and purifies the air from all the infection of camſims, by which I preſume he means the peſtilence: for, after ſome lines interpoſed, he ſubjoins, *The drops or dew purifies the air, for as ſoon as it falls, the plague ceaſes to be mortal, none dies of it; the air is wholeſome, all diſtempers ceaſe, and if any perſon grows ſick, he never dies.*

AND then, he adds, *This dew gives life to every thing; and when it falls upon the wheat, it cauſeth it to continue many years without corruption or worms, and is far more nouriſhing, than that corn, on which it never falls. For this cauſe they never houſe the corn of the Grand Seignior in the barns, till this dew is fallen upon it, that it might keep the longer without worms.*

As well this conjecture, as ſome other things delivered here and there in this paper (about the ſalubrity of the air) may probably gain the more credit, if I here ſubjoin, what I learned by inquiry from a very ingenious gentleman, who was owner of one or more of the mines, that afford the phænomenon I am to mention, which is this, that in the tin-mine countries in *Devonſhire*, it ſometimes happens, (as perhaps I may have elſewhere noted to another purpoſe,) that upon a ſudden a ſpot of ground, and that not always narrow, will be, as it were, blaſted by the aſcending hurtful fumes; inſomuch that not only the graſs, fern, and other more tender vegetables, will be turned black, and, as it were, burnt or ſcorched up; but now and then trees

alſo

alſo, without excepting oaks themſelves, will be blaſted and ſpoiled by the powerful operation of theſe ſubtile and poiſonous effluvia.

It will probably be here expected, that among the epidemical diſeaſes, that our hypotheſis derives from ſubterraneal effluvia, I ſhould particularly treat of the cauſe of peſtilential fevers, and the plague itſelf. But, though ſome ſuch fevers may not improbably be in great part imputed to the noxious expirations of the globe we inhabit; yet as to the true plague itſelf, I freely confeſs I am at a loſs about its origin.

The ſacred writings expreſly teach, that ſome plagues, and particularly that, which in *David*'s time ſwept away in three days 70,000 perſons, have been in an extraordinary manner inflicted by God. And to me it appears either ſcarce poſſible, or far more difficult, than thoſe, that have not attentively enough conſidered the matter, are wont to think it, to deduce the abſtruſe origin, ſtrange ſymptoms, and other odd phænomena of ſome plagues, that are recorded in hiſtory, from merely corporeal cauſes.

On the other ſide it ſeems unphiloſophical, and perhaps rather ſeems, than is very pious, to recur, without an abſolute neceſſity, to ſupernatural cauſes, for ſuch effects as do not manifeſtly exceed the power of natural ones; though the particular manner of their being produced is perchance more than we are yet able to explicate. And I think it the more queſtionable, whether all plagues are ſupernatural exertions of God's power and wrath againſt the wicked, becauſe I obſerve, that brutes (which are as well uncapable of moral vice, as moral virtue) are yet oftentimes ſubject to murrains, ſuch as may without incongruity be looked upon as the peſtilences of beaſts. And it is the leſs likely, that theſe ſweeping and contagious maladies ſhould be always ſent for the puniſhment of impious men, becauſe I remember to have read in good authors, that as ſome plagues deſtroyed both men and beaſts, ſo ſome other did peculiarly deſtroy brute animals, of very little conſideration or uſe to men, as cats, &c.

Upon theſe and the like reaſons I have ſometimes ſuſpected, that in the controverſy about the origin of the plague; namely, whether it be natural or ſupernatural, neither of the contending parties is altogether in the right: ſince it is very poſſible, that ſome peſtilences may not break forth, without an extraordinary, though perhaps not immediate, interpoſition of almighty God, provoked by the ſins of men; and yet other plagues may be produced by a tragical concourſe of merely natural cauſes.

But though the difficulties, that incumber each of the oppoſite opinions, keep me both from dogmatically aſſerting, that all plagues have a ſupernatural origin, and from denying, that any have it; yet, to ſay ſomething on ſuch an occaſion, though I can ſpeak but very heſitantly, I ſhall venture to add, that, whether or no the true plague be ſaid to deſcend to the earth from a higher ſphere, than that of nature; yet its propagation and effects are (at leaſt for the moſt part) carried on mainly by a malignant diſpoſition in the air; without which ſome plagues could never have been ſo catching, as they were, nor ſo ſuddenly mortal; and that in divers peſtilences this malignant diſpoſition of the air may probably be in great part imputed to ſome kinds of ſubterraneal expirations, I am prone to think, and that chiefly upon two accounts.

The firſt thing, that induces me to this conjecture, is, that not any of the ſeveral cauſes, to which the plague is wont to be imputed, ſeems to me to be ſufficient. Thoſe, that fetch it from the malevolent aſpects and influence of the celeſtial lights, beſides that they ſuppoſe ſome things, very difficult to be proved, have recourſe to agents too remote, too general, and too indeterminate, to be acquieſced in as the cauſes of ſuch particular ſymptoms and phænomena, as oftentimes accompany peſtilences.

And

And as for thoſe other ſects of phyſicians, that confidently derive the plague, ſome from internal putrefaction, and others from exceſſive heats, noiſome ſtinks, corrupt aliments, and ſuch other celebrated cauſes; though each party alledges plauſible reaſons for its own opinion, yet their objections againſt their adverſaries are much ſtronger, than their arguments are for themſelves. And the learned *Diemerbroeck*, though his own hypotheſis ſeems to be more theological than philoſophical, has much enervated the arguments brought for the ſeveral opinions lately named, and by him diſſented from.

THE reaſons he employs to refute all the received opinions about the origin of the plague, except his own, are divers of them worthy of ſo learned a man, to whom, though I had leiſure to tranſcribe them, I ſhould refer the curious; my preſent deſign being only to deliver ſome few things, that ſeem more favourable to my conjectures, than to his opinion, and were ſuggeſted to me, partly by my own thoughts, and partly by the informations, that, to examine thoſe thoughts, I procured by conſulting ſome uncommon authors, and aſking queſtions of great travellers and navigators. By this means I came to learn, that divers great countries are uſually free from the plague, that, according to the vulgar hypotheſes, ought to be as much ſubject to it, if not more, than *England*, *France*, *Italy*, and thoſe other parts of *Europe* and *Aſia*, where that fatal diſeaſe rages from time to time in the parched regions of *Africk*, to which the exceſſive heats would make one expect, that the plagues ſhould make far more frequent viſits, than to our temperate European countries. *Leo Africanus* informs us, that ſome parts are ſo ſeldom afflicted with that dreadful diſeaſe, that it uſually ſpares the inhabitants 29 or 30 years together. And he expreſsly records, that in *Numidia* itſelf, (if I much miſremember not the country's name,) notwithſtanding the raging heat of the climate, the plague is wont to be produced but once in a hundred years. Our * *Purchas* informs us, that in the land of the negroes it is not known at all. And to omit what ſome travellers and navigators relate of *Japan*, as if it were ſeldom or never invaded by the peſtilence; I do not remember, that in *New-England*, which contains a great extent of land, though I have had both curioſity and opportunity to inquire after the diſeaſes of that country, I ever heard the Engliſh take any notice of the plague, ſince their ſettling there above threeſcore and ten years ago. And as for the *Eaſt-Indies*, Sir *Philibert Vernatti*, a virtuoſo of great fame and authority at *Batavia*, where he reſides, in his ingenious returns to the queries ſent him by the Royal Society (of naturaliſts) anſwers thus to the fifteenth: [*Peſtis morbus eſt Indiarum incolis incognitus.*] "The plague is a diſeaſe unknown amongſt the Indians." And of the countries, that lie yet more remote, as the great empire of *China*, and the kingdoms of *Tunquin*, and of *Cochinchina*, that great traveller *Alexander de Rhodes*, who ſpent 30 years in thoſe parts, affirms, that the plague is not ſo much as ſpoken of there: and yet the ſame Jeſuit does, upon grounds probable enough, eſtimate the number of the people of *China* alone to be two hundred and fifty millions; [a number I take to exceed by far that of all the nations of *Europe*.] Now when I conſider, how vaſt tracts of land are comprized in thoſe countries, ſome of which the plague does not at all, and others but exceeding unfrequently, invade; this immunity ſeems to me very unfavourable to moſt, if not all, the opinions received among phyſicians, as alſo that of *Diemerbroeck* himſelf, who derives the plague from a ſupernatural cauſe, the wrath of God againſt the ſins of men. For in regions of ſuch extent, and divers of them very populous, which are ſeated under very differing climates, and which are ſome of them inhabited by nations, that make war with numerous armies, fight bloody battles, leave heaps of unburied bodies expoſed to the putrifying heat of the ſun; are ſometimes forced, as well as others, to live upon very unwonted and unwholſome

* *Purchas's Pilgrimage*, lib. 6. cap. 13.

foods; that worſhip ſtocks and ſtones, and beaſts, and ſome of them devils, whom they know to be ſuch; that are at leaſt as guilty as Europeans, of aſſaſſinates, poiſonings, rapes, oppreſſion, ſodomy, and other crying ſins: in theſe regions I ſay, it is not imaginable, but that great intemperatures of the air, eſpecially in point of heat, ſtench of dead bodies killed in fights, unwholeſomneſs of aliments, malevolent aſpects of celeſtial bodies, high provocations of the divine juſtice, and in ſhort all the cauſes, to one or other of which the ſeveral parties of phyſicians are wont to refer the plague, ſhould be wanting any more than in our *Europe*; and yet the plague, which is preſumed to be the effect of one or other of theſe cauſes, is not here obſerved to be produced.

I KNOW, that it may be ſaid, that the hiſtorical things I have been reciting do not only oppugn the ſeveral received opinions of phyſicians about the cauſe of the plague, but diſfavour my conjectures too. But if this be ſaid, I deſire it may alſo be conſidered, that my judgment about the plague conſiſts of two parts: one, that it is exceeding difficult to aſſign the true and adequate cauſe of the origin of the peſtilence; and the other, that whatever be the cauſe of its firſt eruption, its propagation, and divers of its ſymptoms, may be probably enough referred to the depravation of the air by ſubterraneal ſteams, and their effects. If this be duly conſidered, the hiſtorical obſervations will appear not to overthrow the firſt member of our hypotheſis, but rather to confirm it; and it is upon this account that I have mentioned them in this place: and as to the ſecond member, it may be ſaid, that ſince in the *Eaſt-Indies* and the other countries I have named, as privileged from this raging diſeaſe, it is not obſerved to break out; as it cannot be ſaid, that ſubterraneal effluvia do in thoſe countries promote the propagation of it; ſo it cannot be proved, that they could not do it, in caſe the plague were begun by other cauſes. But in regard I think it not improbable, that ſometimes the plague is not only fomented, but begun, by noxious expirations of the terreſtrial globe; I ſhall add, that this ſuppoſition, though I confeſs it to be ſomewhat diſfavoured by ſome of the lately mentioned obſervations, yet is not abſolutely inconſiſtent with them. For firſt, it may be ſaid, that ſome of the countries I ſpeak of, may be deſtitute of thoſe noxious minerals, to which we impute ſome plagues, it holding true in minerals as well as in plants, *Non omnis fert omnia tellus*. And to omit what I have not without ſome wonder obſerved, of the limits of differing ſorts of mines and mineral veins in very bordering parts of the ſame tract of land, I cannot but here take notice, that though ſulphur be in many countries uſually found, and that in plenty, where there are other metalline veins, inſomuch that chymiſts make it one of the three principles of all metals; yet, in the mines of *England*, more ſtrictly ſo called, I do not remember I ever met with ſo much as an ounce of native ſulphur, and I could not find by divers mineraliſts, of whom I purpoſely aſked the queſtion, that they had met with any among the various mines they had frequented. It may alſo happen, that there may be hurtful minerals in a country, and yet not capable of often producing or promoting peſtilences there, even upon moderate earthquakes. For it is poſſible, that theſe orpimental or other noxious minerals may have their beds or veins lying ſo deep in the earth, that they are not ordinarily able to ſend up effluvia ſtrong and copious enough to make a peſtilential depravation of the air; and even in leſſer earthquakes the commotion or agitation of the ground, eſpecially if the earthquakes proceed (as one may ſuſpect, that divers of them do) from the ſudden fall of ponderous maſſes in the hollow parts of the earth, and the ſhaking of the ground thereby produced, and ſometimes ſpreading far, may not reach ſo far downwards, as much to affect theſe very deep mines, and yet ſome other more violent earthquakes may affect even theſe: upon which ground one may give ſome tole-

tolerable account, why the plague in ſome parts of *Africk* has been obſerved to rage but once in thirty, or once in a hundred years; for there may be periodical paroxyſms, if I may ſo call them, or grand and vehement commotions in ſubterraneal parts, though men have not yet, for want of ſufficient longevity or curioſity, obſerved them. On which occaſion I remember, that a late judicious French hiſtorian recounts, that in part of the laſt age, and part of this, a very pernicious diſeaſe of the nature of a cholick reigned in *France* every tenth year for a long tract of time. And the experienced * *Platerus* relates, that at *Baſil*, where with great ſucceſs he practiſed phyſick fifty-ſix years, the city was afflicted with furious plagues once about every tenth year for ſeventy years together, of each of which peſtilences he gives a particular account in his uſeful obſervation. It may alſo farther be ſaid, that thoſe exhalations in the *Eaſt-Indies*, *&c.* that would otherwiſe be peſtiferous, may be corrected by other expirations, that may be either of benign nature, or of ſuch a nature, as, though noxious in themſelves, may fit them, by combining with thoſe, that would be peſtiferous, to diſable them to be ſo; as I elſewhere obſerved out of *Beguinus*, that a country abounding in veins and maſſes of cinnabar, which is the ore of quickſilver, was preſerved from the plague, when the neighbouring regions were waſted by it. And I ſhall illuſtrate this matter ſomewhat farther, by taking notice, that though corroſive ſublimate be ſo miſchievous a mineral compoſition, that a few grains may kill a man, yet the fumes of this, combining with thoſe of crude common quickſilver, which are themſelves unwholeſome enough, make *Mercurius dulcis*; which is a mixture ſo innocent, that being well prepared, and well adminiſtered, it is both ſafely and uſefully given even to children.

* Lib. 2. P. M. 323.

IF what has been ſaid will not ſuffice, I ſhall propoſe another poſſible way of accounting for the immunity of ſome countries from the plague. For one may conceive, that in ſuch regions the ſoil, and other aſſiſting cauſes, may conſtantly produce in the air ſuch a conſtitution, as is found in the air of *Egypt*, during the time of the increaſe and overflowing of *Nile*, which uſually laſts every year for ſeveral weeks; for during this time the air is ſo antipeſtilential, that not only the plague does not make a new eruption, but is either wonderfully checked or quite ſuppreſſed in thoſe houſes, that it has already invaded; ſo that its mortal infection reaches no farther. And that it may not be thought incredible, that ſome countries may have, if I may ſo ſpeak, an antidotal nature, in reference to ſome pernicious evils, I ſhall repreſent, that there are ſome whole countries, which are privileged from producing vipers, toads, and other venomous creatures, as is vulgarly known concerning *Ireland*, where I could never ſee any ſuch, nor find by enquiry of either the natives, or Engliſh inhabitants, that they had met with any in that kingdom, where it is uncontrolled tradition, that if poiſonous creatures have been carefully brought there from other parts, they have died almoſt as ſoon as they came thither. There are ſome other iſlands, to which a like hoſtility to venomous animals is aſcribed: and as it ſeems not impoſſible, that ſome countries ſhould have a ſoil, that ſo impregnates the air, as to make it ſuppreſs, or quite enervate many different ſorts of poiſons; ſo others may, by their conſtitution, be qualified to maſter or reſiſt poiſonous expirations, or wandering corpuſcles, that elſewhere are wont to produce the plague. And this may ſuffice for the firſt thing whereon we ground our hypotheſis.

THE ſecond thing that invited me to the above propoſed ſuſpicion or conjecture, is, that it affords a not improbable account of ſome conſiderable things, relating to the production and phænomena of the plague.

(1.) As firſt, it is obſerved, that ſometimes the plague breaks out, when there has not preceded any ſuch immoderate diſtemper of the air, or any caſual enormity, ca-

pable of producing ſo great and anomalous an effect: nay, which is more, it has been obſerved, that very great and unuſual intemperateneſſes of the air have ſeveral times happened, and divers notable and threatning aſpects of the ſtars have been noted by good writers without being followed by the plague. The celebrated * *Fernelius* relates, that near the time he writ this obſervation, that year, which of all thoſe, that had paſſed in the memory of man, was all the world over the moſt immoderately hot, and was yet moſt healthful. And the ſame author reports the plague to have begun in the midſt of winter, and to have gone off in ſummer, and that ſeveral times ardent ſummers have been altogether free from the plague; which I alſo have noted to be true. *Johannes Morellus* obſerves, that in his country, after a dry winter, and wherein the north wind reigned, though it were ſucceeded by a moſt temperate and healthful ſpring, yet this brought in the plague, and that when the north wind was predominant, and the air pure and ſerene: which I the leſs ſcruple to believe, becauſe I obſerved ſomething very like it in the conſtitution of the air, that preceded and accompanied the dreadful *London* plague, that broke out in the year 1665. Which phænomena much disfavour their opinion, that impute the plague to the exceſſes of the manifeſt qualities of the air; but are agreeable to our hypotheſis, ſince by what has been formerly delivered, we may gather, that noxious ſubterraneal fumes may be ſuddenly, and without any warning, belched up into the air, and, by depraving it, produce fatal diſeaſes in many of thoſe, that are conſtantly ſurrounded by it, and draw it in, almoſt every moment, with their breath.

* *De abditis rerum cauſ.* lib. 2. c. 13.

Of the deadly hurtfulneſs of divers ſubterraneal expirations, at their firſt eruption, there are many hiſtories extant in approved authors; and we have obſerved inſtances of that ſort in the times and countries we live in. But becauſe all poiſonous, and even mortal, exhalations, are not therefore truly peſtiferous, but may, like many other poiſons, kill the perſons they immediately invade, without qualifying them to infect others; I ſhall add a paſſage out of that excellent hiſtorian, *Monſieur de Mezeray*, who relates in the life of *Philip de Valois*, "that the plague, that happened in "*France* in the year 1346, was ſo contagious and deſtructive, that ſcarce a village, or "even a houſe, eſcaped uninfected by it. He adds, that this peſtilence, than which "none had been obſerved more furious and ſpreading, began two years before in the "kingdom of *Cathay*, by a vapour, that was moſt horribly ſtinking, which brake "out of the earth like a kind of ſubterraneal fire, conſumed and devoured above 200 "leagues of that country, even to the very trees and ſtones, and infected the air in a "wonderful manner. From *Cathay*, ſays he, it paſſed into *Aſia* and *Greece*, thence "into *Africk*, afterwards into *Europe*, which it ranſacked throughout." Other inſtances of peſtilences begun by noxious ſubterraneal fumes I have met with in good authors; but cannot now recal the particulars to mind, and therefore ſhall paſs on to the ſecond obſervation.

See *Diemerbroeck de peſte*, lib. 1. c. 8.

(2.) In the next place then; whereas it is noted by diligent obſervers, that there is a wonderful diverſity in ſeveral countries, and even in the ſame country at ſeveral diſtant times, of thoſe raging diſeaſes, that phyſicians agree in calling the plague, (whence it happens, that ſuch medicines or methods of curing, as are in one plague ſucceſsful, as phlebotomy, purging, *&c.* do oftentimes in another prove dangerous, if not mortal;) whereas (I ſay) this great variety has been obſerved in plagues, it may be fairly accounted for, by the great number and diverſity, that has been actually found, or may be reaſonably ſuppoſed, in the numerous minerals, and other bodies, that nature has laid up in the ſubterraneal regions: eſpecially if we conſider, that the number of ſuch bodies may be much increaſed or diverſified by the various combinations which may be made of them, not only by caſualties, but by the action of ſubterraneal

terraneal fires, and æſtuaries, and menſtruums, ſuch as I have elſewhere ſhewn to be lodged beneath the turf or ſuperficies of the earth. And the aſcending corpuſcles of thoſe mineral bodies, being moſt of them ſolid and ſubtile, may produce in the blood, and ſo in the body, far more odd and violent ſymptoms, than the peccant humours, that uſe to beget ordinary diſeaſes: which may be one reaſon, and perhaps the chief, why the ancient heathens, and *Hippocrates* himſelf, acknowledged in peſtilential diſeaſes θεῖον τι, ſomewhat of divine, ſurpaſſing ordinary nature.

WHAT theſe mineral ſubſtances are, whoſe ſteams produce ſuch odd and diſmal ſymptoms, I think exceeding hard to determine; yet, if I were to name one ſort, I ſhould perhaps think the leaſt unlikely to be orpiment. For, of the poiſonous minerals we are acquainted with, I know not any, of which there is greater quantity in the bowels of the earth, eſpecially taking that name in the latitude allowed it by thoſe ſkilful men, that make three ſorts of it, *viz.* yellow, red and white orpiment; divers of whoſe miſchievous effects ſeem to agree well enough with the ſymptoms of ſome plagues, and may be gueſſed to have at leaſt a conſiderable intereſt in the production of them. But yet, to ſpeak candidly, I do not think, that theſe minerals are the cauſes, even of all thoſe peſtilences, whoſe efficients may come from under ground: for ſeveral reaſons, and ſome drawn from experience, make me think, that the ſubterraneal regions have many kinds of very miſchievous foſſiles, of which phyſicians, and even chymiſts, have no knowledge, and for which they have not any diſtinct names; and that the various aſſociations of theſe, which nature may by fire and menſtruums make under ground, and perhaps in the air itſelf, may very much increaſe the number and variety of hurtful matters, and alſo heighten their hoſtility to human bodies; as I think may be argued from the factitious white arſenick, that is commonly ſold in ſhops, which, though uſually made of orpiment, by the addition of ſo innocent a body as common ſalt, (which is found in great plenty under ground,) is obſerved to be far more poiſonous than orpiment itſelf. And I remember, that a ſkilful chymiſt having in my preſence taſted ſome prepared, and, as was thought, ſomewhat corrected arſenick, was quickly invaded by ſuch ſymptoms, as he thought would preſently kill him; but, through God's bleſſing, I quickly put him out of danger, though not out of pain, by early preſcribing him ſtore of oil of ſweet almonds, and ſomething made of lemons, that I chanced to have by me. But to return to what I was ſaying, ſandarach ſeems to be but orpiment, whoſe yellow colour is deepned to redneſs; and native arſenick, (for I have ſeen ſuch a thing, tho' it rarely comes into *England*,) ſeems to be little other, than pale or white orpiment. And indeed in *Hungary*, all three may be found not far from one another in the ſame mine, as I learned by inquiry from an obſerving eye-witneſs, by whoſe means, and of another chymiſt, divers native orpimental minerals (to ſay nothing of realgar, becauſe it is a factitious combination of orpiment and ſulphur) came to my hands. And as this ſort of foſſiles comprizes more numerous and various ones, than is noted, ſo the very noxious effects of the effluvia of orpiment are not unknown to divers phyſicians: and the learned *Sennertus* gives a particular inſtance of it in a painter, who upon opening a box where orpiment, which men of his profeſſion uſe as a pigment, had been long kept, had his face all ſwelled, and was caſt into fainting fits. And as white arſenick is of a more piercing and corroſive nature, ſo it were not difficult to ſhew out of the writings of eminent phyſicians, that its effects have divers times proved very hurtful, and ſometimes mortal, when but externally worn in amulets, eſpecially if the pores of the ſkin were open by exerciſe and ſweat; and the nature of the ſymptoms produced ſeems to confirm our hypotheſis, ſince the perſons that wore theſe arſenical amulets, were affected, ſome with great anxieties about the heart, ſome with inflammations, ſome with burning fevers, ſome with exulceration of the breaſts, ſome with puſtules like

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thoſe of the plague, and theſe were ſometimes black, as if made with a cauſtick: moſt patients were affected with great weakneſs and faintneſs, &c. as if they had ſwallowed poiſon; and of one young man it is recorded, that having heated himſelf in a tennis-court with an amulet upon his breaſt, the virulence of its corpuſcles made him fall down ſtark dead upon the ſpot. And it is a conſiderable circumſtance in theſe obſervations, that ſeveral patients were cured of the ſymptoms that ſeemed to be peſtilential ones, by the ſame remedies that are alexipharmical againſt the plague: whence it may alſo be made probable, that the plague itſelf, many times is a natural, though a dreadful and anomalous diſeaſe, ſince its effects and ſymptoms ſo much reſemble thoſe of acknowledged poiſons, and have been cured by antidotes effectual againſt other poiſons.

I HAVE not time to mention, what I have myſelf tried and obſerved about the bad effects of orpiment, and its kinds. But I remember, that enquiring of an ingenious man, who ſometimes viſited a mine, which was known to abound with orpimental foſſils; he anſwered me, that when he walked over the neighbouring grounds, he found himſelf much diſordered, eſpecially in his thorax, by the effluvia; and that the mine-men and diggers were ſubject to a malignant anomalous and dangerous ſort of fevers, though he ſaid he was apt to impute, I know not how truly, ſome part of their obnoxiouſneſs to it, to their drinking too much ſtrong wine. But though it is probable the effluvia of orpimental bodies may have a great intereſt in ſeveral plagues, yet I ſtrongly ſuſpect, that many others may proceed from the ſteams of ſuch ſubterraneal bodies, as are not yet diſtinctly known to us; and poſſibly have their effluvia variouſly combined, either beneath or above the ſurface of the earth: I ſay above; becauſe I have ſeveral times, and that without heat, combined ſeparately inviſible fumes of differing kinds into manifeſtly viſible ones in the free and open air.

AND that the ſubterraneal effluvia may produce effects, and therefore probably be of natures, very uncommon, irregular, and, if I may ſo ſpeak, extravagant, may appear in thoſe prodigious croſſes, that were ſeen in our time, *viz.* in the year 1660 in the kingdom of *Naples*, after an eruption of the fiery mountain *Veſuvius*; of which prodigies the learned *Kircherus* has given an account in a particular diatribe: for theſe croſſes were ſeen on linen garments, as ſhirt-ſleeves, women's aprons that had lain open to the air, and upon the expoſed parts of ſheets; which is the leſs to be admired, becauſe, as *Kircher* fairly gueſſes, the mineral vapours were by the texture, that belongs to linen (which conſiſts of threads croſſing one another for the moſt part at or near right angles) eaſily determined to run along in almoſt ſtraight lines croſſing each other, and conſequently to frame ſpots, reſembling ſome one, and ſome another kind of croſſes. Theſe were extremely numerous in ſeveral parts of the kingdom of *Naples*; inſomuch that the Jeſuit, that ſent the relation to *Kircher*, ſays, that he himſelf found thirty in one altar-cloth, that fifteen were found upon the ſmock-ſleeve of a woman, and that he reckoned eight in a boy's band; alſo their colour and magnitude were very unequal, and their figures diſcrepant, as may appear in many pictures of them drawn by the relator; they would not waſh out with ſimple water, but required ſoap; their duration was alſo unequal, ſome laſting ten or fifteen days, and others longer, before they diſappeared. And theſe croſſes were found not only upon linen garments expoſed to the air, but upon ſome of thoſe (belonging to altars) that were kept locked up in cheſts (to which poſſibly they might have acceſs by the key-holes, or ſome unheeded chink.) To which ſtrange phænomena, if I had the leiſure to add ſome others, that I have met with in *Agricola*, and other approved authors, whoſe relations my memory doth not now ſerve me particularly to cite; I preſume it would appear yet more probable, that ſubterraneal effluvia may now and then be of

a very anomalous nature, and produce ſtrange effects, and among them variety of peſtiferous ones in the air.

BUT, to add this upon the bye, though I fear phyſicians will not be able to diſcover all the ſubterraneal bodies, whoſe effluvia produce or contribute to the plague; yet, I do not think it impoſſible, that, by diligent obſervations and trials, ſagacious men may diſcover divers of them, and perhaps antidotes againſt them.

AND though the buſineſs of this paper be to treat of the cauſes, not the remedies of the plague; yet I love mankind too well, to ſuppreſs on this occaſion an obſervation, that, by God's bleſſing, may in ſome caſes ſave the lives of many. In the late great plague, that ſwept away ſo many thouſands in *London*, there ſtaid in the city an ingenious phyſician, that was bred by the learned *Diemerbroeck*, (whoſe book *de Peſte* I prefer to any I have yet read of that diſeaſe.) This doctor (whoſe name I am ſorry I have forgotten) hearing, that I was deſirous to receive an account of the plague from ſome intelligent eye-witneſs, and having ſoon after ſome occaſion to paſs near the place in the country, where I then reſided, was pleaſed to give me a viſit, and a rational account of the main things I deſired to know; and when I inquired about his method of cure, after he had told me, that he had twice had the plague himſelf, whereof he ſhewed me ſome effects, he added, that after many and various trials he perceived, that abundance of his patients died, after the buboes, (carbuncles) or peſtilential tumours appeared; becauſe upon a little refrigeration of the body by the air, and oftentimes by the very fear, that diſheartened the patient, the tumours would ſuddenly ſubſide, and the peſtilential matter recoiling upon the vital parts, would quickly diſpatch the fatal work. Wherefore he bethought himſelf of a method, by means of which he aſſured me, he had not loſt one patient of very many he treated, if he could but, as he uſually did, by good alexipharmical, and cordial remedies, enable and excite nature to expel the peccant matter into a tumour; for then he preſently clapped on an appropriated drawing plaiſter, which would never ſuffer the tumour to ſubſide, but break it, or make it fit for an opening; and thereby give nature a convenient vent, at which to diſcharge the matter, that oppreſſed her. This plaiſter, it will eaſily be thought, I was deſirous to know; and he told me it was a chymical one, and that it was no more than the *magnes arſenicalis* of *Angelus Sala*, whoſe deſcription, becauſe the book, wherein it is found, is in few hands, I have here annexed. If this prove as ſucceſsful in other plagues, as it did to thoſe, that uſed it in that of *London*, there will be juſt cauſe to admire and praiſe the benignity of divine providence, which in a poiſonous mineral, that probably does oftentimes concur to produce the plague, has laid up a remedy for it.

Emplaſtrum attractivum peſtilentiale noſtrum.

℞ *Gummi ſagapeni, ammoniaci, galbani an.* ℥iij. *Terebinthinæ coctæ, ceræ virginis ana* ℥ivſs. *Magnetis arſenicalis ſubtiliter pulveriſati* ℥ij. *radic' Aronis pulveriſat'* ℥i. *Gummi depurentur cum aceto ſcyllitico, & ad conſiſtentiam emplaſtri coquantur, & poſtea ponderentur, deinde cum rebus aliis fiat emplaſtrum lege artis: hoc emplaſtro carbunculus obducatur, quod paucis horis venenum extrahit.*

An attractive Peſtilential Plaiſter.

" TAKE of the gums ſagapen, ammoniac, galbanum three ounces, of boiled turpentine and virgin-wax four ounces and an half, of the arſenical loadſtone well pulveriſed two ounces, of *Aron*'s root pulveriſed an ounce; let the gums be depurated with the vinegar of ſquills, and boiled to the conſiſtency of a plaiſter, and laſtly

" laſtly weighed: then according to the uſual method with other things make up a " plaiſter; cover the carbuncle with this plaiſter, and in a few hours it will draw out " all the venom."

Præparatio Magnetis Arſenicalis antea dicti.

℞ *Arſenici Chryſtallini, ſulphuris vitri antimonii crudi ana: hæc tria in mortario ferreo pulveriſentur in vaſe fortiſſimo vitreo: ponantur ad ignem arenæ, donec vitrum optime incaleſcat, & prædicta ſolvantur & liquentur inſtar picis, quod obſervabitur, quando filum quoddam immititur in fundum, quod extractum poſtea inſtar Terebinthinæ trahetur ubi ſatis coctum erit: poſtea remove vitrum ab igne, &, ubi refrigeratum eſt, rumpe, & ſubtiliter pulveriſa, & ad uſum ſerva.*

The true preparation of the fore-mentioned arſenical loadſtone.

" TAKE equal parts of chryſtal-arſenick, of ſulphur of glaſs, of crude antimony; " bray them to powder in an iron mortar, ſet them in a ſtrong glaſs on a fire of ſand, " till the glaſs be very hot, and the fore-mentioned drugs melted like pitch; which " you ſhall know, when having thruſt a thread into the bottom, the matter ſticking " to it does rope like turpentine; which is a ſign of its being well enough boiled: " remove then the glaſs from the fire, and when it is cold break it; reduce the mat- " ter into ſmall powder, and keep it for your uſe.

BY the ſame motive, *Philanthropy*, I am induced to add on this occaſion, that having had ſome opportunity to oblige an antient and very experienced phyſician, to whoſe care was committed a great peſthouſe, where the contagion was ſo ſtrong, that he loſt three phyſicians, that were to be aſſiſtants to him, and three chirurgeons of four, that were to be ſubſervient to him; I deſired to learn of him, if he counted it not too great a ſecret, what antidote he uſed to preſerve himſelf from ſo violent and fatal an infection. This requeſt he readily granted, but withal told me, that his method would not ſeem to me worth mentioning, if I were one, that valued medicines by their pompouſneſs, not their utility. For, beſides ardent prayers to God, and a very regular diet, his conſtant antidote was only to take every morning faſting a little ſea-ſalt in a few ſpoonfuls of fair water; which he made choice of, both becauſe it kept his body ſoluble without purging or weakning it, and for other reaſons, which I muſt not now ſtay to ſet down. I know this medicine may appear a deſpicable one: but yet, in my opinion, it ought not to be deſpiſed, after ſuch experience, as I have related, has recommended it. For I think it deſireable, that notice be taken of all remedies, that have been found by good trials, not bare conjectures, or uncertain reports, available againſt the plague: for, ſince peſtilences, as we have lately noted, are exceeding various in their kinds, it is very poſſible, and not unlikely, that their appropriated remedies may be ſo too; and therefore I would not eaſily lay aſide every medicine, that this or that learned phyſician may ſpeak ſlightly of, or even may declare, that he has found it unſucceſsful againſt the plague; ſince the ſame medicine may be available in a peſtilence of another kind, in which perhaps the remedies commended by the phyſician we ſpeak of, will be found inefficacious.

THIS conſideration forbids me to paſs by, what happened to me in the great *London* plague above-mentioned; namely, that a very learned phyſician having once recommended to me an herb little noted in *England*, as a moſt effectual and experienced antidote againſt the plague, I cauſed it to be cultivated in a garden (as I ſtill do every year;) and when the peſtilence raged moſt, having ſome of it by me made up with a little ſugar in the form of a fine green conſerve, I ſent it to two infected perſons, who, by

by the divine benediction on it, both of them recovered. But having made but thoſe two trials, I dare not ground much upon them only; though I uſually keep the plant growing in a garden, partly becauſe both the taſte and colour, one or other of which in moſt antidotes is offenſive, are in this pleaſant; and partly becauſe ſome little experience has invited me to believe the commendations, that I have found given of it againſt the bitings of venomous creatures: whereof I remember a notable inſtance is recorded by *Petrus Spehrerius* of a Roman, who having with a ſtaff pierced or cruſhed a viper, that he took to be dead, had ſo ſtrong a venom tranſmitted along the ſtaff, that the enſuing night he had a very great inflammation in both his lips, to which ſupervened an exceeding ardent fever, and ſtrange tortures; from all which *Serianus Pacyonius*, a noted phyſician, that was called to him, freed him, as it were, by miracle, by the juice of goat's-rue, or, as others call it, galega, that grew copiouſly in that place. It may without diſguſt be taken ſomewhat plentifully, (and ſo it ought to be) in its entire ſubſtance as a ſalad; or elſe one may give its conſerve, its ſyrup, or, which is better, its juice newly expreſſed.

In obſervat. nobil. apud Schenkium, *l. 7. Obſerv. Med. Tit. de venenis ex animalibus.*

(3.) IT likewiſe agrees with our hypotheſis, that ſometimes the plague ceaſes, or at leaſt very notably abates of its infectiouſneſs and malignity, in far leſs time, than according to the wonted courſe of that ravenous diſeaſe, phyſicians did, or rationally could expect. For ſometimes it may happen, that, though the temperature or intemperateneſs of the air continues the ſame, the matter, that afforded the peſtiferous exhalations, may be either ſpent under ground, or ſo altered by combination with other ſubterraneal bodies, or by ſome of thoſe many accidents, that may happen, altogether unknown to us, in thoſe deep and dark receſſes. And if once the fountain of theſe noxious effluvia be ſtopt, ſo that thoſe, that are in the air, ceaſe to be recruited, the wind and other cauſes may in a ſhort time diſſipate them, or at leaſt dilute them with innocent air, ſo far, as to keep the diſeaſe they produced from being any thing near ſo miſchievous as before. And here I conſider, that it may ſeveral times happen, that though the minerals that emit the hurtful expirations, remain where they were under ground, and be not conſiderably waſted; yet their fatal effects may not be laſting, becauſe the effluvia were generated by the conflict of two or more of them, which vehemently agitated one another, and ſent up fumes, which ceaſed to aſcend, at leaſt in great plenty, when the conflict and agitation ceaſed: as I have tried, that by putting good ſpirit of ſalt upon filings of ſteel or iron in a conveniently ſhaped glaſs, there will be made a great conflict between them; and without the help of external heat, there will be ſent up into the air ſtore of viſible fumes of a very ſulphureous odour, and eaſily inflammable; which copious elevation of fumes will leſſen or ceaſe, as does the tumultuous agitation, that produced them. And ſo likewiſe, if you pour *aqua fortis* upon a convenient proportion of ſalt of tartar, there will be at firſt a great ebullition produced, and, whilſt that continues, ſtore of red and noiſome fumes will be elevated, but will not outlaſt the commotion of the mixture, whoſe active parts will in no long time combine into a kind of nitrous ſalt, wherein the noxious parts of the menſtruum are as it were pinioned, and hindered from evaporating or aſcending, though really they retain much of their priſtine nature, as I elſewhere ſhew.

IT may alſo happen, that ſoon after that commotion of ſubterraneal matter, which ſent forth peſtiferous exhalations, a more intenſe degree of ſubterraneal heat, or perhaps the ſame latent fire, extending itſelf farther and farther, may force up fumes of another ſort, that being of a contrary nature, may be, if I may ſo ſpeak, antidotal againſt the former; and by precipitating them, or combining with them, may diſable them from acting ſo miſchievouſly, as otherwiſe they would. To countenance which, I ſhall

tell you, that I have ſometimes purpoſely made diſtillations, in which one part of the matter being, after the operation ended, put to the other, there will inſue a ſudden and manifeſt conflict between them, and ſometimes an intenſe degree of heat. And that mineral exhalations, though otherwiſe not wholeſome, may diſable peſtiferous effluvia, may be gathered from what I lately noted about a country, which abounding with veins of cinnabar, was, probably by their expirations, preſerved from the peſtilence. And our hypotheſis will perhaps appear ſomewhat the more probable, if we reflect on what I lately mentioned of the ſudden check, that is almoſt every ſummer given to the plague, which at that time is wont to reign at *Grand Cairo*. For ſince it is generally obſerved and complained of, that morbific cauſes do their work much more effectually than ſanative ones; it ſeems very probable, that exhalations aſcending from under-ground into the atmoſphere may be capable of producing peſtilential fevers, and the plague itſelf, ſince thoſe corpuſcles, that impregnate the Ægyptian air upon the ſwelling of the Nile, are able to put a ſpeedy ſtop, not only to the contagiouſneſs but to the malignity of the plague, even when it is aſſiſted by the ſummer heat, which at *Grand Cairo* is wont to be exceſſive.

But having inſiſted perhaps too long on this Egyptian peſtilence, I ſhall only add, by way of illuſtration of the conjecture, that invited me to mention it, that the acceſſion even of expirations, that are not themſelves wholſome, may ſometimes ſerve to correct the air, and put a ſudden check to an epidemical diſeaſe; for corpuſcles of differing kinds may by their coalitions acquire new qualities, and each ſort of them loſe ſome of thoſe they had before: as, ſuppoſe there wandered in the air a great many effluvia, which by their determinate ſhape and bulk were apt to corrode or irritate the lungs, or the membranes of the brain, *&c.* as thoſe of nitre are to corrode ſilver; it may happen, that another ſort of reeks, though in their own nature unwholſome, may, by aſſociating themſelves with the firſt ſort, and compoſing with them corpuſcles of new qualities, aboliſh or much weaken the noxious ones they had before, in reference to this or that part of the human body. Though the ſpirits of ſalt-petre will readily corrode ſilver; yet if you add to them (as for ſome purpoſes I am wont to do) about half as much, or leſs, of the ſpirituous particles of common ſalt, (which yet are corroſive enough, and will fret aſunder the parts of iron, copper, antimony, *&c.*) there will emerge a body, that will not at all corrode pure ſilver.

Proposition IV.

It is very probable, that moſt of the diſeaſes, that even phyſicians call new ones, are cauſed either chiefly or concurrently by ſubterraneal ſteams.

The product of my firſt endeavours to bring credit to the foregoing propoſition appearing to have miſcarried, when I came to ſend to the preſs the things I had written about it; that at leaſt what can be preſerved of it may not be loſt, I ſhall ſubſtitute inſtead of it the following account.

At the entrance of my diſcourſe I obſerved, that the term *new diſeaſe* was much abuſed by the vulgar, who are wont to give that title to almoſt every fever, that, in autumn eſpecially, varies a little in its ſymptoms, or other circumſtances, from the fevers of the foregoing year or ſeaſon. And therefore I declared, that by new diſeaſes I meant only ſuch, whoſe ſymptoms were ſo uncommon, that phyſicians themſelves judged them to deſerve that appellation: ſuch, for inſtance, as the ſudor Anglicus, or ſweating ſickneſs; that diſeaſe, which the learned *Wierus* and others call in Dutch *Die Varen*; an unheard of diſeaſe deſcribed by *Ronſeius*, that in the year 1581 invaded

and deſtroyed many in the dukedom of *Lunenburg*; to which many phyſicians add the rickets, and others generally the *lues venerea*. Having cleared the terms, I next conſider, whether there were really any new diſeaſes properly ſo called, and gave ſome reaſons to ſuſpect, that ſome diſeaſes, which among phyſicians themſelves have paſſed for new, were extant before *in rerum natura*, though not in the country, wherein even the learned judged them to be new. And I intimated, that to examine this ſuſpicion throughly, it is not ſafe to acquieſce in the books of phyſicians only; but it is fit to conſult the writings of geographers, whether ancient (among whom I particularly recommended *Strabo*) or modern, together with the relations of hiſtorians, navigators, and other travellers. And here I enquired, without determining any thing, whether the *lues venerea* be, as moſt phyſicians are wont to ſuppoſe, a diſeaſe wholly new, or only new to our European world, and brought hither from ſome African, or other remote region, where it may be probably ſuſpected to have long been endemical.

BUT taking it for granted, with the generality of phyſicians, that ſome new diſeaſes are to be admitted; I advanced to conſider ſome of the cauſes, to which they may be imputed, and to give ſome reaſons, why I do not acquieſce in their opinion, though very general, that derive them only or chiefly from the varying influences of the heavenly bodies: for the moſt powerful of thoſe, namely the ſun and moon, act in too general and indeterminate a way, to afford a ſufficient account of this affair; and as for the other lights, the fixt ſtars, beſides their being univerſal and indefinite agents, their ſcarce meaſurable remoteneſs makes it juſtly queſtionable, whether they have any ſenſible operation upon any part of our bodies, ſave our eyes. And, though I deny not, that great intemperateneſs of the air, as to the four firſt qualities, as heat, cold, dryneſs, and moiſture, are wont (not over juſtly) to be called, may diſpoſe men's bodies to ſeveral great diſtempers, and may alſo be concurrent cauſes of thoſe we are ſpeaking of; yet neither can I acquieſce in theſe, when I conſider, how much more frequently they happen, than new diſeaſes do; and that their action, though various, is too general and indeterminate to perſuade me, that they can be the adequate cauſes of effects ſo rare and anomalous, as diſeaſes odd enough to deſerve the title of new.

A diſcourſe of ſubterraneal ſteams as they affect the air.

BUT now, the ſubterranean region of our globe, beſides that it is always near us, abounds with variety of noxious minerals, and probably conceals great quantities of differing ſorts of them, that are yet unknown to us; and ſince we have elſewhere proved, that there want not cauſes in the bowels of the earth to make great and irregular, and ſometimes ſudden confluxes, conflicts, diſſipations, and other conſiderable changes, amongſt the materials, that nature has plentifully treaſured up in thoſe her ſecret magazines; and ſince, in making out the three former propoſitions, we have manifeſted, that the ſubterraneal parts of the globe we inhabit, may plentifully ſend up noxious effluvia of ſeveral kinds into the air: it ought not to ſeem improbable, that among this emergent variety of exotick and hurtful ſteams, ſome may be found capable to diſaffect human bodies, after a very uncommon way, and thereby to produce new diſeaſes, whoſe duration may be greater or ſmaller, according to the laſtingneſs of thoſe ſubterraneal cauſes, that produce them. On which account it need be no wonder, that ſome new diſeaſes have but a ſhort duration, and vaniſh not long after their appearing, the ſource or fumes of the morbific effluvia being ſoon deſtroyed or ſpent; whereas ſome others may continue longer upon the ſtage, as having under ground more ſettled and durable cauſes to maintain them: which laſt part of the obſervation may be illuſtrated by what happened in *Calabria*; which province, though it have been obſerved to have acquired, within theſe two or three ages, the faculty of

producing manna upon certain trees *; yet this great change, though ſudden enough, had it ſeems ſuch ſtable cauſes, as well as of great extent, that it hath laſted ſeveral ſcores of years, and continues in that country to this day.

I AM not ignorant, that the whole doctrine propounded in the four propoſitions about the inſalubrity of the air, is not at all comfortable either to patients or phyſicians: but important theories deſerve to be enquired into, and, if true, to be delivered, though we could wiſh they were untrue. And judicious men rather thank than blame thoſe, that have given us accounts of latent or unſuſpected, though perhaps irremediable cauſes of diſeaſes and of deaths; or have recorded the hiſtories of ſome poiſons, whereof the true antidotes are yet unknown. Uncommon notions about diſeaſes may ſerve to enlarge the phyſician's mind and excite his attention and curioſity: and, beſides that they may keep him from too obſtinately perſiſting in the uſe of received medicines, though unſucceſsful, upon a ſuppoſition, that the diſeaſe can have no other cauſes, than thoſe wont to be aſſigned it by Claſſic authors; beſides this, I ſay, I do not deſpair, but that either the ſagacity or fortune of this inquiſitive age, or at leaſt of poſterity, may by the bleſſing of God be happy enough to find proper remedies, even for thoſe diſeaſes, that proceed from ſubterranean effluvia, when once by proper ſigns they ſhall be diſtinctly obſerved; of which power of appropriated remedies I have known ſome inſtances, as to the very bad ſymptoms produced by antimonial and ſome other mineral fumes.

SOME of the points diſcourſed of, under the fourth propoſition, were of affinity enough to paradoxes, to have need of being illuſtrated or confirmed by obſervations and experiments. And therefore having accidentally retrieved ſome of this laſt-named ſort, I ſhall venture to ſubjoin them as a ſpecimen, though without tranſitions or applications, but juſt as I found them thrown together in one looſe ſheet, wherein I lighted on them. But it is time to conclude with the recital of the promiſed experiments; which I would immediately do, but that I hold it fit to premiſe, by way of introduction to them, that I hope the things hitherto diſcourſed will appear much the more probable, if we ſhall prove, by experiments, that, which ſeems much leſs likely, than any thing we have above delivered; namely, that metals completely formed and malleable may be elevated into the air, and that perhaps without any great violence of fire, in the form of exhalations and vapours; the ſingly inviſible corpuſcles, ſtill retaining their metalline nature. This, at leaſt, as to ſome metals, I have endeavoured to prove in another tract, intitled, *A Paradox about the Fuel of Flames.* But becauſe that diſcourſe was never publiſhed, I will here ſet down two or three experiments, (not mentioned, that I remember in it;) which I do the more willingly, becauſe it may be a thing of no ſmall moment in phyſick, if it be ſhewn, that fixed and ſolid bodies, ſuch as metals are, may by art be reduced into ſuch minute corpuſcles, that, without loſing their nature and all their properties they may become parts of fumes, or perhaps of inviſible vapours, or even of flame itſelf.

Particulars belonging to the fourth Propoſition.

EXPERIMENT I.

WE took three parts or pounds of Dantzic vitriol (which is blue, and ſomewhat partakes of copper) and two parts or pounds of good ſea-ſalt; theſe being very well powdered and mixed, were diſtilled with a ſtrong naked fire, to force out alſ, that could

* C. Magnenus *de manna, cap.* 9. *Dic amabo,* Altomari, *cur ante trecentos annos nullum manna fuit in Oenotria; jam certe aderant pagi ibidem urbiſque vicinæ neque, ſefelliſſet curioſam incolarum ſolertiam,* &c. 15. *ante* 240. *annos nullum Mannæ Calabrenſis in autoribus veſtigium eſt.*

could be driven over; and by this means we not only obtained a ſpirit of ſalt of a manifeſtly blueiſh colour, but there aſcended alſo a conſiderable quantity of powder, which, being ſhaken with the liquor, ſettled at the bottom of it in the form of a powder, which was judged to conſiſt of corpuſcles of a cupreous nature, and perhaps alſo ſome of a martial nature. But I unhappily neglected the opportunity of examining this powder, which came up in quantity enough to have ſerved for various trials.

EXPERIMENT II.

BY ſubſtituting Engliſh vitriol (which is green, and is much more abundant in iron than that of Dantzic) and proceeding in other reſpects as in the former proceſs, we obtained a very yellow ſpirit, with a conſiderable quantity of a yellowiſh powder, that was gueſſed to be a kind of *crocus martis*.

EXPERIMENT III.

WE took very thin plates of copper, and caſt them into a retort, upon an equal or a double weight (for we did not always uſe the ſame) of good mercury ſublimate; and luting on the receiver, gave a fire by degrees for ſeveral hours; by which means we uſually obtained ſome running mercury, (which ſeemed to be very well putrified, and was perhaps alſo impregnated) together with ſome ſublimate, that had not faſtened upon the copper. And at the bottom of the retort we had good ſtore of a ponderous and brittle ſubſtance, that did not look at all like a metal, but rather like ſomething of a gummous or reſinous nature, being alſo fuſible and inflammable almoſt like ſealing-wax. This, having not opportunity to proſecute the experiment at home, I put into the hands of an induſtrious phyſician, that was earneſt with me to impart to him the proceſs, and let him purſue it for me. He, according to my directions, expoſed this metalline roſin, (if I may ſo call it) groſsly beaten, to the free air, where it did, according to expectation, in a ſhort time, change colour, and turn to a kind of verdegreaſe; which being diſſolved in good ſpirit of ſalt, gave a ſolution of a very lovely green colour. This being ſlowly diſtilled *ad ſiccitatum*, yielded but a very weak and phlegmatic liquor; and the *caput mortuum* was again diſſolved in freſh ſpirit, and the menſtruum abſtracted as before. This was done ſeveral times, till the matter was ſo impregnated, that the menſtruum, being drawn off from it, came over as ſtrong almoſt as when it was put on. This done, the thus impregnated verdegreaſe was diligently mingled with Tripoly, or ſome ſuch inſipid and fixed additament, and diſtilled with a ſtrong fire; by which means it afforded good ſtore of a liquor colourleſs, like common water; which made the phyſician ſuppoſe the experiment had miſcarried, till I having dropped into it a colourleſs liquor, namely ſpirit of hartſhorn or of ſal-armoniac, he was much and delightfully ſurprized to find it preſently diſcloſe a deep and lovely blue colour. What afterwards became of this odd ſpirit, I need not here declare; what has been ſaid being ſufficient to ſhew, that corpuſcles of copper may be elevated in the form of exhalations, both tranſparent and colourleſs. The next following experiment, though in part mentioned by ſome chymiſt, is here ſubjoined, becauſe it is neceſſary, and applied to a particular purpoſe.

EXPERIMENT IV.

IF from good Corniſh tin, you warily diſtil an equal or double weight of Venetian ſublimate, into a very large receiver, very well luted on to the retort, you will obtain a ſpirituous liquor, which, as ſoon as the free air comes to touch it, will ſend up abun-

abundance of white exhalations, in the form of a thick ſmoke, which will continue to be emitted much longer than one would imagine. But that, which I deſire to have particularly obſerved in this experiment is, that though this liquor be apt to emit ſmoke, not only plentifully, but, as one would think, with violence, yet I found by trial, that even when I put it into a veſſel, not ſtreight mouthed, if I did but lay a piece of a ſingle leaf of paper flatwiſe upon the orifice of the glaſs, ſo as to cover it all, the viſible production of the fumes would preſently ceaſe; and the liquor would lie like common water, as long as the paper lay, though but lightly, upon the glaſs; though upon the removal of that, the liquor would ſend up plentiful fumes as before: which ſeems to argue, that ſome metalline ſubſtances may, by the contact of the air, have their copious aſcenſion into the atmoſphere very much helped and promoted, as if the air had ſaline, or other ſort of particles in it, that are, in reference to ſome mineral bodies, of a very volatizing nature. The way, by which I have divers time elevated the fixedeſt of metals, gold itſelf, I have delivered in another paper, and ſhall not here repeat it. But I ſhall now ſet down an experiment, that, when it is carefully made, is eaſy to be performed, and yet affords a notable and ſenſible proof, that the corpuſcles of a metal may be made to aſcend, and that plentifully, even with a very moderate heat, under the form of ordinary fumes or ſmoke. To effect this I deviſed the following experiment.

We took copper, and diſſolved it in good aqua fortis, till the menſtruum was ſatiated with it; in the ſtrong ſolution we ſteeped a while ſome brown, or other porous paper, that being fitter than the finer to ſoak up the menſtruum; then ſlowly evaporating the ſuperfluous moiſture, we put a quantity of this imperfectly dried paper upon the hearth, at ſuch a diſtance from a fire of actually flaming wood, that the paper was not kindled, but yet was ſo ſcorched, as to afford very plentiful fumes: theſe looked like ordinary ſmoke, whilſt they moved through the air, and would queſtionleſs have mingled with it, and been diſperſed through it, if the body, that emitted them, had not been purpoſely placed for a future deſign. But when the motion of the air towards the flame had carried theſe fumes to it, the metalline ſmoke did, as I expected, diſcloſe its nature; for being actually kindled, it tinged the flame of a lovely colour, for the moſt part blue, and ſometimes green, as it happened to be variouſly mixed with the flame and ſmoke of the wood.

A N

AN HISTORICAL ACCOUNT OF A Strangely ſelf-moving LIQUOR.

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AN ingenious teacher of mathematicks, having occaſion to make a compoſition for a new fire-engine, whereof he was to ſhew his majeſty a trial, mingled divers ingredients in an earthen pot over kindled coals; but could not, or did not do it ſo warily, but that the matter took fire, and began to blaze furiouſly, which obliged him to ſtifle the flame as haſtily as he could; and having removed the veſſel from the fire, and ſuffered it to grow cold, when afterwards he came to look upon it, to ſee if what remained might be of any uſe to him, he was ſurprized to find, it variouſly and briſkly moved. Wherefore having ſet it aſide, to be ſure that it might be thoroughly cold, he, after ſome hours, viſited it again, and found it move as before: and having caſt ſtore of ſeeds upon it, to ſee if the liquor would move them alſo, the bituminous part of it connected them into a kind of thick ſcum, that covered moſt of the ſuperficies; but yet left ſome intervals, in which the liquor appeared, and diſcovered, that it continued its motions. Two days after, the engineer diſcourſing with me of his fire-work, about which he had adviſed with me before, told me, among other things, of this odd accident. And when I had aſked him, if the motion continued ſtill, and had been anſwered affirmatively, though it was then a dark night and ill weather, my diffidence, or my curioſity, made me engage him to ſend for the pot as it was; partly to be ſure of the matter of fact, and partly to try, if the knowledge I had of the ingredients, which he had before told me, would afford any hint of the cauſe of ſo odd an effect; a like to which in kind, though not in degree, I had many years before deviſed, and ſucceſsfully practiſed, the way of producing.

THE veſſel being come, though the haſty tranſportation of it ſeemed to have ſufficiently diſturbed it, there did appear manifeſt ſigns of ſuch a motion, as the engineer had aſcribed to it; and therefore he being willing to leave it with me, I cauſed it to be ſet aſide in a laboratory, where ſome furnaces kept the air conſtantly warm, and did there and elſewhere, at diſtant times, look heedfully upon it, now and then diſplacing, or quite taking off, ſome of the thick ſcum, that too much covered the ſurface of it; and by this means I had the opportunity to take notice of ſeveral phænomena, whereof theſe are the chief.

FIRST, I obſerved, that the motion of this liquor was not only briſk, but very various; ſo that having looſened ſome ſmall portions of the ſcum from the reſt, one of them would be carried towards the right hand for inſtance, and another towards the left, at the ſame time.—2. Where the liquor firſt came out from under the ſcum, it ſeemed to move the moſt briſkly, flowing almoſt like a ſtream, whoſe motion upwards had been checked, and, as it were, reverberated, by that incumbent obſtacle.—3. Several motions in this liquor were the more eaſy to be obſerved; becauſe, though it were dark, yet it was not uniform; conſiſting in part of oily and bituminous ingredients, which, though they ſeemed to have but one common ſuperficies with the reſt of the liquor, yet, by their colours and power of vigorouſly reflecting the light, they were eaſily enough diſtinguiſhable from the reſt. And I often obſerved, that ſome of theſe unctuous portions of the matter, emerging to the ſurface of the liquor, though perhaps at firſt one of them would not appear bigger than a pin's head, yet, in moving forwards, it would,

would, at the ſame time, diffuſe itſelf circularly, and make, as it were, a great halo, adorned with the colours of the rainbow, and ſo very vivid, as afforded a very pleaſant, and at firſt ſurprizing ſpectacle; theſe phantaſms often nimbly ſucceeding one another, and laſting, till they loſt themſelves againſt or under the thick ſcum.—4. The motions of this odd liquor were not only various, but frequently vortical; to be ſatisfied of which I ſometimes put ſhort bits of ſtraw, or fragments of ſome ſuch like ſtuff, upon the diſcovered part of the ſurface of the liquor, by which they were carried towards very diſtant, if not oppoſite, parts of the veſſel at the ſame time. But to make the vortical motion more evident, I ſeveral times detached conſiderably large pieces of the thick ſcum from the reſt of the body; and had the pleaſure to ſee them move both with a progreſſive motion in crooked lines, and with a motion about their own middlemoſt parts. All this while the liquor, whoſe parts were thus briſkly moved, was actually cold, as to ſenſe.—5. To obſerve what the preſence, or abſence, of the free air would do to this liquor, I cauſed many ſpoonfuls of it, with ſome of the ſcum, to be put into a cylindrical glaſs, which, though large itſelf, had a neck belonging to it, that was but about the bigneſs of one's thumb, that it might be well ſtopped with a cork. But having by this means, kept the free air from having a full and immediate contact with the whole ſurface of the mixture, as it had, when that mixture lay in the wide-mouthed veſſel, I could not perceive the liquor to move to and fro, no not though the orifice of the neck were left open: whereas having, at the ſame time, poured ſome of the liquor into a very ſhallow and wide-mouthed veſſel, called in the ſhops a clear caked glaſs, it moved rather more than leſs nimbly and variouſly than in the great earthen pot, (which yet was of the ſame ſhape) and ſhewed us many of thoſe vivid and ſelf-dilating circles, that have been mentioned in the third number. And theſe, by the fineneſs of their colours, and the quickneſs, wherewith they ſucceeded one another, afforded a delightful ſpectacle, as long as I ſtayed to obſerve the liquor.—6. Though the motions of the hitherto mentioned liquor did not ſeem to be always equally briſk, yet they appeared to continue manifeſt and various in ſome diverſities of weather, as to cold and heat; and when I looked on it by candle-light, as well as by day-light. And, when being not well enough to viſit it myſelf, I ſent one purpoſely to look upon it, about ten o'clock at night, he brought me word, that it continued to move as formerly, and ſo it has done for ten days. And how much longer it will continue to do ſo, time muſt determine.

POSTSCRIPT.

Some time after the foregoing account had been written, when I came to look upon the liquor (which in the mean time had been ſeveral times viewed, and appeared to retain its motions) I found, to my trouble, that ſome body's impertinent curioſity and heedleſſneſs had cracked the lower part of the earthen pot; at which overture the liquor, though not the ſcum, was run out; which had put a period to our obſervations, but that foreſeeing, that ſuch an accident might happen, I had long before taken out ſome ſpoonfuls of the liquor, and kept it cloſe ſtopped in a vial. By this means I had the opportunity to obſerve, that when I poured out the liquor into a wide mouthed veſſel, it would move as before, though this were done ſome weeks after it had been put up. And I remember, that long after having one day received the honour of a viſit from a foreign miniſter, who was an inquiſitive perſon, and a man of letters, we chanced, among other things, to talk of this liquor: and though it were ſcarce to be hoped, that it could ſtill retain any of its motive virtue, yet, to gratify his curioſity, and that of ſome ingenious men there preſent, I cauſed the vial to be brought, and having unſtopped it, I poured out the liquor into a convenient

ſhaped veſſel; in which, after we had ſuffered it to reſt a while, they were delightfully ſurprized to ſee it move, (though not, in my opinion, quite ſo briſkly as before, yet) very manifeſtly and variouſly. This encouraged me to think it poſſible, that it might retain ſome motion, though but languid, ſeven or eight weeks after; and therefore on the 25th of *July*, I looked upon it again, and having cauſed it to be poured into a China cup, it manifeſted, at firſt, a briſk and various motion: but this, after a while, did ſo ſlacken, that I began to have ſome ſuſpicion, that the motion it was put into by effuſion, and the firſt contact of the air, might have given it the greateſt part of its agitation. But this being but ſuſpicion, I put the veſſel into divers poſtures in a window, the better to diſcover the true cauſe of this phænomenon; but whilſt I was buſy about this, which ingroſſed my attention, a miſchance overturned the cup, and by throwing down the liquor, put an end to my ſpeculation: yet this miſchance hindered me but from obſerving, how long the odd agitation of our liquor would have continued, but not from finding, that it laſted a great while; for I ſhewed it the foreign miniſter about or after the beginning of *June*, that is, about five months, or more, after the liquor was firſt obſerved to move.

OF THE Reconcileableneſs of SPECIFIC MEDICINES TO THE CORPUSCULAR PHILOSOPHY.

To which is annexed,

A Diſcourſe about the Advantages of the Uſe of SIMPLE MEDICINES.

The PREFACE.

THE riſe of the following tract, intimated near the beginning of it, was not ſuch a fictitious thing as the reader may imagine: but though I really received a viſit from a phyſician, known to me but by his reputation, purpoſely to propoſe to me his objections againſt the corpuſcular philoſophy, and he had a long conference with me about them; yet, becauſe the hiſtorical paſſages of that interview cannot be circumſtantially related in few words, I ſuppoſe the reader will willingly allow me to employ this preface, in giving him advertiſements about the ſcope and deſign of the treatiſe it uſhers in.

I SHALL therefore advertiſe him, that he will be much miſtaken, if he ſhall expect, as I perceive ſeveral have done already, to find in this book a collection of receipts of ſpecific remedies: for a moderate attention to the title page will enable him manifeſtly to diſcern, that the following paper, in its own nature, and in the direct and immediate deſign of it, is a ſpeculative diſcourſe; ſince it tends but to ſhew, that, in caſe there be ſpecific medicines (as it is probable there are ſome) their experienced virtues are reconcileable to the principles of the corpuſcular, or (as many call it) the new philoſophy; and, at leaſt, do not ſubvert them, if theſe effects and operations be not clearly explicable by them. And as this is the avowed ſcope of the following eſſay, ſo I choſe to treat of it leſs like a phyſician than a naturaliſt; for phyſicks being a ſcience, whoſe large extent invites and warrants its cultivators to ſearch into the nature and phænomena of things corporeal indefinitely, it muſt often happen, that the medicinal art, and this ſcience, will be converſant about the ſame ſubject, though in differing ways, and with differing ſcopes; for there are divers hurtful or advantageous accidents and changes of the human body, whereof the naturaliſt takes notice, but as they are phænomena, or changes produced by natural cauſes in the body of an animal, whilſt the phyſician conſiders them as ſymptoms of diſeaſes, or effects of medicines: the former directing his ſpeculations to the diſcovery of truth, and the other his theory to the recovery of health. But becauſe I elſewhere particularly conſider the cognation and diſtinction between the diſcipline, that the naturaliſt, and that, which the phyſician cultivates, I ſhall forbear to mention them in this place; but rather acknowledge, that I ſcarce doubt, but that I might have inriched the following diſcourſe with ſome choice particulars, if I would have peruſed and borrowed from the learned writings of the famous Dr. *Willis*: but beſides that I had not his books at hand, I was unwilling to be prepoſſeſſed or byaſſed by his notions; and I preſumed the perſon I wrote to would not be unwilling to ſee, what, without their help, the conſideration of

the thing I treated of ſuggeſted to me. About this I ſhall now proceed to obſerve, that though the direct ſcope of the following diſcourſe being to explicate the phænomena of ſome bodies, which, from their uſe, are called medicinal, and declare how poſſibly they may produce the effects aſcribed to them, the enſuing diſcourſe is for the main of a ſpeculative nature; yet the conſequences, that may be drawn from it, and the applications, that in this induſtrious age, are like to be made of ſome things, that it contains, may probably render it practical. For I have more than once obſerved, that divers conſiderable remedies, and ſome not unpromiſing methods too, have either remained unthought of, both by many Galenical phyſicians, and divers of their modern antagoniſts too; or, if propoſed by others, have been rejected or ſlighted, barely upon this ſuppoſition, that no rational account can be given of their way of working, or how they ſhould do good; and it is ſaid to be unworthy of a rational phyſician to make uſe of a remedy, of whoſe manner of operating he cannot give a reaſon. How prejudicial it may be to many patients, that phyſicians be prepoſſeſſed with a bad opinion of an uſeful remedy, may be gueſſed by him, that ſhall conſider, what multitudes of teeming women, that probably might have been ſaved by the ſkilful uſe of phlebotomy, have been ſuffered to die for want of it, upon a diſlike of that remedy, that phyſicians for many ages thought to be grounded upon no leſs authority than a poſitive aphoriſm of *Hippocrates*. And therefore, if, to remove the ſpecious objection newly mentioned againſt that whole kind of remedies called ſpecifics, the following tract has been ſo happy as to ſhew, that it is at leaſt poſſible, that medicines, ſaid to be ſpecific, may perform their operations by ways, which, though not explicable by the vulgar doctrine of the ſchools, are intelligible, and reconcileable to the clear principles of the mechanical philoſophy: if, I ſay, this has been done by the theory propoſed in this treatiſe, it may conduce ſomewhat to inlarge the minds of many phyſicians, and invite them to make uſe of ſeveral remedies, of which they did not think, or againſt which they were prejudiced. And ſince ſpecifics, where they can be had, are wont to be free from any immoderate manifeſt quality, and for the moſt part to work more benignly, as well as more effectually, *cæteris paribus*, than other medicines; I think that to bring them into due requeſt, and invite phyſicians to ſearch for new ones, as well as employ thoſe already known, may tend much to ſhorten many cures, and make them more eaſy and more ſafe.

Eſt aliquid prodire tenus, ſi non datur ultra.

The ADVERTISEMENT of the PUBLISHER.

THE author had occaſion to touch upon ſome of the ſame ſubjects, that he here treats of, in a book, *The uſefulneſs of Experimental Philoſophy*, long ſince publiſhed; but he had the misfortune to be reduced to write the following diſcourſe about the ſpecific medicines, and the utility of ſimple remedies, in a village, where he had not that book at hand, and could not call to mind all, that he had therein publiſhed ſeventeen or eighteen years before: on which account, though he ſtudiouſly forbore to repeat the particulars, that he remembered to have ſet down in that treatiſe, how appoſite ſoever they would have been to his preſent purpoſe, yet having, ſince the following diſcourſe was ſent to the preſs, got a ſight of that other (which he had not read in many years) he finds, upon a tranſient view, that ſome of the ſame things are mentioned in both books; at which diſcovery, though he be ſomewhat troubled, yet he is the leſs ſo, becauſe they are but few, in compariſon of the new ones, and ſet down on ſuch occaſions, or with ſuch other circumſtances, that may make a favour-

able reader look on them, as not bare repetitions. And though in the forecited treatiſe, ſome of the motives to make uſe of ſimple medicines, be lightly touched; yet beſides that they are not all, that are mentioned in the following invitation, thoſe arguments, that are there but pointed at, are here treated of, and both confirmed, and explained by other obſervations and receipts. And ſince the printed book above mentioned has been for divers years very ſcarce, it is preſumed, that thoſe many readers, that have it not, will not be diſpleaſed to find here ſome few things, for which they cannot reſort thither: and as the author foreſaw he might be obliged to conſent to the tranſlation of the following papers into the Roman tongue, ſo he thought his Latin readers would not repine, though a great number of particulars had been borrowed of a book, that is not yet extant in their language.

I SHALL give you no farther account of the particulars contained in the two enſuing treatiſes, ſince the title pages give a ſufficient hint of the noble author's main ſcope and chief deſign. I ſhall only ſay, that the firſt treatiſe effectually performs what has not been as yet attempted, by anſwering a very conſiderable objection againſt the doctrine of the corpuſcularian philoſophers; namely, that, which is taken from what we call ſpecific medicines, their virtues and operations being hitherto judged by ſeveral of the learnedeſt ſort wholly irreconcileable to the principles of the new philoſophy; whereby he gratifieth, not only the curioſity of ſpeculative philoſophers, but does likewiſe a notable piece of ſervice to all phyſicians, uſhering in here and there ſuch notions, as may be the principles of a ſure and eaſy practice; yea, and enable them too, to give a good account of their own receipts; I mean of thoſe, that contain ſpecific medicines, whoſe virtues hitherto we could not deſcribe to our patients, but by ſaying they did work we knew not how, or by ſome ſpecific, that is by ſome occult or hidden quality. The ſecond treatiſe, which is an invitation to the uſe of ſimple medicines, is of ſuch a general uſe, that mankind is much indebted to this noble author for it: it is ſo well grounded both upon reaſon and experience, that this, as well as the forementioned diſcourſe, does fully anſwer the great repute of the author, both at home and abroad, where he is commonly ſtiled *the Engliſh philoſopher*.

OF THE

Reconcileableneſs of SPECIFIC MEDICINES TO THE CORPUSCULAR PHILOSOPHY.

The INTRODUCTION.

To my learned Friend Dr. *F.*

SIR,

PErceiving by our late conference, that the thing, which moſt alienates you from the corpuſcular philoſophy, is an objection drawn from your own profeſſion and experience; namely, that the ſpecific virtues of medicines are not reconcileable to it; my unwillingneſs, that an hypotheſis I am ſo kind to, as I am to the mechanical, ſhould continue under the disfavour of a perſon I ſo much eſteem, as I do Dr. *F.* makes me venture to offer you the annexed paper, though it be but an inlargement

of a diſmembered part of what I long ſince, to gratify a friend, noted about the origin or production of occult qualities. For though I pretend not, that this trifle ſhould ſatisfy a man of your judgment and learning, yet it may perhaps ſerve to keep you from thinking it impoſſible, that a ſkilful pen may be able quite to ſurmount thoſe difficulties, that ſo bad a pen as mine is capable of leſſening.

A paper belonging to the writings about the mechanical origin of qualities.

AMONG the ſeveral kinds of occult qualities, that, which is afforded by the ſpecific virtues of medicines, is not here to be pretermitted: for theſe qualities do not only, like other hidden ones, invite our curioſity, but concern our health, and may hereafter (if I miſtake not) appear to be of much greater importance, than as yet they are commonly thought. However, it may be worth while to take ſome notice of them in this place, if it were but becauſe divers learned phyſicians do, as ſome of them owned to me, reject or disfavour the corpuſcular philoſophy upon this account, that they think it cannot be reconciled to the virtues of ſpecific remedies, or at leaſt cannot, either in a particular, or in a general way, give any tolerable account of them.

I FIND three ſorts of qualities mentioned in the books of phyſicians, under the notion of ſpecific virtues; for by ſome a medicine is ſaid to have a ſpecific faculty, becauſe it is eminently, and peculiarly friendly to this or that particular part of the body, as the heart, the brain, the eye, *&c.* by others it is ſaid, by a ſpecifie power, to attract and evacuate ſome determinate humour, as choler, phlegm, *&c.* But the moſt uſual account, upon which a medicine is ſaid to be ſpecific, is, that it has the virtue to cure, by ſome hidden property, this or that particular diſeaſe, as a pleuriſy, an aſthma, the cholick, the dropſy, *&c.* And this being the principal and moſt common ſenſe, in which the word ſpecific is employed by phyſicians, I ſhall ordinarily make uſe of it in that ſenſe, in the following diſcourſe, but yet without ſo confining myſelf to it, as not to conſider it in the two other ſenſes, when occaſion ſhall require.

BUT before I deſcend to particular conſiderations, it will not be amiſs to obviate miſtakes, by declaring in what ſenſe, in this paper, I ſhall employ the term ſpecific medicine, eſpecially in the laſt of the three aforementioned acceptations.

I DO not then by a ſpecific underſtand a medicine, that will cure the diſeaſe it is good for infallibly, and in all perſons, that take it; for I confeſs I never yet met with any ſuch remedy; nor do I by ſpecific underſtand a medicine, that, almoſt like a charm, works only by ſome latent and unaccountable property, without the aſſiſtance of any known quality, as purgative, diuretic, ſudorific, *&c.* to be found in other medicines: but by ſpecific I mean in this diſcourſe, ſuch a medicine, as very often, if not moſt commonly, does very conſiderably, and better than ordinary medicines, relieve the patient, whether by quite curing, or much leſſening his diſeaſe, and which acts principally upon the account of ſome property of peculiar virtue; ſo that if it have any manifeſt quality, that is friendly, yet the good it does is greater, than can be aſcribed to the degree it has of that manifeſt quality, as hot, cold, bitter, ſudorific, *&c.*

THERE are two grand queſtions, that may be propoſed about the ſpecific virtue aſcribed to medicines: the firſt is, whether there be really any ſuch? and the ſecond, whether, if there be, the mechanical hypotheſis can be accommodated to them.

THE former of theſe queſtions may admit of a double ſenſe; for it may be propoſed,

poſed, with reſpect either to the preſent meaſure of our knowledge, or to thoſe further attainments, that, in future times, men may arrive at.

In the latter of theſe ſenſes, (to diſpatch firſt the conſideration of that) I ſhall not preſume to maintain, without reſtriction, either part of the queſtion: for I do not only hope, but am apt to think, that in time the induſtry and ſagacity of men will be able to diſcover intelligible cauſes of moſt of thoſe qualities, that now paſs for occult, and among them of many of the ſpecific virtues aſcribed to medicines. And yet, on the other ſide, I much fear, that men will not be ſucceſsful in tracing out the true and immediate cauſes of thoſe good effects of ſome remedies, that depend upon ſuch fine and uncommon textures, and ſuch latent and oddly guided motions, as fall not under our ſenſes, though perhaps aſſiſted by inſtruments: which conjecture will appear the leſs improbable, if we conſider thoſe admirable *idioſyncraſiæ*, or peculiarities of diſpoſition, whereof the books of eminent writers afford us many inſtances, to whoſe number I could, upon my own obſervation, add ſeveral, if I thought it needful. And though I am not ignorant, that ſome of theſe may be plauſibly accounted for, as that of ſome men's averſion to cheeſe, or to cats; yet I do not think, that the like explications can be extended to ſome others, that might be named, if it were here pertinent to diſcuſs that thoroughly.

As to the former ſenſe of the queſtion lately propounded, I confeſs myſelf very inclinable to the affirmative, as far as I can judge by thoſe writings of phyſicians I have had occaſion to peruſe: which limitation I add, becauſe I would not derogate from the knowledge of particular perſons, who, in ſo learned and inquiſitive an age, may be arrived at far greater attainments, than thoſe phyſicians have done, that have entertained the public about the occult and ſpecific qualities of medicines.

I know there have been, and ſtill are, dogmatical phyſicians, that upon the principles, as they pretend, of the ſchool-philoſophy, reject all medicinal virtues, that they think not reducible to manifeſt qualities: but of ſuch *Galen* ſomewhere juſtly complains, that they either deny matters of fact, or aſſign very incompetent cauſes of the effects they pretend to explain; and, for my part, I am ſo far from believing theſe men capable of giving ſufficient reaſons of the more hidden properties of medicines, that I am not apt to think them able, by their principles, to give clear and particular explications even of the more eaſy and familiar virtues of ſimples.

I am therefore diſpoſed to think, that, in the ſenſe formerly delivered of the term ſpecific medicines, there are ſome remedies, that deſerve that name.

To this opinion I have been led by ſeveral reaſons. And firſt, (to begin with the leaſt weighty) it has the ſuffrage of many learned phyſicians, both ancient and modern, and particularly that of *Galen* himſelf, in ſeveral places of his works. And I remember, that treating of a ſpecific remedy againſt the biting of a mad dog, which virtue he aſcribes to an occult quality, or, as he ſpeaks, to the propriety of the whole ſubſtance, he takes occaſion to promiſe, that he would write a book of things, that operate upon that account: which book, if it had eſcaped with his other works (for he elſewhere cites it as having written it) would probably have furniſhed us with ſeveral things to ſtrengthen our opinion. And though in matters philoſophical I am little ſwayed by mere authority; yet the concurrent ſuffrage of many eminent phyſicians may, in this controverſy, be the more conſiderable, becauſe moſt of them, being noted practitioners, had opportunity to obſerve, whether or no any remedies deſerved the name of ſpecifics: and their teſtimony is, in our caſe, the more to be regarded, becauſe phyſicians, eſpecially famous ones, are not wont to be willing to acknowledge, that there are effects, which fall under the cognizance of their art, whereof they cannot give the cauſes.

Galen. *de Simpl. Medicam. Fac.* lib. 11.

MY next inducement to admit ſpecifics, is founded upon parity of reaſon: for it is manifeſt, that there are divers formidable maladies, that are produced by inconſiderable quantities of poiſons, that have not been diſcovered to produce ſuch great and diſmal effects by any manifeſt quality, whether firſt, ſecond, or third, as medical authors (I doubt not over accurately) diſtinguiſh them.

ON this occaſion I ſhall add a very odd accident, about which I was adviſed with by an expert oculiſt, very ſoon after it happened: the caſe was this: a man lying ſomewhat long in bed in the morning, and chancing, as he lay upon his back, to caſt up his eyes to the teſter, ſaw a great ſpider, that ſtood ſtill juſt over his face. Wherefore having reproached his wife, who happened to be in the room, with groſs negligence, ſhe took a broom, and ſtruck it upon the upper part of the teſter, to beat down the ſpider; but the animal held ſo faſt with his feet, that ſhe miſſed her aim, and he, whether frighted or irritated by this rude ſhake, let fall upon the man, that was ſtaring at it to ſee what would happen, a drop of liquor, that lighted directly upon one of his open eyes: but finding no heat nor ſharpneſs enſue, but rather a very ſenſible coldneſs, he made nothing of it, but roſe and put on his clothes: but preſently after, happening to rub with his finger the other eye, he was ſadly ſurpriſed to find himſelf ſuddenly benighted; and calling for aſſiſtance, he found, that the eye, which the ſpider had let fall ſomething on, though no change were noted in it by the by-ſtanders, was totally deprived of ſight. Upon which ſcore he repaired to the above-mentioned oculiſt; but whether he afterwards recovered his ſight or no, I cannot tell; all the endeavours the oculiſt and I employed to find out his lodging (to which it ſeems he had left a wrong direction) having been fruitleſs. This brought into my mind, that I had ſometimes wondered to ſee, how much more quickly ſpiders will kill flies, than the cutting off their heads, or running them quite through with pins or needles will do.

BUT to return to what I was ſaying, of the great miſchief done to human bodies by very ſmall quantities of poiſon, methinks one may thence argue, that it ſeems not improbable, that appropriated medicines, eſpecially when adminiſtered in greater quantity, may produce very notable changes in the human body to the advantage of it. But on this occaſion I expect to be told, that it is much more eaſy to do harm than good, and I confeſs it is ſo in the general; but yet, in the particular caſe before us, I conſider that ſome poiſons, that produce ſuch dreadful ſymptoms in the body, are frequently cured by their appropriated antidotes, which therefore muſt have a ſanative power great enough, with the help but of the ordinary concourſe of nature, to ſurmount the efficacy of the venomous matter. To which I ſhall add this more familiar inſtance, that as perfumes do often enough produce various, and ſometimes frightful ſymptoms, in many hiſterical women; ſo the fumes of the burnt feathers of partridges, woodcocks, *&c.* do frequently cure the fit in as little time, as the ſweet ſmell procured it. And I have often found the ſmell of ſtrong ſpirit of harts-horn, or of ſal-armoniac, recover ſuch women in far leſs time, than the fragrant odours employed to make them ſick.

THE third and principal inducement I had, to think there are ſpecific remedies, is, from experience. I might urge, on this occaſion, the teſtimony of *Galen*, who tells us more than once, that he himſelf therefore confided in the aſhes of burnt craw-fiſhes, for the cure of the biting of a mad dog, becauſe never any of thoſe, that took it, died. And to annex that upon the bye, for the uſefulneſs of it, he adds, that though the effect of theſe aſhes be admirable, even when given alone, yet their virtue may be increaſed, by adding to ten parts of burnt craw-fiſhes five of gentian and one of frankincenſe.

Galen. de ſimpl. Medic. Fac. lib. 11.

incenſe. And the great virtue of theſe burnt ſhell-fiſhes I find to have been taken notice of ſome ages before *Galen*; *Dioſcorides* much commending them againſt the ſame diſeaſe, that the *Pergamenian* does.

I SHALL in this place purpoſely forbear to mention ſuch medicines, as though by diverſe learned phyſicians commended as ſpecifics, are yet by others much queſtioned, if not flatly denied to be ſo; ſince it may be more proper, and may perhaps ſuffice, to mention two or three, whoſe efficacy is more notorious.

IT is known, by almoſt daily experience, in *Italy* and divers other hot countries, that though the ſtings of ſcorpions oftentimes produce very acute pains, and formidable ſymptoms, yet the miſchief is eaſily remedied, either by preſently cruſhing the body of the ſcorpion upon the hurt, or by anointing the part affected with oil of ſcorpions, (for that reaſon to be almoſt every where found,) which being made by ſuffocating thoſe inſects in common oil, and keeping it long in the ſun, the liquor does not at all appear to have any manifeſt quality, to which its ſanative efficacy may be aſcribed.

THE bitings of thoſe ſerpents, which, for the noiſe they are wont to make with a kind of empty bladders in their tails, the Engliſh call rattle-ſnakes, are counted much more poiſonous and dangerous, than the ſtings of ſcorpions; of which I remember a learned eye-witneſs, that lived divers years in *Virginia*, where they much abound, related to me a very ſtrange inſtance, which I cannot now ſtay to ſet down: and yet the Engliſh planters, when they have the misfortune to be bitten by theſe ſerpents, are wont to cure themſelves very happily by the uſe of that plant, which from its effects, and the place it grows in, is well known by the name of Virginia ſnake-weed, [or *ſerpentaria Virginiana*.]

THAT the Peruvian bark, commonly called here in *England* the Jeſuits powder, is a ſpecific againſt agues, particularly quartans, divers learned phyſicians not only grant but aſſert; and I remember the juſtly famous Dr. *Willis* gave me this character of it in private diſcourſe, (not without taking notice, that ſome decried it,) it is the nobleſt medicine we (meaning the phyſicians) know. But though I will not diſpute, whether it be ſo certain and ſafe a ſpecific for agues, as it is believed by divers eminent doctors; yet I think it can ſcarce be denied to be a ſpecific medicine to ſtop the fits of agues, (in the notion of ſpecific remedies formerly delivered) ſince it does that more effectually, than the generality of phyſicians, for many ages, were wont to do with their other antifebrile medicines.

I MIGHT here tell you, that I have myſelf ſeen a ſtone, whoſe efficacy in ſtopping hæmorrhages invited my wonder; and another, which performed extraordinary things in more than one diſtemper, though I could not perceive, that either of them did theſe things by any manifeſt quality. And I might here add ſome other particulars, that may be borrowed from experience, in favour of our opinion; but that it is like they will be more properly alledged hereafter, in ſome places of the remaining part of our diſcourſe.

I KNOW thoſe, that have rejected ſpecific medicines, have confidently urged three plauſible arguments againſt them. For ſome phyſicians deny there are any effects of medicines ſo conſiderable as to make them deſerve the name of ſpecific; others would probably allow, that experience favours our opinion, if they did not think the way of a ſpecific medicine's operating muſt be inexplicable, and conſequently ought not to be admitted by phyſicians; and others again (being of ſentiments very differing from theſe) will allow them to be very efficacious, but endeavour to derive their whole efficacy

cacy from manifeſt qualities as heat, cold, tenuity of parts, faculty of making large evacuations by vomit, ſiege, *&c.*

BUT theſe objections will be more opportunely conſidered in due places; only there is one argument, that may be objected by the deniers of ſpecific remedies, which I confeſs is ſo ſpecious, as to deſerve to be particularly examined in this place, leſt it ſhould, if unremoved, beget too ſtrong a prejudice againſt a great part of the enſuing diſcourſe. For it may be ſaid, that a medicine taken in at the mouth muſt in the ſtomach and guts be at leaſt very much changed by digeſtion and the aliments it meets with there, and a good part of it will be proſcribed among excrements: that, after it has paſſed out of the ſtomach, it muſt meet with divers ſtrainers of differing textures, which will probably ſtop all or moſt of the medicinal corpuſcles, that would pervade them: and that if any ſhall be ſo lucky, or ſo penetrating, as to ſurmount all theſe obſtacles, they will probably either be aſſimilated unto the ſubſtance of the body, or quite changed by the parts they will be fain to combine with there; or, if yet any ſhould be able ſo obſtinately to retain their priſtine nature, they will in all likelihood be too few to have any conſiderable operation upon the body. But to this plauſible objection I have ſeveral things to oppoſe by way of anſwer.

1. AND firſt I may repreſent, that divers ſpecific medicines, as ſome ointments, plaiſters, pultiſes, amulets, pericarpia, *&c.* being outwardly applied, their corpuſcles can get into the maſs of blood without paſſing through the ſtomach, and conſequently are not concerned in the propoſed objection.

2. AGAINST moſt of the Galenical phyſicians, that are wont to urge the formerly propoſed objection, I ſee not, why one may not argue *ad hominem*, by putting them in mind, that the ſame difficulties for the main, or others not inferior, may be alledged againſt a common opinion of their own: for ſince they believe that purgatives, cordials, diaphoreticks, beſides cephalicks, hepaticks, and ſome other ſorts of medicines, do contemperate and ſweeten the blood, and uſefully affect the newly mentioned ſtable parts; and ſince theſe medicines act not by naked qualities, but by ſmall particles of their own ſubſtance, if they can give us an intelligible account of the ingreſs of theſe particles in conſiderable numbers into the receſſes of the body, without being diſpoiled of their particular virtues, they will at the ſame time inſtruct us, how to anſwer the objection they urge againſt us.

3. AND in regard the generality of phyſicians hold, that milk and urine were materially in the maſs of blood, and are ſeparated from it by the breaſts and kidneys, I think one may by experience ſhew the invalidity of their ratiocination againſt ſpecificks: for it is obvious to obſerve, and I have ſeveral times done it myſelf, that rhubarb will (perhaps for many hours) tinge the urine of thoſe, that take any conſiderable doſe of it. And in ſome of our Engliſh American colonies there grows a fruit, which the planters call the prickled pear, whoſe inward ſubſtance is exceeding red, and whoſe being pleaſant in taſte as well as colour frequently invites eaters; but its juice is of ſo penetrating a nature, that it paſſes from the ſtomach into the bladder, and then into the chamber-pot, with ſo little loſs of its redneſs, that ſtrangers are wont to be ſurprized and frightned at it, as thinking this unknown fruit had made them void bloody urine, if not blood rather than urine. This is a known thing among thoſe, that have dwelt in our ſouthern plantations, and has been affirmed to me by unſuſpected eye-witneſſes, and among them by a famous phyſician. As for milk, the great *Hippocrates* himſelf informs us, that if a woman, or a ſhe-goat, take elaterium, the cathartic virtue paſſes into the milk, and will purge the child that drinks it; and I remember, that having occaſion to make ſome ſtay in the ſpring or beginning of ſummer, in the confines of Switzerland and Savoy, I had the opportunity to obſerve this odd

phænomenon; that when the cows in that diſtrict fed, as they would in that ſeaſon plentifully do, upon a certain weed, ſaid to be a kind of wild garlick, that grew copiouſly in the paſtures, the very butter made of their milk had ſo rank a taſte of the herb, that though I was not, yet divers other ſtrangers were, thereby diverted from eating of it, though otherwiſe freſh and good. And I remember too, that having paſſed a winter on the ſea-coſt of the county of *Cork* in *Ireland*, I found it a known obſervation, that a ſort of greedy ſea-fowl, whoſe name comes not now into my mind, living almoſt wholly upon fiſh (upon whoſe ſhoals I have ſometimes wondered to ſee ſuch a multitude of ravenous fowls attending) they acquire a taſte, that makes ſome pleaſantly queſtion, whether the food they afford be to be reputed fleſh or fiſh. But how conſtantly the particles of divers bodies may retain their nature in all the digeſtion and ſtrainers they paſs through, I have more amply diſcourſed in another tract, *About the concealments and diſguiſes of ſeminal principles*; and I preſume I have here ſaid enough to allow me to proceed to the fourth part of my anſwer.

4. I CONSIDER then, in the laſt place, that whereas it is objected, that ſo ſmall a quantity of the matter of a ſpecific, as is able to retain its nature, when it arrives at the part it ſhould work on, muſt have little or no power left to relieve it; this difficulty will not much ſtagger thoſe, that know, how unſafe it is to meaſure the power, that natural agents may have to work upon ſuch an engine as the human body, by their bulk, rather than by their ſubtilty and activity. A ſober gentleman, that was governor of a colony in the torrid zone, and commanded a warlike Engliſh veſſel, that ſailed up very far in the great river of *Gambia* or *Gambra* in *Africk*, and ſtaid there ſome time to trade with the Negroes of the inland country, being inquired of by me, among other things, about the poiſons, that are ſaid to be extraordinarily powerful in the parts he came from; he anſwered me, that the Blacks had a poiſon, that was, though ſomewhat ſlow, yet very mortal, in ſo ſmall a doſe, that it was uſual for them to hide enough of it to kill a man under one of their nails, which they wear ſomewhat long; whence they would drop it ſo dextrouſly into the drink, or milk, or broth, or other liquid aliment of thoſe they owe a ſpite to, that it is ſcarce poſſible for a ſtranger to be watchful enough to prevent it. For which reaſon, as he told me, though he ſometimes eat with their petty princes or governors at the ſame table, yet he would never eat out of the ſame diſh, nor drink out of the ſame cups with any of them. He added, that in another part of *Africa*, a famous knight, who commanded the Engliſh there, and lately died a ſhip-board in his way home, was ſo poiſoned at a parting treat by a young Negroe woman of quality, whom he had enjoyed, and declined to take with him, according to his promiſe, into *Europe*. And though my relator early gave him notice of what he ſuſpected to be the cauſe of this indiſpoſition, and engaged him thereupon to take antidotes, and cordials, as treacle, *&c.* yet his languiſhing diſtemper ſtill increaſed till it killed him.

I COULD name a vegetable ſubſtance growing in *Europe*, and perhaps not far from hence, which though ſome empiricks employ as a medicine, is ſo violently operative, that a learned and famous modern phyſician relates, that no more than half a grain would work ſo violently, as to cauſe very dangerous hypercatharſes, of which though he remedied ſome, yet he was not able to keep all from being mortal. And becauſe many ingenious men deny, that our Engliſh vipers are poiſonous, I ſhall add in favour of the argument that I have been enforcing, that I know a young man, who having been bitten by an Engliſh viper, which he too raſhly laid hold on, though the tooth pricked but his hand, yet the venom conveyed by ſo ſmall a hurt, which perhaps equalled not in quantity the hundredth part of a pin's head, quickly produced in him the bad ſymptoms, that uſually follow the biting of that ſerpent; and among others (for I particularly aſked him about that) a violent vomiting of ill-conditioned ſtuff.

I know

I know alſo a perſon, that practiſed phyſic in the iſle of *Java*, where ſcorpions are held to be more venomous than in *Italy*, who having, after he had drank ſomewhat freely, provoked, and been ſtung by, a ſcorpion, though the hurt was but in his thumb, and was ſo ſmall, that I could not perceive the leaſt ſcar it had left, that it put him preſently to ſuch violent tortures, for ſome hours, till he had procured ſpecific remedies, that he looked upon himſelf a dead man; and felt ſo raging a heat within, that he thought (to uſe his own expreſſion) that hell-fire was got into his body. Nor is it only by mere poiſons, that a human body may be greatly affected, though the agent be but very inconſiderable for bulk and weight; for we ſee, that divers women, otherwiſe ſtrong and healthy, will be caſt into ſwooning fits, and perhaps will complain of ſuffocation, and be put into convulſive motions, by the fragrant odours of muſk or civet; though if all the effluvia, that cauſe theſe ſymptoms, were reduced into one aggregate, this would not probably amount to a hundredth, nor perhaps to a thouſandth part of a grain. And I have ſometimes ſpeedily ſuppreſſed ſuch fits by the odour of the volatile ſalts, hartſhorn, ſal armoniac, or the like, or of diſtilled ſpirits abounding with ſuch ſalts; though perhaps all the particles, that actually relieved the patient, and calmed theſe frightful ſymptoms, if packed together, would not have equalled, either in bigneſs or in weight, the tenth, not to ſay the fifteenth, or the hundredth part of a grain of muſtard-ſeed. And as for inward remedies, it is vulgarly known, that in the infuſion of crocus metallorum, the corpuſcles, that render the liquor vehemently vomitive and purgative, are ſo very minute, that great proportions of wine, or other vehicles, may be ſtrongly impregnated with them, without any ſenſible diminution of the body, that parts with them. And of this we have a not leſs, if not more, conſiderable inſtance, when quickſilver is decocted or long infuſed in common water. For *Helmont* obſerves, that though the liquor be not altered in colour or taſte, nor the quickſilver at all ſenſibly changed, nay, nor grown any thing lighter in a balance; yet the liquor does, by means of theſe inſenſible and unponderable effluxes of the quickſilver, acquire a notable virtue againſt worms; for which purpoſe, not only *Helmont*, but before him that experienced chymiſt *Hartman*, and another eminent writer, extol this medicine. And, on this occaſion, I remember, that a fine boy, born to be heir to a very illuſtrious family, falling into a dangerous fever, which was judged to proceed from worms or verminous matter; a famous and experienced phyſician, that treated him, confeſſed to me, that he was out of hopes of him; becauſe the child having been bred to have his will, and tired with unſucceſsful remedies, was ſo obſtinate and careful in refuſing to take any thing, that ſmelled or reliſhed of a medicine, that he forbore, in ſpite of all the art uſed to deceive him, even to drink any thing but ſmall beer. Whereupon I perſuaded both the doctor, and the lord, whoſe ſon the child was, to impregnate his ſmall beer with mercurial particles, by frequently ſhaking it with good quickſilver in it; by which means the patient perceiving no change of colour or taſte in the drink, ſwallowed it greedily, and through the bleſſing of God was ſoon after reſtored to a health, which the parties concerned aſcribed to the mercurial remedy.

I SHOULD condemn myſelf for having beſtowed ſo many words upon one objection, but that I hope the anſwer given to it in this place will facilitate and ſhorten ſeveral things relating to my preſent ſubject, ſpecific medicines; about which I ſhall now proceed to offer my thoughts in ſome propoſitions, and ſhort diſcourſes upon them.

HAVING now diſpatched the firſt of the two formerly propoſed enquiries, I proceed to the ſecond; namely, whether the mechanical hypotheſis can be accommodated to ſpecific medicines, ſo as that they may be either intelligibly explicated by

it, or at leaſt ſhewn to be reconcileable to it? I preſume you will eaſily believe, that there are few writers more inclinable, than I am, to confeſs the dimneſs of our knowledge, and the obſcurity of many things in nature: or that are more forward, than I, to grant, that many of the operations of ſpecific medicines are to be reckoned among thoſe abſtruſe things, whereof nature ſeems to affect the concealment: But notwithſtanding this, when I conſider, how comprehenſive and fertile the principles of the corpuſcular philoſophy are, I cannot deſpair, but that it will be found, that divers of the effects of theſe medicines may be, in a general way, explicated by them, and not any will appear inconſiſtent with them. This I deſire may be here taken notice of once for all, that, retaining the ſcope of the following diſcourſe ſtill in your memory, you may not think it ſtrange, that I content myſelf, on moſt occaſions, to give in general poſſible explications, and to ſhew, that ſpecific medicines may operate on ſome ſuch account as I propoſe, without affirming, that they certainly do ſo. I obſerved ſoon after the beginning of this paper, that there were three ſorts of virtues, to which phyſicians (though not unanimouſly) have given this title of ſpecific; namely, ſuch as evacuate ſome particular humour, ſuch as are peculiarly friendly to this or that part of the human body, and ſuch as in an unknown way cure or much leſſen this or that determinate diſeaſe. But yet I ſhall now apply my diſcourſe peculiarly to the laſt ſort of theſe medicines, as being both more conſiderable in itſelf, and the chief ſubject intended in the preſent diſcourſe; giving nevertheleſs, as occaſion ſerves, ſuch additional hints and obſervations, as may make the reflections belonging to this third ſort of ſpecifics, eaſily applicable, *mutatis mutandis*, to the other two.

And I ſhall begin with laying here for a foundation, what I have in another treatiſe had occaſion to deliver and make out; namely, that a living human body is not to be looked upon as a mere ſtatue, or a mere congeries of the materials it is compoſed of, fleſh, blood, bones, fat, nerves, veins, arteries, *&c.* but an admirably framed engine, conſiſting of ſtable, liquid, and pneumatic ſubſtances, ſo exquiſitely adapted to their reſpective functions and uſes, that oftentimes the effects of an agent upon it are not to be meaſured ſo much by the power of that agent conſidered in itſelf, as by the effects, that are conſequently produced by the action of the parts of the living engine itſelf upon one another.

This premiſed, I conſider, that there is no need to grant, that the operations of all ſpecifics, or of the ſame in differing diſeaſes, muſt be of one kind; but that differing ſpecifics may operate in ſeveral manners, and ſome by one of theſe ways may oppugn ſuch a diſeaſe, and others may do good againſt ſuch another. And of theſe general ways I ſhall briefly propoſe ſix or ſeven, that now occur to my thoughts; having firſt given you this important caution, that the ſpecific remedy does not commonly (though ſometimes it may) relieve the patient by this or that ſingle way of operating, but by a concurrence of two or more, that, as it were, join their forces to produce the deſired effect.

Proposition I.

And firſt, ſometimes the ſpecific medicine may cure by diſcuſſing or reſolving the morbific matter, and thereby making it fit for expulſion by the greater common ſhores of the body, and the pores of the ſkin.

It is known that many diſeaſes, and thoſe oftentimes ſtubborn and chronical, proceed from certain tough or viſcous humours, that obſtruct the paſſages, whereby the blood ſhould circulate, or other uſeful liquors be tranſmitted; and theſe peccant humours,

mours are oftentimes ſo viſcid and obſtinate, that ordinary remedies will do little or no good upon them. And yet a ſpecific may, by the ſmallneſs and congruous figure of ſome of its corpuſcles, get through the pores into the receſſes of this ſtubborn matter: and by their ſolidity, figure, and agitation, promoted by the heat of the patient's body, may diſſolve and ruin the texture of the morbific matter, and render it capable of being proſcribed by nature, by urine, ſweat, or ſome other commodious and innocent evacuation. Thus the blood, or ſome other liquor of the body, being (to uſe the chymiſts phraſe) impregnated with the friendly and operative particles of the remedy, becomes an appropriated menſtruum in reference to the peccant matter; impregnated with ſal armoniac, becomes a menſtruum, that by degrees will diſſolve both copper and iron, as compact bodies as they are. I ſaid appropriated menſtruum, becauſe there is no ſufficient reaſon to ſuppoſe, that the menſtruum works by any manifeſt quality, as heat, moiſture, *&c.* or even by acidity itſelf; but rather by virtue of the fitneſs, which the ſhape, bulk, ſolidity, and other mechanical affections of its particles, concur to give it, to disjoin the parts of a body of ſuch a determinate texture. For, as I have in another paper amply ſhewn, there are far more menſtruums of diſtinct ſorts, than are commonly taken notice of; and the operations of theſe cannot ſafely be meaſured by the ſtrength of their manifeſt qualities, ſince it may ſeveral times happen, that a menſtruum, leſs acid or leſs ſtrongly taſted, may diſſolve this or that body, which another menſtruum, that ſeems far ſtronger, will not work on. Thus cold water will diſſolve the white of an egg, which pure ſpirit of wine will be ſo far from diſſolving, that it will coagulate it; [and ſo will ſpirit of ſalt and oil of vitriol itſelf.] Thus dephlegmed ſpirit of urine will readily diſſolve minute filings of copper, which ſpirit of vinegar will but ſlowly work upon; and yet this liquor will ſpeedily diſſolve crabs eyes, which ſpirit of urine will leave entire. Thus quickſilver, that is inſipid, will in the cold diſſolve gold, which *aqua fortis* itſelf, though aſſiſted by external heat, will not work upon; and yet *aqua fortis* will furiouſly beat aſunder the parts of iron, though quickſilver will not ſo much as adhere to its ſurface. And thus in fine (not to accumulate inſtances) common oil, that is ſo ſmooth upon the tongue, and will not diſſolve ſo much as an egg-ſhell, will diſſolve brimſtone, which yet will reſiſt *aqua fortis* itſelf, that will diſſolve almoſt all metals, beſide many hard ſtones and minerals. And I know a liquor, having more than once prepared it, which, though ſo weak, that one may drink a wine glaſs full of it pure without danger, will yet work on ſome very hard bodies, both ſtones and metals, in a way that is not to be matched, among the highly corroſive menſtruums in uſe among chymiſts.

AND now ſuppoſing, that the active corpuſcles of a ſpecific medicine, aſſociated with the blood or other vehicle they impregnate, may act upon the morbific matters they meet with in the body, after the manner of a menſtruum; ſuppoſing this, I ſay, we may hence illuſtrate ſeveral things, that have reference to the operation of ſpecific medicines.

1. AND we may hence derive a gueſs, why an appropriated medicine will perform things, which will not be done by another, whoſe manifeſt qualities ſeem to be the ſame for kind, and much ſtronger in degree. For menſtruums do not always act according to the degree of their acidity, or the like ſenſible quality; but according to the congruity of their corpuſcles to the pores of the body they are to diſſolve, and alſo oftentimes according to a fitneſs, that depends upon other mechanical affections of the acting liquor: and therefore phyſicians, as well as others, may eaſily miſtake in their argumentations *à majori ad minus, & à minori ad majus.* For the conſequence is not good to argue either thus; water, which is ſo ſtrengthleſs a liquor, will diſſolve gum Arabic; therefore highly rectified ſpirit of wine, which is a much more ſubtile and

and penetrating liquor, will do the ſame thing more powerfully: for experience ſhews it will not diſſolve it at all: or thus, ſtrong oil of vitriol is more corroſive in taſte, and will diſſolve many bodies, that *aqua fortis* will not; therefore it will alſo diſſolve ſilver as well as *aqua fortis*, the contrary of which is true. Nay it is not a good inference to argue thus; *aqua fortis* diſſolves ſilver by virtue of its acid ſpirits: therefore the more it abounds with theſe, the more potently it will diſſolve that metal; whereas I have elſewhere proved by experience, that if *aqua fortis* be made exceeding ſtrong, it will not work upon ſilver; but it will readily do it, if it be weakened by the addition of a fit quantity of common water.

To this I ſhall add, that the diſſolution of a body may depend, as well upon the peculiar texture of the body itſelf, as the manifeſt ſtrength of the menſtruum.

2dly. The foregoing doctrine may ſuggeſt a reaſon, why a medicine, that does wonders in one diſeaſe, may do little or nothing in another, that ſome may think to be a kin to it, and perhaps too, more eaſily ſuperable by it; for the preſumed cognation may not be ſo great, but that ſome diſſimilitude of texture in the morbific matters may make one of them unfit to be wrought upon by the ſame menſtruum, that diſſolves the other: and though pure ſpirit of wine will eaſily enough diſſolve *gummi Guajacum*, and alſo the little portions of reſinous matter, that are harboured in the pores and ſmall cavities of the wood; yet the ſame menſtruum will not work upon the wood itſelf of the tree, that affords thoſe ſoluble ſubſtances.

3. This may keep it from being thought ſtrange, that ſpecific medicines ſhould ſometimes fail of their uſual effects. For as the bodies of individual patients may differ very much, either according to their natural conſtitution, or to that, which they acquire by the diſeaſe, that diſtempers them, or on both thoſe accounts; ſo it ought not to ſeem ſtrange, that, in ſome ſick perſons among many, the congruity between the agent and patient ſhould be altered, either by ſome conſiderable change in the texture of the morbific matter, or by ſome notable alteration, that the corpuſcles of the medicine receive in their paſſage through the veſſels, by the admixture of ſome incongruous particles of the blood, or other vehicle. Thus ſpirit of ſalt will, as I have tried, diſſolve copper, as ſpirit of nitre does: which notwithſtanding, though this laſt named liquor will diſſolve ſilver, yet if you mix with it ſpirit of ſalt, which, by the like operation of both upon copper, ſeems to be amicable to it, the ſpirit of nitre will no more be able to diſſolve ſilver as it could before.

4thly. Our hypotheſis may alſo hint to us an anſwer to one of the main and moſt plauſible objections of the deniers of ſpecific medicines. For ſome of them aſk in a ſcornful way, how it is poſſible, that a medicine ſhould rove up and down in the maſs of blood, and, neglecting all other things, ſhould ſingle out and faſten upon the morbific matter men wiſh it ſhould proſcribe? For if the medicine acts by impregnating the blood, or ſome other liquor of the body, and turning it into a kind of menſtruum, it is very poſſible, both that the ſtrainers, through which the corpuſcles muſt paſs, may keep back the inconvenient parts of the vehicle; and (which is in our caſe more conſiderable) the menſtruum may be either appropriated to the peccant humour, as has been formerly declared, or elſe may at leaſt be qualified to reſolve that more eaſily, than any other ſubſtance it meets with in the body. As if you take ſome bone-aſhes, and *Crocus Martis*, and ſaw-duſt, and powdered ſea-ſalt, and filings of gold, and blend all theſe together: if upon one half of this mixture you pour common water, it will not meddle with any other of the ingredients except the ſea-ſalt, which it will readily diſſolve: and if upon the other half of the ſame mixture you put a ſufficient quantity of quickſilver, and rub them together, this metalline liquor will neglect all the reſt of the ingredients, and the ſea-ſalt itſelf, and faſten upon the gold.

And thoſe, that work in the Spaniſh gold-mines, inform us, that when they have well ground ſome ore, that contains gold and copper, beſides heterogeneous minerals, well heated quickſilver, will take up the gold much ſooner and better, than it will the copper, ſcarce meddling with the latter, as long as there remains any not deſpicable quantity of the former to be wrought upon by it. And as for the ſuppoſed difficulty, that the medicine ſhould ferret out, if I may ſo ſpeak, the morbific matter, in what veſſel ſoever of the body it lies, this objection might have been conſiderable, before the diſcovery of the blood's circulation; but it is not ſo now, that we know, that things, that once get into the maſs of blood, are preſently whirled about with it, and may be conveyed by it even to ſmall veſſels lying in the remoteſt parts of the body.

5thly. AND this prompts me to take notice, that our hypotheſis may help us to anſwer thoſe many learned phyſicians, that either reject, or at leaſt deſpiſe, moſt external remedies, eſpecially pericarpia, amulets, and appenſa, upon a ſuppoſition, both that they neither can furniſh the body they do but externally touch with any ſtore of medicinal particles; and, which is chiefly in this place to be conſidered, that being but external remedies, they muſt be very unable to do good in internal diſeaſes, eſpecially ſuch as are ſeated in parts remote from thoſe, which the medicine is applied to. But as to the former part of the objection, it will not be difficult to anſwer it to him, that has read what I have elſewhere written of the ſubtilty, numerouſneſs, and efficacy of effluviums. And we need but conſider, what plenty of particles, ſenſible to the noſtrils, are for a long time emitted by a ſmall quantity of ambergreaſe, or even of camphire (which is often externally uſed, and the multitude of magnetical corpuſcles, that for many years conſtantly effluviate from a ſmall vigorous loadſtone, to think it poſſible, that even dry and ſtable bodies may afford ſufficient ſtore of effluvia to perform conſiderable things in ſo curiouſly framed an engine as the human body is; where we ſee, that the odour of muſk or civet, for inſtance, may ſpeedily caſt divers perſons into fits, and the ſmell of caſtor or *aſſa fœdita*, and much more that of ſalt of harts-horn, or of ſal-armoniac, quickly relieve them. And as to the ſecond part of the objection, what I have elſewhere made out, and the beſt modern phyſicians grant, of the poroſity of the ſkin, ſhews, that it is very poſſible for the ſubtil effluvia of ſeveral bodies to get through the pores of the ſkin; and when they have once got admittance, ſo much as into the ſmaller veſſels, it is eaſy to conceive, how theſe may carry them into the greater, and conſequently into the maſs of blood, by whoſe circulation they may be readily conveyed to all the parts of the body, and among them to the ſeat of the diſeaſe: and perhaps, (to add that upon the bye,) the efficacy of theſe corpuſcles, that, if I may ſo ſpeak, get in at the key-hole, not at the door, may be the more conſiderable, becauſe they get preſently into the maſs of blood, without paſſing through thoſe digeſtions in the ſtomach and other parts, which oftentimes much weaken the virtue of medicines taken in at the mouth before they arrive at the blood.

The Eſſay of the Poroſity of animal bodies.

PROPOSITION II.

Sometimes a ſpecific medicine may mortify the over acid or other immoderate particles, that infeſt the maſs of blood, and deſtroy their coagulatory or other effects.

THOUGH I am not of their opinion, who of late are wont to impute almoſt all diſeaſes to acidity abounding in the blood and other liquors of the body, by whoſe intervention the ſtable parts alſo are offended; yet I readily grant, that a conſiderable number of diſtempers are, at leaſt in great part, produced either by acids themſelves, or

or by their bad effects or productions. Agreeably to which doctrine we may very probaby conceive, that ſeveral maladies may be either quite cured, or much leſſened, by a ſpecific remedy, that abounds in corpuſcles fitted to mortify acids. This mortification may be effected by more than one way; and of theſe ways the chief, that now occur to my thoughts, are two.

For there are ſome bodies, that mortify or diſable acids by a poſitive hoſtility, if I may ſo term it; that is, by ſuch a contrariety, as is diſcernible by the taſte, and more by the viſible conflict and manifeſt tumult, that is produced, when they come to invade an acid. Of this ſort of mortifiers of acids are the moſt part of thoſe, that are called alcaliſate ſalts; whether fixt, as the lixivial ſalts of plants, or volatile, as the ſpirits and aſcending ſalts of urine, blood, hartſhorn, ſoot, *&c.* as may be exemplified, when any of theſe comes to be mingled with *aqua fortis*, ſpirit of ſalt, oil of vitriol, or the like acid liquors, by which, by the way, we may ſee, that thoſe Galeniſts miſtake, who aſcribe the virtues of ſpirit of hartſhorn, and of urine, only to their tenuity of parts, briſkneſs of motion, and the like affections, that they might not ſeem beholden to the chymiſts for ſo uſeful a notion, as that of the contrariety of acids and alcalies.

The other principal way, by which acids may be mortified, or diſabled to bite, is by ſheathing them, if I may ſo expreſs it, for as a kniſe may be diſabled to cut, either by filing off or otherwiſe blunting its edge, or elſe by covering the blade with a ſheath fit for it, or by ſticking it into a loaf of bread, or the like body fit to receive and detain the whole blade; ſo an acid corpuſcle may loſe its power of cutting or pricking, either by having its figure ſpoiled by the action of a ſtrong and manifeſt alcali, or elſe by being, as it were, ſheathed in a porous body, though perhaps endowed with no taſte or any other manifeſt quality, by which one would think it contrary to the acid it diſables, as a file is to the edge of a knife. Of this way of mortifying acids, chymical operations afford us many inſtances; as when *menium* deſtroys the acidity of ſpirit of vinegar; as I have found chalk will do that of *aqua fortis* itſelf; and *lapis calaminaris* very much leſſens, as well as alters, the acidity of ſpirit of ſalt, and even of ſpirit of nitre. And I the rather mention this mineral, both becauſe its qualities are leſs known to phyſicians and the generality of chymiſts, and becauſe it ſupplies me with an argument to prove, that acids may be, though I do not think they always are, rather ſheathed in, than deſtroyed, by the bodies that ſilently mortify them; for, as *Glauber* has truly enough obſerved, acid ſpirits (as I have tried in ſome) may by force of fire be driven in diſtillation out of the *lapis calaminaris* very much dephlegmed, and ſtronger than before.

I know it may be here objected, that the mortification of acids is performed by a manifeſt quality, and therefore makes nothing for the favourers of ſpecific medicines; but to this I anſwer,

1. That the power of mortifying acids, eſpecially by ſheathing them, or, if you pleaſe, by abſorption of them, is none of thoſe qualities, whether firſt, ſecond, or third, that the former phyſicians took notice of in medicines; though the ſufficiency of theſe qualities to cure diſeaſes, has been, and ſtill is, uſed by many, as a ground of denying the ſpecific virtues of remedies.

2. That I have often looked upon it as an unhappy miſtake, and of ill conſequence, that ſo many learned modern phyſicians take it for granted, that if a medicine be endowed with a manifeſt quality, as acid or alcaliſate, the good it does, (and the like for the moſt part may be ſaid of the harm) may ſafely be aſcribed to that quality, that is, to its being of an acid, or elſe of an alcaliſate nature; whereas, in my

poor judgment, there being a conſiderable diſparity, as various trials have aſſured me, between acid and acid, as likewiſe between alcali and alcali, it is fit to diſtinguiſh betwixt an acid, for inſtance, as meerly ſuch, and the peculiar modification, that may belong to that acid. Thus, though all acid menſtruums, that I know of, if they be well dephlegmed, will diſſolve copper; yet *aqua regis*, that will diſſolve not only that metal, but the much more cloſely compacted body of gold, will not at all diſſolve ſilver; as on the other ſide *aqua fortis*, as corroſive a menſtruum as it is, will not of itſelf diſſolve gold, but, if you give it a new modification, by adding to it common ſpirit of ſalt, which itſelf I have often found (whatever chymiſts think or have written to the contrary) will leave it entire, the *aqua fortis* will eaſily diſſolve that metal. Nay, a different modification may not only make a diſparity between acids, but that, which, according to the received way of judging, ought to be called a contrariety; for ſpirit of ſalt will precipitate ſilver, which *aqua fortis* has diſſolved; and ſpirit of nitre, though one of the acideſt menſtruums we have, will not only precipitate an antimonial powder out of that odd ſubſtance, that chymiſts call butter of antimony, but will do it with a wonderful conflict, tumult, and efferveſcence; and yet this butter of antimony is ſo highly acid, that a little quantity of it, put into a conſiderable one of water, makes it ſo ſour, that many chymiſts call it *acetum philoſophorum*. And now, to apply theſe things to the lately propoſed objection, I deſire it may be remembered, that near the beginning of this letter I plainly intimated to you, that I did not deny, but that a ſpecific medicine may ſometimes be accompanied with, or even in part operate by a manifeſt quality; but that yet I thought the good effect was not due barely to the kind or degree of the manifeſt quality, but to ſomewhat ſuperadded, which gave it a ſpecific virtue againſt this or that particular diſeaſe. And ſuitably to this it may be ſaid, that as there are ſeveral kinds of acids, and of alcalies too, it is not every acid, that will be mortified by every alcali, and have its effects deſtroyed by it; which may be illuſtrated by this: that though, when copper is diſſolved in *aqua fortis*, it is poſſible, by the help of mere chalk ſkilfully applied, to make the menſtruum let go the corpuſcles of the metal; yet if upon ſuch a high coloured ſolution of copper you ſhall pour (as, to convince ſome ingenious men, I have purpoſely done) a due quantity of ſpirit of urine, or the like volatile alcali, though there will preſently enſue a great conflict and manifeſt ebullition, with noiſe and ſtore of bubbles, yet between theſe hoſtile ſalts a multitude of the acid corpuſcles of the *aqua fortis* will not be ſo mortified, as to let go the metal, but the ſolution, varying its colour, will have and keep a deeper one than before.

AND when I conſider the differences, that a ſkilful obſerver may find between vinegar, allum, chryſtals of tartar, juice of lemons, juice of barbaries, the eſſential ſalts, (as chymiſts call them) of thoſe plants, that are ſour in taſte, to omit divers other acids; I am apt to think, that diſordered nature may have, in a diſeaſed body, produced acids of ſeveral ſorts; which are not particularly known to us; and that ſome of theſe may be of ſuch a nature, that none of our common alcalies, as ſuch, is able to mortify them, and which yet may be more mortified, at leaſt by the way of ſheathing, by ſome appropriated, or peculiarly modified corpuſcles of a ſpecific remedy: which may be illuſtrated by what is elſewhere obſerved, that though neither ſpirit of vinegar, nor ſpirit of ſalt, nor oil of vitriol itſelf, would, as far as I have tried, diſſolve a ſtone taken out of a man's body, yet ſpirit of nitre, (which does not diſſolve ſeveral bodies, that I have found diſſoluble in oil of vitriol) will readily work upon it, and thereby loſe its corroſiveneſs.

BEFORE I leave this ſubject, it will not be amiſs to intimate a couple of things, that perhaps you will not think impertinent to it.

One of theſe is, that whereas I not long ago diſtinctly named acids themſelves, and their productions, I did it (not out of inadvertence, but) becauſe I think preternatural acids do not only diſaffect the body, whilſt they continue ſenſibly acid, but may, in divers caſes, be the cauſes of ſome diſtempers, whereof moſt men would think them more likely to be the remedies. For though acids be reputed to have an inciſive and reſolutive virtue, and therefore oxymel, and ſome other acetous medicines, are commended to cut tough phlegm, and ſpirit of vitriol is uſed for the ſame purpoſe, and to diſſolve coagulated blood; yet, as I am willing to grant this virtue unto acids, in ſome caſes, ſo there are others, wherein I much ſuſpect, that obſtructions, and conſequently the diſeaſes, that uſually attend obſtinate ones, may be occaſioned by acids, as they coagulate ſome fluids in the maſs of blood, that are diſpoſed to be thickened by them, and by that conſiſtence made unfit to paſs with the reſt of the circulating blood through the ſmaller veſſels and ſtrainers of the body, where upon that account they make obſtructions. This I ſhall exemplify by the coagulation, that I have made by ſome acid ſalts, as ſpirit of ſalt, of the white of an egg, eſpecially if, by beating, reduced to an aqueous conſiſtence. And the like coagulation may eaſily be effected in milk, which may not only be ſpeedily curdled with ſpirit of ſalt, but, as is known, by bodies not chymically prepared, as rennet and juice of lemons. And experiments, purpoſely made, have ſhewn, that, if ſome acids be conveyed immediately into the maſs of blood, they will coagulate even that liquor, whilſt it continues in the veſſels of the yet living animals.

The other thing I lately told you I was to obſerve is, that though acid corpuſcles are thoſe, that modern phyſicians and chymiſts are wont to take notice of as hurtful, both in the blood and ſtable parts of the body, except the ſtomach, and perhaps ſome few neighbouring parts, as the ſpleen and pancreas: and though ſome ingenious men proceed ſo far as to impute almoſt all diſeaſes to the bad effects of acids, yet I am very inclinable to think, that divers maladies and troubleſome ſymptoms proceed from corpuſcles, that, whether they be of a ſaline nature, or not, are different from acids, properly ſo called: for I conſider, that there may be many bodies, which may, as it were, reſult from the combination of acids with other ſaline particles, that much alter their nature; as I have elſewhere noted, that ſpirit of ſalt will, with ſpirit of urine, compoſe a kind of ſal-armoniac; and ſpirit of nitre, with ſalt of tartar, diſſolved in common water, will concoagulate with it into ſalt-petre, (or a body exceeding like it) and the ſame ſpirit of nitre, or aqua fortis, with ſpirit of urine, or of blood, or the like, will afford a very fuſible ſalt, differing enough from what either of the ingredients was before their conjunction. And it is vulgarly known, that oil of vitriol, and oil of tartar *per deliquium*, do, by their coalition, produce *tartarum vitriolatum*, in which the acidity of the former, and the alcaliſateneſs of the latter, are very much infringed, a third body being by reſultancy produced, that differs much both from the former and the latter oil, or rather ſaline liquor. And when, beſides inſtances of this nature, I conſider, how many differing ſorts of corpuſcles ſo fruitful a principle as nature may have formed, that, without being acid, may yet have notable and hurtful effects upon the blood, or ſome particular ſolid part of the body; it ſeems probable to me, that there may be other qualities required to mortify or diſable theſe morbific corpuſcles, than a contrariety to acid ſalts; and conſequently, that a medicine, that affords corpuſcles peculiarly fitted to correct or enervate this particular ſort of hurtful ones, may deſerve the name of a ſpecific.

And here I further conſider, that as in the body there may be divers coagulations made by ſaline corpuſcles manifeſtly acid; ſo there may be others produced by corpuſcles, whether ſaline in taſte or no, that are not manifeſtly acid, but perhaps rather of a contrary nature; which obſervation being wont to be overlooked by phyſicians,

cians, and yet, in my opinion, of no ſmall importance, may deſerve to be a little the more carefully made out. I have ſometimes, for curioſity, made a liquor, that was not in taſte either acid or urinous; to which having put a moderate proportion of a diſtilled liquor, which itſelf was not in taſte either acid or urinous, or lixiviate, it would in a very ſhort time, perhaps in not many minutes, be coagulated into ſo conſiſtent a body, that, though the wide mouthed veſſel were held with the orifice downwards, nothing would fall out of it.

I HAVE taught in another (unpubliſhed) paper, that if upon a certain ſolution (which I there ſhew how to make) one drop ſome ſpirit of urine, or another volatile alcali, there will preſently be produced a gelly, whoſe conſiſtence and colour may make it eaſily be taken for common ſtarch, ready to be employed to ſtiffen linnen.

THE like gelly, but more tranſparent, I have more than once made; without the help of any thing, that is ſenſibly acid or urinous.

I HAVE alſo, to convince ſome virtuoſi, ſhewn them, ſomewhat to their ſurprize, a ſubſtance I had prepared without the help of urine, or any volatile alcali, (and ſometimes almoſt in a trice) that would in very few minutes coagulate above twice, if not thrice its weight of highly rectified and inflammable vinous ſpirit into a ſtable maſs.

AND to ſhew you, that it is not requiſite, that a liquor be ſtrongly, or ſo much as ſenſibly acid to coagulate an animal ſubſtance, as I lately noted, that the ſpirit of ſalt did the white of an egg, I ſhall add, that well dephlegmed ſpirit of wine will do the ſame thing as well, if not better.

PROPOSITION III.

Sometimes the ſpecific medicine may help the patient, by precipitating the peccant matter out of the blood, or other liquor (of the body) that harbours it.

THOUGH precipitation be oftentimes a conſequent of the mortification of acids, or of alcalies, by corpuſcles of a contrary quality, yet I thought fit to ſay ſomething of it apart; becauſe I have obſerved, that ſome acids and alcalies may be put together, without cauſing precipitation by their contrariety: and, on the other ſide, that divers precipitations may be produced, where there does not appear any hoſtility; though I know divers ingenious men, who think this effect itſelf a ſufficient argument, that the hoſtility of acids and alcalies muſt be the cauſe of it: but that ſhould not be taken for granted, but proved by collateral experiments, that do not ſuppoſe the truth of the hypotheſis itſelf. But to proceed to our examples; I know (and elſewhere mention) ſeveral urinous ſpirits, that I could mix with acid menſtruum, without making any manifeſt conflict or precipitation; and, on the other ſide, acids and alcalies, that will make a manifeſt conflict by their mutual creation; and yet, if they be mingled in a juſt proportion, will have, for the conſequent of their mixture, coalition inſtead of precipitation; as may be exemplified in certain mixtures of ſpirit of ſal-armoniac (made with ſalt of tartar, or pot-aſhes) and ſpirit of nitre or aqua fortis; and alſo when ſpirit of urine and ſpirit of ſalt, being mingled in a certain proportion, convene into corpuſcles for the making of ſal-armoniac, which the phlegm of thoſe liquors will keep ſwimming. But that, which makes moſt for my preſent purpoſe is, that there may be precipitations, where, whatever may be ſuppoſed, it does not appear, that there is any tumult or contrariety; as when ſilver, being diſſolved in aqua fortis, and the menſtruum diluted with thirty or forty parts of diſtilled water, or of rain water, if clean plates of copper be immerſed in the ſolution,

the metal will be very ſlowly precipitated out of it, in the form, not of a calx, conſiſting of metalline and ſaline parts, incorporated together, but, at leaſt at the beginning, in the form of pure ſhining ſcales of ſilver, almoſt like the white and glittering ſcales of ſome ſmall fiſhes. There is alſo a way, by which I have brought diſſolved gold to ſettle about a body, ſuſpended in the ſolution, in the form of a fine and high-coloured calx of pure gold. But you may eaſily ſee an inſtance of ſilent precipitation, if you do but rub a little either Roman or Dantzick vitriol upon the well-whetted blade of a knife, wetted with water or ſpittle; for you will have the ſteel, almoſt in a trice, overlaid with a reddiſh ſubſtance, which, by its colour and other ſigns, appears manifeſtly to be cupreous. And here I ſhall advertiſe you, that it is not only, as is wont to be ſuppoſed, out of ſolutions made with acids, that bodies may be thus precipitated; for upon ſearch I have found, that there are in nature precipitants, that are capable of ſilently precipitating ſome bodies diſſolved in urinous menſtruums, or others not acid. I know it may be ſuſpected, and that not without colour of reaſon, that ſuch precipitations may be dangerous by producing heterogeneous corpuſcles in the blood, that may be too heavy or groſs to be evacuated; and I look upon this as a ſuſpicion, for whoſe reſolution it were fit to conſult experience; but in the mean time one may repreſent,

1. That though ſome inconvenience may happen from the bulk of the precipitated corpuſcles, yet that may be much inferior to the danger threatned by the over-active and hoſtile particles, that produced or fomented the diſeaſe.

2. That it is not neceſſary, that all concretions ſhould conſiſt of corpuſcles ſo bulky, as to be too big to be thrown out of the maſs of blood; for we ſee that ſtony matter, which, as the chymical analyſis of it ſhews, is of a very compounded nature, may be carried to all parts of the body. And I remember I knew a lady, who, a while before ſhe told me the ſtory, had a ſtone taken out of the lower part of her tongue. And phyſicians, that preſcribe great quantities of mineral waters, impregnated with iron, ſuch as I found thoſe of *Tunbridge* to be, and with ſulphur, ſuch as ſome of the *Bath* waters are, are wont to build their expectations of curing with them, upon a ſuppoſition, that they are carried into the maſs of blood, and conſequently to the innermoſt parts of the body.

3. That yet it is poſſible precipitations may be made of matters contained in the blood by medicines, that do not get into the maſs of it: as phyſicians give ſteel in ſubſtance ſometimes crude, as well as often times prepared, to mortify the acidities of the blood, though the metalline corpuſcles do not, for aught we know, paſs into the maſs of it, but are wrought upon by the matter, that in its circulation is thrown out of it into the ſtomach and guts, where their operation on it is probably inferred from the blackneſs, that chalybeats are wont to give the excrements of the lower belly. And if they will have it, that prepared ſteel, for inſtance, calcined with ſulphur, gets through the pores of the bowels, or the extremities of the capillary veſſels, into the maſs of blood itſelf; it will be obvious to demand, why nature ſhould not be able to expel precipitated corpuſcles at the ſame paſſages, at which ſuch compounded concretions, as thoſe of ſulphur and metal, can get in.

4. That ſome may very ſpeciouſly pretend, that experience has been already conſulted about the expediency of employing precipitating medicines. For not to urge, that the learned and judicious *Sennertus* ſeems to intimate, that, in ſome caſes the febrile matter may be ſurmounted by being precipitated out of the blood; there is a profeſſor of phyſic, who, though I cannot aſſent to ſome of his principles and doctrines, has delivered ſeveral conſiderable things about fermentation and fevers; and this profeſſor,

by name, *Kergerus*, very ſolemnly declares*, that for fourteen years he cured above a 1000 febricitants, without bleeding, purging, or ſweating medicines, (to which he adds ſome other ſorts) by a ſingle precipitating remedy. I endeavoured to obtain from *Germany* an account of the truth of the matter of fact, but did not receive it; only I found, that a phyſician of this emperor's does, in a lately publiſhed book, declare himſelf inclined to believe it to be true.

I SHALL much the more eaſily be induced to think, that great and deſirable changes may be wrought in the fluid parts of the body by appropriated precipitants, if that be true, which is unanimouſly taught by a multitude of phyſicians, who impute many diſeaſes to the putrefaction of the blood and other liquors of the body. For, though certain reaſons oblige me to deſire you, not to aſk me any queſtions about the remedy I am going to ſpeak of, becauſe I muſt not yet anſwer them; yet I am willing you ſhould, on this occaſion, know hiſtorically, (what probably you will think ſtrange) that there is in *rerum natura* a certain ſubſtance, which is ſo powerful an enemy to putrefaction, that, when a few grains or drops of it were put into a conſiderable quantity of water, that had been kept till it ſtunk ſo ſtrongly and offenſively, that, if I had not known what it was, I ſhould have judged the ſmell to have proceeded from carrion; this medicinal liquor, I ſay, (for ſo I may call it) being diffuſed by agitation through this abominably ſtinking water, (which did not appear turbid to the eye) in ſo very ſmall a proportion, precipitated out of it a very little and light feculency, which being ſeparated, the reſt of the liquor was quite freed from all ſtink; nor did I obſerve, that the feculency itſelf had any; and, which is very notable, all this was done in a very few minutes, by a precipitant, whoſe taſte was not at all either bitter, or acid, or urinous, or lixivial: all which are circumſtances, that may afford good hints to ſpeculative and ſagacious enquirers.

PROPOSITION IV.

Sometimes the ſpecific remedy may work, by peculiarly ſtrengthening and cheriſhing the heart, and by that means, or without it, the part affected.

THIS obſervation can ſcarce be made good, without entering into the controverſy, which, for its difficulty and importance, has perplexed divers modern phyſicians; whether there be any medicines, that have a ſympathy with the head, heart, liver, *&c.* and thereby deſerve the name of cephalick, cordial, or hepatic, *&c.* or, to ſpeak ſomewhat more clearly, whether there be any medicines, that, in a peculiar manner, do good to this or that internal part of the body. In this diſpute the affirmative part has been held, but I doubt upon ſlender grounds of reaſon, in

* *Ego ab anno* 1649. *in hunc diem per integros* 14 *annos ultra mille febricitantes ſine venæſectione, ſine purgatione, ſine ſudoriferis, ſine diureticis, ſine alterantibus, ſine corroborantibus, ſine topicis, et ſiquid præterea unico fere medicamento precipitante, Deo imprimis benedicente, curavi: non conſiderando, an febris ſit intermittens, an continuo, an tertiana, vel quartana (quæ tamen difficilius curatur quam aliæ) nec expectata coctione, nec habito reſpectu ſexus, (ne puerperis quidem exceptis) ætatis, anni, temporis, vel aliarum circumſtantiarum: et quidem paucorum dierum ſpatio, ſine reſidiva vel aliquo notabili incommodo, niſi ubi æger ipſe per incontinentiam de novo paroxyſmos provocarit.* Kergerus de Fermentatione, ſect. 3. cap. 3. p. mihi 250. " From the year of " our Lord 1649. in the ſpace of 14 years I cured above a thouſand febricitants, without bleeding, " purging, or ſweating, by the help of a ſingle precipitating remedy, without any regard to the nature " of the fever, whether it were intermitting, or continued, whether it were a tertian, or a quartan, " which is harder to cure than any other; yea, without conſidering any other circumſtance either of time, " place, ſex or age, and that in a very ſhort time, without any danger of relapſe, and without any " conſiderable trouble of the patient, if, through his own intemperance, he fell not into new fits again.

moſt of the phyſic ſchools for ſeveral ages. But in our times, many do not only main tain the negative, but deride the opinion they have forſaken: for ſome of them object, in a triumphant ſtyle, that it is ridiculous to fancy ſuch a ſympathy betwixt a dead medicine, and the parts of a living body, as that the phyſician may ſend the drug, as it were, of an errand, to find out one in the dark, among a multitude of others, and do it good offices.

But notwithſtanding this, I think it very poſſible, that a medicine may ſo far reſpect a particular part, as, though not to be beneficial to that only, yet to be friendly to that, in a particular manner or degree; and this I conceive it may be, upon one or more of the accounts, that I ſhall briefly mention.

And firſt, when I conſider that the ſtable parts of the body, as the heart, brain, liver, kidneys, *&c.* have each its particular ſtructure, wherein it differs from others, and probably the fluid parts alſo, as blood, gall, lympha, *&c.* have their diſtinct textures; it ſeems not improbable to me, that the corpuſcles of a medicine diſſolved in the ſtomach, and carried to and fro by the liquors of the body, may, according to the determinate ſhape, ſize, ſtiffneſs or flexibility, motion, *&c.* be much more fit to be detained by one part of the body, as the brain, the heart, *&c.* than by the reſt; and ſo, by lodging itſelf in its pores, or aſſociating with its fibres, may ſupply it with ſuch congruous particles, as it either does want, or in caſe it do not, may by their congruity be of advantage to it, by re-eſtabliſhing or ſtrengthening the tone of it. And by this corroboration the part may be made able to reſiſt the hoſtilities of morbific matter, which phyſicians uſually obſerve to be wont, by the more vigorous parts, to be thrown upon the weakened or diſtempered ones: as is manifeſt in perſons, that are much ſubject to the gout, in whom oftentimes peccant humours are very apt, upon ſeveral occaſions, to be thrown off by the nobler parts, if they be robuſt, upon the frequently debilitated joints; on which ſcore the gout, if it be well managed, is, not irrationally, wont to be thought conducive to long life: and on this occaſion I remember, that I formerly knew a learned phyſician, who, though a great traveller, and, as ſuch, accuſtomed to great varieties in point of diet, had ſuch a peculiar indiſpoſition in his jaw, that though he could moderately drink wines of ſeveral ſorts without inconvenience, yet the drinking even of a very little brandy, would ſoon after give him the tooth-ach, of which odd diſtemper he has ſometimes complained to me. But this upon the bye; for I muſt now proceed to illuſtrate and make probable, what I was ſaying of the poſſible fitneſs of ſome medicinal corpuſcles to aſſociate themſelves with thoſe of the parts they are to befriend, by obſerving what happens in nutrition, eſpecially in that of ſucking children; for in theſe one ſingle aliment, namely milk, does afford, beſides various excrements, ſuch as the groſſer fæces of the guts, and the more fluid ones of the bladder, the mouth, the noſe, the pores of the ſkin, *&c.* a great number of corpuſcles, that are not only detained, but aſſimilated by parts of differing ſtructures, as the brain, the heart, the bones, *&c.* ſince otherwiſe theſe parts could never be ſo plentifully nouriſhed by them, as daily to increaſe in all their dimenſions; and it is conſiderable, that ſome parts, which in babes are cartilaginous, do in proceſs of time become bony; which change ſeems not probably referrible to the bare exſiccation, produced by native heat increaſing with the perſon's age.

Secondly, the friendly corpuſcles of a ſpecific medicine may not only confirm the good eſtate of a determinate part, but, which makes moſt for our preſent purpoſe, they may very much conduce to reſtore it to a ſound condition, when it is diſtempered; and this they may do upon two or three accounts.

For, in the firſt place, thoſe friendly particles may diſpoſe the obſtructing or other morbific matter to be more eaſily and ſafely expelled; and this they may do, not

barely as they impregnate the whole maſs of blood, and ſo may be carried by it, as well to many other parts, as to that we now conſider; but as by their particular texture, motion, *&c.* they may in a peculiar manner reſpect that peculiar modification, which the peccant matter may have acquired by being produced or harboured in that determinate part. And that the diſtinct ſtructure of an affected part may much diverſify the condition of a morbific matter, I argue from this, among other things, that phyſicians are wont to teach (though I have found the obſervation rather to hold commonly than unreſervedly,) that in thoſe, that are ſubject to the ſtone, the petreſcent matter, when it is bred in the kidneys, is reddiſh or yellowiſh, but when in the bladder, white, or of a light grey; and that the ſtones, that are generated in the firſt named parts, are more friable, or at leaſt of a ſlighter texture, than thoſe, that have their original in the bladder, ſome of which are exceeding hard, eſpecially in compariſon of large ones, that I have had out of the bladder or gall of luſty animals. The aptneſs then, that the corpuſcles of the ſpecific may give the blood, or other liquor, that conveys them, to act as an appropriated menſtruum upon the peculiarly modified matter that obſtructs, or otherwiſe diſaffects the liver, for inſtance, may enable the remedy to be very helpful to that part, by preparing the moleſting matter for expulſion; but it may alſo ſuccour the ſame part in another way.

FOR in the ſecond place, it may ſo work upon the fibres and ſtable portion of the part affected, as both to enable it and excite it to free itſelf from its enemy; for it may give firmneſs and ſtrength to the fibres of the part; it may alſo contemporate, or correct the immoderate heat, coldneſs, *&c.* of it; it may mortify the acid, or other incongruous particles, that are lodged in the minute intervals of the ſtable parts, and perhaps even in the pores of the fibres; it may appeaſe its convulſions, cramps, or other inordinate motions, that hinder it from daily executing its proper functions; it may relax or widen the pores, according to the exigency of the work to be performed: and having thus, by means of its friendly corpuſcles, prepared the matter to be expelled, and diſpoſed the part to expel it, it may then alſo excite the part to do its office, by irritating the fibres, or motive organs, or ſtimulating them to diſburthen the part of the matter, that offends it; as a very ſmall doſe of cantharides is known, by this way of irritation, to be capable of making the bladder forcibly, though not ſafely, diſcharge itſelf of urine, and with that oftentimes expel the ſand and gravel, or leſſer ſtones, and the excrementitious ſlime, that moleſted it before.

AND this inſtance may be of uſe to us in anſwering that, which we formerly noted to be ſo confidently urged by the rejecters of ſpecific medicines; for here we have a medicine, though a dangerous one, whoſe corpuſcles have ſuch a peculiar reference to the bladder and urinary organs, that, though being gotten into the maſs of blood, they are carried by it indiſcriminately to other parts of the body, as well as to theſe: yet oftentimes, without manifeſtly diſaffecting the reſt, they exceedingly irritate the bladder, and determine it to the excretion of what it contains. And whereas it may be objected, that the firſt of the three ways, by which we noted, that a particular part may be ſuccoured by a ſpecific, ſeems contrary to the ſecond; the former tending to corroborate the part, and the latter to relax and irritate it: I anſwer two things; one, that ſince the part may be ſometimes in a natural, and ſometimes in a preternatural ſtate, in the former a medicine may deſerve the name of friendly or appropriated, becauſe it keeps it ſound, which is moſt properly done by ſtrengthening it; and in the latter it may merit the title of a ſpecific, becauſe it helps to reſtore it to a ſtate of ſoundneſs: and the other, that though, to effect this recovery, it is often very expedient, if not neceſſary, that the medicine procure an evacuation of ſome matter, that offends it; yet that evacuation itſelf is often much promoted and facilitated, by

ſtrength-

ſtrengthening the part ſo, as to enable it to diſburthen itſelf: and the ſame medicine may contain, and communicate to the blood, corpuſcles of ſuch differing ſhapes, ſizes, motions, &c. as may at leaſt ſucceſſively relieve the part by both theſe ways; as phyſicians obſerve, that rhubarb does, not only by its finer and laxative parts, purge the liver of choler, but by its more earthy aſtringent corpuſcles ſtrengthen the tone of that part: [what farther belongs to the illuſtration of this matter will be met with in due place.] On this occaſion, it will not be impertinent to add, that, in ſome caſes, this very corroboration of a diſtempered part may reſtore it to ſoundneſs; there being ſome diſeaſes of ſuch a nature, that they are, if I may ſo ſpeak, almoſt always in *fieri*, that is, they could not continue to ſubſiſt in the affected part, unleſs through its debility, and the conſequences of it, it were ſubject to admit from time to time freſh recruits of peccant matter to foment the malady: and in ſuch diſtempers, if the ſtructure and tone of the part be re-eſtabliſhed by the operation of the ſpecific medicine, its acquired vigour will enable it to reſiſt the ingreſs of new ſupplies of peccant matter, and turn them off into the maſs of blood, to be thence diſcharged by the common ſewers of the body: whilſt, in the mean time, nature will be able by degrees to ſubdue, diſſipate, or otherwiſe diſpoſe of, that comparatively little portion of peccant matter, that was lodged in the diſeaſed part.

We have not in this paper given any example of the peculiar reſpect of a ſpecific medicine to a determinate diſaffected part, that one would think ſo incredible, as that a heavy ſtony ſubſtance, being in no great quantity taken in at the mouth, ſhould manifeſtly contribute to the cure of a broken bone in one of the limbs, as the leg or the hands; and yet, not to urge the teſtimony of chymical writers, I remember a German phyſician, that was famous for notable cures, related wonders to me of the efficacy of that ſtone growing in his country, which from its effect they call oſteocolla, eſpecially if it be improved by a ſkilful preparation, which he communicated to me, but I had not opportunity to make trial of it. But, without preparation, the judicious and long experienced chirurgeon *Fabricius Hildanus* much commends, upon his own obſervation, a ſingle drachm of it, finely powdered, for the breeding of a callus, to ſolder together the parts of a broken bone; inſomuch that he gives a caution to uſe it but ſparingly in young and vigorous patients, leſt it breed too great a callus, of which he gives a notable inſtance: and the like caution was inculcated to me from experience by the lately mentioned German doctor, becauſe otherwiſe, he ſaid, his preparation would in ſuch perſons make the medicine generate a callus too ſoon and too great.

Proposition V.

Sometimes a ſpecific medicine may do its work, by producing in the maſs of blood ſuch a diſpoſition, as may enable nature, by correcting, expelling, or other fit ways, to ſurmount the morbific matter, or other cauſe of the diſeaſe.

He, that ſhall heedfully obſerve the practice of divers learned and ſucceſsful modern phyſicians, may diſcern, that many, if not moſt, of their preſcriptions, are founded upon a ſuppoſition, that a great part of the diſeaſes incident to man's body, and the recovery from them, depend mainly upon the vitiated conſtitution of the blood, and the reſtoring it to a ſound condition.

This advantageous change of the blood may be effected by a ſpecific ſeveral ways, (ſometimes ſeparately, and ſometimes jointly,) and particularly by thoſe, that follow.

1. That,

1. THAT, which I ſhall firſt name, is, by furniſhing the blood with ſome ſort of active corpuſcles, that it needs to ferment it, or excite an uſeful commotion or agitation in it.

I WILL not here examine, whether the maſs of blood, contained within the veſſels of a living man is capable of a fermentation, properly and ſtrictly ſo called; and therefore I employed alſo the word commotion, which will be eaſily admitted, if the other be diſliked: but in regard fermentation is a term, that hath generally obtained, I ſhall not ſcruple to make uſe of it, after what I have intimated about it.

BUT becauſe many modern phyſicians, eſpecially ſince the learned Dr. *Willis*'s notions came to be in requeſt, have looked upon fevers and agues to conſiſt in, or be produced by various fermentations of the blood; I thought fit to add to the fermentation I am about to ſpeak of, the diſtinguiſhing epithet of uſeful.

THIS premiſed, it ſeems not improbable to me, that as there is oftentimes a vitious fermentation of the blood, ſo there may be ſometimes a want of fermentation, or a certain ſluggiſhneſs, upon whoſe account either the briſk inteſtine agitation, that it ought to have as a warm fluid of ſuch a nature, as it is wont to be in ſound perſons, or a due quickneſs of circulation through the heart, is wanting; to which ſluggiſh ſtate of the blood, if it be obſtinate and laſting, ſeveral diſtempers are wont to be conſequent. Now, although there be divers medicines, ſuch as ſpices, brandy, and other ſpirituous liquors diſtilled from fermented vegetables, that are uſually, and oftentimes ſucceſsfully enough, employed to correct this dull indiſpoſition of the blood; yet in regard they are wont to be very hot, being uſually pitched upon by thoſe, that preſcribe them, becauſe they are ſo, there are ſeveral conſtitutions of patients, and divers other circumſtances, wherein they are not ſafe, but may do more harm by their immoderate heat, than good by their ſpirituoſity; beſides that the ſluggiſhneſs of the blood may ſometimes proceed from cauſes, that this ſort of hot medicines will not correct. I remember, that having, for trial's ſake, moderately dried a parcel of human blood, a vinous ſpirit totally inflammable would not, at leaſt in many hours, that my experiment laſted, make a ſolution of it, or draw a red tincture from it, though it were well pulveriſed; whereas a well rectified urinous ſpirit grew red upon it in leſs than the tenth, or perhaps the twentieth, part of that time.

Now a ſpecific medicine may abound in corpuſcles of ſuch a nature, that without dangerouſly or incommodiouſly heating the blood, they may diſable thoſe corpuſcles they meet with in the blood, that make that liquor viſcous or ropy, or diſpirited; and alſo by enlivening the maſs of blood, if I may ſo ſpeak, or putting it into a more briſk and kindly agitation, may make it fit to throw off thoſe heterogeneous parts, or recrements, that were blended with it before, and to permeate, as freely as it ought, the viſcera, whoſe capillary veſſels and pores would formerly ſcarce, and but very ſparingly, admit it.

THAT a ſpecific may perform this, you will perhaps the more eaſily allow, if you conſider, that the generality of phyſicians teach, that there are ſeveral cordials, which they ſtyle ſome of them temperate, and divers of them cold, (as in effect it is not uſually obſerved, that they conſiderably, if at all ſenſibly, heat the body) as pearls; and ſome of them, being gratefully acid, ſhould rather cool it, as wood-ſorrel (alleluja) and goat's-rue (galega.) And it is very poſſible, that the corpuſcles, that make the blood thick and ſluggiſh, may not be of a cold nature, but of a hot, and therefore may have their effects rather befriended than deſtroyed by divers hot remedies: as, if the white of an egg be, by beating, reduced to water, (which is not neceſſary to the experiment, but ſhews it better) if you put to it a certain proportion of well dephlegmed ſpirit of wine, inſtead of deſtroying the viſcoſity of the liquor, it will curdle a

good part of it, and thereby produce a body far more remote from thinneſs and fluidity.

And I remember I once, for trial ſake, made a vegetable liquor, which, from ſomewhat ſluggiſh that it was before, did preſently, by the addition of a little ſpirit of wine, grow ſurpriſingly viſcous and ropy.

2. Another way, by which a ſpecific may befriend the maſs of blood, is, by imparting to it a dilatation or tenuity, that it wants. This ſecond way is of much affinity to the firſt, but yet is not the ſame; becauſe in that, the thing mainly conſidered was the fermentation or agitation of the blood; whereas this mainly reſpects the conſiſtence of it, which is a thing of no mean importance to health. For if the blood be too thick, as oftentimes it is, it cannot paſs ſo freely and readily, as it ought, through the capillary veſſels, which thereby come to be by little and little obſtructed, and the circulation inconveniently retarded; whence it is eaſy to foreſee, that divers miſchiefs muſt in time ariſe. And on the other ſide, if the blood be too thin, eſpecially if it be over much agitated too, it is apt to make its way out of the veſſels, and produce hemorrhages, in caſe it flow out of the body, or other bad effects, that uſually attend the extravaſation of the blood; which liquor, when it is out of its proper veſſels in ſo warm a place as a living human body, is very ſubject to putrefaction, and thereby apt to produce impoſthumes and ſeveral miſchievous ſymptoms.

Now a ſpecific medicine may remedy this faulty conſiſtence of the blood, by furniſhing it with corpuſcles fitted by their figure, bulk, motion, *&c.* to diſable thoſe peccant ones, that make the blood groſs, or elſe to cut, or divide the parts of the blood itſelf, and ſo diſpoſe them to be more fluid; or elſe they may produce in it ſuch pores, as may, as it were, invite the ſubtile ætherial matter, that abounds in the atmoſphere, to inſinuate itſelf into the maſs of blood, and rarify it: and on the other ſide, when the blood is too thin, as not only ſome diſeaſes but ſome medicines, eſpecially alloes, are wont to make it; a ſpecific remedy may reduce it to a good conſiſtence, either by furniſhing it with corpuſcles apt to combine themſelves with the active ones, that did too much attenuate the blood; or by helping nature to expel thoſe over-buſy particles, by inſenſible tranſpiration, or ſome other undiſturbing way.

3. There is yet another way, by which a ſpecific remedy may conduce to rectify the ſtate of the blood, and that is, by ſo working on the heart, as to make it advantageouſly regulate the tranſmiſſion of that liquor through it.

That a ſpecific medicine may peculiarly befriend this or that particular part, and conſequently the heart, is granted by the generality of phyſicians, who are wont to reckon up many cordials, (of which yet I fear but few deſerve that name.) But ſince it is elſewhere in this paper ſhewn, that ſome medicines may particularly reſpect a determinate part of the body, and conſequently the heart; one may be allowed to ſuppoſe, that the corpuſcles of a ſpecific may either diſſolve ſome particles they meet with in the heart, by which that noble viſcus is by irritation, or otherwiſe, diſturbed in the regularity of its dilatations and contractions; or ſo corroborate the fibres, or motive organs of it, as to diſpoſe it to moderate the circulation of the blood, that paſſes through it, in the moſt advantageous way. And that the diſpoſition of the heart, even when men have no ſenſe of it in the part itſelf, may be of moment, as to health and ſickneſs, will appear credible, if we reflect on two things; one, that a living human body is not a meer aggregate of fleſh, bones, *&c.* but an exquiſitively contrived, and very ſenſible engine, whoſe parts are eaſily ſet a work by proper, though very minute agents, and may, by their action upon one another, perform far greater things, than could be expected from the bare energy of the agents, that firſt put them into motion: the ſecond, (which ſuppoſes the firſt,) that the diſpoſition of the heart being, though perhaps inſenſibly

ſenſibly, changed, it may produce a notable alteration in the motions of the blood, and its paſſage through the heart, in point of quantity, celerity, or both.

How much this change in the circulation may in many caſes conduce to ſickneſs or recovery, may partly appear by the effects of vehement or durable paſſions of the mind; as it is obſerved, that in a deep ſorrow, which does in a manner ſtraiten the paſſages of the heart, the blood being too ſparingly diſpenſed, the enlivening ſpirits are not generated plentifully enough; and (beſides other bad effects of this ſtate of the heart) the blood is ſo diſpirited, as (in theſe parts of *Europe*) to diſpoſe the body to the ſcurvy, which does either produce or irritate divers other maladies. We ſee alſo, that the paſſion of ſhame does oftentimes ſuddenly alter the motion of the blood, and make it ſwell the little veſſels, that lie under the cuticula of the face, and ſometimes other parts; as is very manifeſt in young maids, and other perſons of a delicate complexion, the white part of whoſe faces in bluſhing turns red. The like effect I have ſeen produced by a great and ſudden joy. And through grief, which is the oppoſite paſſion to it, has been uſually taken notice of, as a thing, that deads the appetite to meat; yet ſo much does depend upon a well moderated tranſmiſſion of the blood, that it has been obſerved in divers perſons, and I have known an eminent inſtance of it, that great joy has very much leſſened hunger: of which effect Mr. *Des Cartes* ingeniouſly attempts to derive the cauſe from the varied dilatation and motions of the heart. And it ſeems not abſurd to conceive, that ſuch like motions may be cauſed by the corpuſcles of a ſpecific medicine; which by affecting the fibres of the heart, after the like manner, that joy is wont to do, may produce in it ſuch friendly dilatations and contractions, as are wont to flow from the agreeable paſſions: in favour of which conjecture, I ſhall take notice, that a lady of my acquaintance has complained to me, that the ſmell of perfumed gloves is wont to make the blood fly to her face, and continue there for a great while, giving it ſuch a colour, as if ſhame, or joy had covered it with bluſhes; and the like, ſhe ſays, ſhe has obſerved in others of her ſex. But having in another tract ſpoken of the power of the paſſions of the mind to alter the ſtate of the body, by producing changes in the blood, that is tranſmitted through the heart; what has been ſaid may now ſuffice to make it credible, that a ſpecific remedy, by peculiarly befriending the heart, may contribute much to introduce, or re-eſtabliſh a healthy craſis in the blood; and this being thus rectified and invigorated itſelf, may both befriend the body in general, and conduce to the removal of ſome particular diſeaſes, by ſtrengthening, and, perhaps too, exciting the particular part, in which the peccant matter reſides, to ſubdue or expel that, which it already harbours, and reſiſt any acceſſion of more. And the blood, being itſelf well conſtituted, as well as the ſtable parts corroborated, the ſpecific medicine, that produces theſe good effects, may be ſaid to cure, though perhaps but ſlowly, divers particular diſeaſes; ſuch as thoſe, elſewhere mentioned in this paper, which, to continue, muſt be frequently ſupplied with vitious matter by the circulating blood.

PROPOSITION VI.

Sometimes a ſpecific remedy may unite its particles with thoſe of the peccant matter, and with them conſtitute a neutrum quid, *that may be eaſily proſcribed, or not neceſſary to be expelled.*

THIS I take to be one of the moſt proper and genuine ways of doing good, that belongs to a ſpecific medicine, as ſuch, becauſe in this operation an effect is produced, either without the aſſiſtance, or beyond the meer power, of the manifeſt qua-

good part of it, and thereby produce a body far more remote from thinneſs and fluidity.

And I remember I once, for trial ſake, made a vegetable liquor, which, from ſomewhat ſluggiſh that it was before, did preſently, by the addition of a little ſpirit of wine, grow ſurpriſingly viſcous and ropy.

2. Another way, by which a ſpecific may befriend the maſs of blood, is, by imparting to it a dilatation or tenuity, that it wants. This ſecond way is of much affinity to the firſt, but yet is not the ſame; becauſe in that, the thing mainly conſidered was the fermentation or agitation of the blood; whereas this mainly reſpects the conſiſtence of it, which is a thing of no mean importance to health. For if the blood be too thick, as oftentimes it is, it cannot paſs ſo freely and readily, as it ought, through the capillary veſſels, which thereby come to be by little and little obſtructed, and the circulation inconveniently retarded; whence it is eaſy to foreſee, that divers miſchiefs muſt in time ariſe. And on the other ſide, if the blood be too thin, eſpecially if it be over much agitated too, it is apt to make its way out of the veſſels, and produce hemorrhages, in caſe it flow out of the body, or other bad effects, that uſually attend the extravaſation of the blood; which liquor, when it is out of its proper veſſels in ſo warm a place as a living human body, is very ſubject to putrefaction, and thereby apt to produce impoſthumes and ſeveral miſchievous ſymptoms.

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That a ſpecific medicine may peculiarly befriend this or that particular part, and conſequently the heart, is granted by the generality of phyſicians, who are wont to reckon up many cordials, (of which yet I fear but few deſerve that name.) But ſince it is elſewhere in this paper ſhewn, that ſome medicines may particularly reſpect a determinate part of the body, and conſequently the heart; one may be allowed to ſuppoſe, that the corpuſcles of a ſpecific may either diſſolve ſome particles they meet with in the heart, by which that noble viſcus is by irritation, or otherwiſe, diſturbed in the regularity of its dilatations and contractions; or ſo corroborate the fibres, or motive organs of it, as to diſpoſe it to moderate the circulation of the blood, that paſſes through it, in the moſt advantageous way. And that the diſpoſition of the heart, even when men have no ſenſe of it in the part itſelf, may be of moment, as to health and ſickneſs, will appear credible, if we reflect on two things; one, that a living human body is not a meer aggregate of fleſh, bones, *&c.* but an exquiſitively contrived, and very ſenſible engine, whoſe parts are eaſily ſet a work by proper, though very minute agents, and may, by their action upon one another, perform far greater things, than could be expected from the bare energy of the agents, that firſt put them into motion: the ſecond, (which ſuppoſes the firſt,) that the diſpoſition of the heart being, though perhaps inſenſibly

ſenſibly, changed, it may produce a notable alteration in the motions of the blood, and its paſſage through the heart, in point of quantity, celerity, or both.

How much this change in the circulation may in many caſes conduce to ſickneſs or recovery, may partly appear by the effects of vehement or durable paſſions of the mind; as it is obſerved, that in a deep ſorrow, which does in a manner ſtraiten the paſſages of the heart, the blood being too ſparingly diſpenſed, the enlivening ſpirits are not generated plentifully enough; and (beſides other bad effects of this ſtate of the heart) the blood is ſo diſpirited, as (in theſe parts of *Europe*) to diſpoſe the body to the ſcurvy, which does either produce or irritate divers other maladies. We ſee alſo, that the paſſion of ſhame does oftentimes ſuddenly alter the motion of the blood, and make it ſwell the little veſſels, that lie under the cuticula of the face, and ſometimes other parts; as is very manifeſt in young maids, and other perſons of a delicate complexion, the white part of whoſe faces in bluſhing turns red. The like effect I have ſeen produced by a great and ſudden joy. And through grief, which is the oppoſite paſſion to it, has been uſually taken notice of, as a thing, that deads the appetite to meat; yet ſo much does depend upon a well moderated tranſmiſſion of the blood, that it has been obſerved in divers perſons, and I have known an eminent inſtance of it, that great joy has very much leſſened hunger: of which effect Mr. *Des Cartes* ingeniouſly attempts to derive the cauſe from the varied dilatation and motions of the heart. And it ſeems not abſurd to conceive, that ſuch like motions may be cauſed by the corpuſcles of a ſpecific medicine; which by affecting the fibres of the heart, after the like manner, that joy is wont to do, may produce in it ſuch friendly dilatations and contractions, as are wont to flow from the agreeable paſſions: in favour of which conjecture, I ſhall take notice, that a lady of my acquaintance has complained to me, that the ſmell of perfumed gloves is wont to make the blood fly to her face, and continue there for a great while, giving it ſuch a colour, as if ſhame, or joy had covered it with bluſhes; and the like, ſhe ſays, ſhe has obſerved in others of her ſex. But having in another tract ſpoken of the power of the paſſions of the mind to alter the ſtate of the body, by producing changes in the blood, that is tranſmitted through the heart; what has been ſaid may now ſuffice to make it credible, that a ſpecific remedy, by peculiarly befriending the heart, may contribute much to introduce, or re-eſtabliſh a healthy craſis in the blood; and this being thus rectified and invigorated itſelf, may both befriend the body in general, and conduce to the removal of ſome particular diſeaſes, by ſtrengthening, and, perhaps too, exciting the particular part, in which the peccant matter reſides, to ſubdue or expel that, which it already harbours, and reſiſt any acceſſion of more. And the blood, being itſelf well conſtituted, as well as the ſtable parts corroborated, the ſpecific medicine, that produces theſe good effects, may be ſaid to cure, though perhaps but ſlowly, divers particular diſeaſes; ſuch as thoſe, elſewhere mentioned in this paper, which, to continue, muſt be frequently ſupplied with vitious matter by the circulating blood.

PROPOSITION VI.

Sometimes a ſpecific remedy may unite its particles with thoſe of the peccant matter, and with them conſtitute a neutrum quid, *that may be eaſily proſcribed, or not neceſſary to be expelled.*

THIS I take to be one of the moſt proper and genuine ways of doing good, that belongs to a ſpecific medicine, as ſuch, becauſe in this operation an effect is produced, either without the aſſiſtance, or beyond the meer power, of the manifeſt qua-

lities (as phyſicians call them) of the remedy; and the cure or relief the patient finds is uſually attained without violence, and without tormenting or much diſordering him.

THIS way of working of a ſpecific medicine is of near affinity with one or two of thoſe formerly diſcourſed of; but yet theſe ways differ in ſome things, as may be gathered by the ſequel of § this diſcourſe. § Sometimes when a certain kind of acid has impregnated the blood, or lodged itſelf in ſome ſtable part, as the liver, ſpleen, kidneys, *&c.* the corpuſcles of a ſpecific may, without any ſenſible luctation or conflict, which uſually happens, when acids are mortified by ſapid alcalies, be ſo qualified, as both to make coalitions with the ſmall parts of the peccant acid, and with them to conſtitute little concretions, which, differing from the minute parts of the acid, either in bulk, figure, ſolidity, ſtiffneſs, motion, or in two or more of theſe; may be quite of another nature, and of a much innocenter, than the acid was before it was ſo corrected. Of this we may be furniſhed with a notable illuſtration, by what I have elſewhere taken notice of about *aqua fortis* itſelf; for as corroſive a menſtruum as that is, yet by digeſting it, and perhaps diſtilling it too, with an equal, or rather double weight of ardent ſpirit, I found the highly acid liquor would be ſo changed, as not to retain any ſenſible corroſiveneſs, and exchange its piercing ſtink and great acidity, for a not only inoffenſive but pleaſant ſcent, and a grateful and poſitively ſweetiſh taſte; which brings into my mind the practice of a preſident of the famous *London* college, who (as himſelf told me) was wont to relieve a patient of very great quality in nephritic torments, by giving her a good doſe of an inflammable ſpirit. But this upon the bye. I have elſewhere given an account of the effects of ſpirit of wine upon ſeveral other acid menſtruums, wherewith I mingled and digeſted it; by which it may appear, that it does not work upon them uniformly, as they are all of them acids, but differingly enough, according to the nature and proportion of the acid corpuſcles, with which the vinous ſpirits are brought to be aſſociated.

AND to ſhew, that this change and contemperation of the menſtruum by the ſpirit of wine is produced rather by a peculiar fitneſs of the convening corpuſcles of both, than by the contrariety or hoſtility, that the vinous ſpirit, which ſome moderns will have to be an alcali, has to the *aqua fortis*, as an acid; I ſhall add, that pure ſpirit of wine being mixed in a due proportion with highly rectified ſpirit of urine, which is reckoned by chymiſts among volatile alcalies, and of which a drop or two is ſo fiery upon the tongue, as to be ready to burn it, or to bliſter it; this vinous ſpirit, I ſay, will very much take off the cauſtic penetrancy of the urinous one, and compoſe with it a ſalt much more moderate, than the ſpirit was, and which being ſublimed, or (which is better, but harder to be done,) reduced into a liquor, affords a mixture of no little uſe in ſome fevers and other diſeaſes, as a medicine; and with a ſmall, if ſkilful, alteration, is of great uſe in divers chymical experiments, as a menſtruum.

A FEW grains of glaſs of antimony, made without addition, being taken inwardly, will vehemently both vomit and purge: but though wine, notwithſtanding its copious ſpirits, will, if it be well impregnated with the corpuſcles of this glaſs, work upwards and downwards violently enough; yet if ſpirit of vinegar, that is, of degenerated wine, be for a competent time digeſted upon this glaſs finely powdered, and, when the liquor is ſufficiently impregnated with the particles of the glaſs, be abſtracted from it, there will emerge from the antimonial and acetous corpuſcles a multitude of minute concretions, of which many grains may be given without ordinarily provoking either vomits or ſtools: which correction may hint, that it is not neceſſary that all mortifications uſefully made by medicines ſhould be of acids, ſince here we ſee, that acids themſelves

ſelves prove correctors: and perhaps it may be by ſuch kind of combinations, that ſome poiſons (for I do not think they all work one way, or peculiarly aſſault the heart) may be ſubdued. And I have ſometimes ſuſpected, that it may as probably be upon this account, as upon any, that has been offered, that a man ſtung with a ſcorpion may be cured, by cruſhing the animal, that ſtung him, upon the hurt; as is preſcribed by many phyſicians, and as an acquaintance of mine told me he tried upon himſelf (as another virtuoſo did on a ſoldier) with good ſucceſs. And when I conſider what a multitude and variety of figures may fit the corpuſcles, that are endowed with them, to make coalitions very different from both the component parts; I can ſcarce think it very improbable, that in a patient's body there may be made, between the corpuſcles of the peccant matter, and thoſe of a medicine, ſuch uſeful combinations, as may produce reſulting concretions, innocent, if not alſo beneficial.

IF I had leiſure, and thought it fit, I could eaſily add a great number of inſtances about ſuch changes of colours, odours, taſtes, and other qualities, as are produced by the coaleſcence of the ſmall parts of differing bodies, and diſcourſe of the natural conſequent of ſuch coalitions; but that having done that ſufficiently in other papers, it will be here more proper to intimate to you, that when a particle of peccant matter comes to be aſſociated with one of a ſpecific medicine, that combination may alter it for the better, not only by changing its bigneſs and figure, but alſo by increaſing, or leſſening its ſtiffneſs and ſolidity, and giving a new modification to its motion; as a little attention to the natural conſequences of the coalitions of bodies may eaſily induce you to grant.

AND I ſhall add (as it were *ex abundanti*) that the ſmall concretions, made by the union of ſome morbific with ſome medicinal corpuſcles, may not only become innocent, but ſometimes alſo beneficial; which may be illuſtrated by what happens by a further preparation to common ſublimate: for though this be a ſubſtance ſo highly corroſive and miſchievous, that a few grains of it may ſuffice to kill a man; yet by making a coaleſcence of it with leſs than its weight of quickſilver, which is a body inſipid as well as inodorous, the corroſive ſublimate will be ſo altered and tamed, as to be turned into what chymiſts call, becauſe it is freed from ſharpneſs, *Mercuriis dulcis*; which, if it be ſkilfully prepared and given, though in the quantity of many grains, is not only for the moſt part an innocent thing, but a very good medicine, and that perhaps in more caſes, than phyſicians generally know it to be good in.

THE newly mentioned account may hint to us a probable argument to ſhew, that notwithſtanding all the digeſtions and changes that a ſpecific medicine may receive in its way, it may prove a ſalutary one, when it arrives at the part it ſhould relieve. For though the corpuſcles of the medicine ſhould in their way to the part affected be conſiderably changed, yet it is poſſible, that theſe altered corpuſcles may, by that very alteration, be made medicinal; ſince they may be qualified (even by thoſe changes) when they arrive at the part affected, to combine themſelves ſtrictly with ſome corpuſcles, whether morbific or others, that they find already there; and may with them compoſe new concretions, that may acquire a new nature very friendly to the patient. Something analogical to this we may obſerve in aſparagus, which, being eaten, afford ſtore of particles, that, mixing with thoſe they meet with in the kidneys or the bladder, produce a new odour very differing, both from that of meer urine, and from that of the plant itſelf. And ſo if good turpentine be taken at the mouth, it is known, that, arriving at the kidneys and bladder, it will mingle its minute parts with thoſe it meets with there; whence will emerge corpuſcles, that will impregnate the urine with

a very differing odour from that, which belongs to either of the liquors, ſince it oftentimes has a fragrancy ſomewhat like the ſmell of violets.

BEFORE I conclude this paper, it is like it will be thought fit, that I ſhould take notice of a difficulty, that I know may be objected, if not againſt the paſt diſcourſe, yet againſt the ſufficiency of it to anſwer the deſign I propoſe to myſelf in writing it. For it may be ſaid, that whereas my arguments and explications ſuppoſe all along, that the ſpecific remedies are taken in at the mouth; it is known, that divers of the aſſertors of ſpecifics reckon among them ſome, that are not by ſwallowing taken into the body, but only outwardly applied, or perhaps do but barely touch it; as may be obſerved in amulets, rings, *&c.* On occaſion of this conſiderable difficulty I have, if I miſremember not, repreſented divers things in another tract: but however, it may be fit in this place briefly to ſay ſomewhat, by way of anſwer to it. We may then take notice, that the confidence, with which many phyſicians reject, and ſome of them deride, external ſpecifics, if I may ſo call them, ſeems to be built upon theſe two things: the one, that the medicine cannot in part, as it is certain it does not in the maſs, get into the body; and the other, that in caſe a ſpecific ſhould have ſome part of it ſubtil enough to gain admittance, that part muſt be too ſmall and inconſiderable to be able to produce in the body any ſuch notable change, as is neceſſary to the expulſion of peccant humours and the conquering of a diſeaſe.

As to the former of theſe grounds, I largely enough ſhew in another paper *, that a man's ſkin, though it ſeems an entire continued body, is really perforated with a great multitude, and perhaps a not inconſiderable variety, of little outlets and inlets, which we call pores; many of which are viſible, even in the ſkins of dead animals, by good microſcopes, and others are manifeſtly inferred from the numerous little drops, that cover all the ſkin at the firſt eruption of ſweat. And that theſe little perforations may be inlets to the finer particles of externally applied medicines, may appear probable by ſeveral phænomena, ſuch as theſe: that water will ſoak through the pores of a fine bladder, and diſſolve ſalt of tartar, or even white ſugar, contained in it: that I have prepared a certain liquor, whoſe fumes, though not agitated by heat, would quickly penetrate divers membranes of dead animals, and manifeſtly work on metalline bodies wrapt up in them: that it is a known thing, that quickſilver outwardly applied in ointments, girdles, *&c.* will get in at the pores of the ſkin, and invade the internal parts of the body, and ſtay there longer, and perhaps too operate more, than the phyſician deſired. And when once the effluvia of theſe externally applied remedies have gained admittance at the pores of the ſkin, it is not very difficult to conceive, how they may proceed further; for underneath the cuticula or ſcarf-ſkin, and cloſe to it, there are ſo great a multitude of capillary veſſels, that you can ſcarce thruſt a ſmall pin into any part, but that the point of it will meet and tear ſome of theſe little veſſels; as will appear by a ſmall drop of blood, that will be made to iſſue out at the new made hole, as ſmall as it is: to which inſtance, if it were neceſſary, I could add divers others of the multitude and ſpreading of the capillary veſſels, that lie cloſe beneath the ſkin, and for the moſt part carry blood, though ſome of them may contain other juices, and diſcharge their recrements by ſweat, or inſenſible tranſpiration, at the cutaneous outlets. Now theſe capillary veſſels, as ſmall as they are, having their cavities immediately continued with thoſe of leſs ſlender ones, and by their intervention with thoſe of the greater, which are branches of the greateſt of all; the corpuſcles of the medicine once got into the capillary veſſels may have an eaſy paſſage, by means of the liquors they contain, into theſe greater branches of the principal veins, and ſo, by virtue of the

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circulation, come to be quickly mingled with the maſs of blood, and by it may be eaſily conveyed to all the parts of the body: as it has been oftentimes obſerved, * that arſenical amulets worn upon the breaſt, did, though they ſcarce touched the ſkin, produce threatning diſtempers in the heart, and ſeveral miſchievous ſymptoms in other parts of the body. And I find it recorded in good authors, that cantharides, even when but held in the hand, nay ſometimes though but carried in one's pocket, tranſmitted their hurtful effluvia as far as the bladder, and excited great pain and other bad ſymptoms there.

As for the ſecond ground, on which ſpecific remedies are rejected, that though they could get entrance into the body, yet it would be but by their effluvia, and theſe are no way likely to prove efficacious enough to have any conſiderable effect upon an internal diſeaſe; to remove this difficulty, I ſhall briefly obſerve,

1. THAT the number of the corpuſcles, that may paſs from the outward medicine into the body, may be far greater, and therefore make them more conſiderable, than moſt men are apt to think. This may be rendered probable by the great multitudes of odorous, and conſequently ſenſible expirations, that are continually emitted for a very long time together by ambergreaſe, muſk, civet, and much more by ſkilfully made compoſitions of them. And that alſo ſubtil effluvia, even without the aſſiſtance of heat, may quickly penetrate membranes ſo plentifully, as to act on ſtable bodies contained in them, I have intimated a little above, and have experimentally made appear to divers curious men.

2. THAT the corpuſcles of a medicine may retain their nature, and not loſe their power of operating, notwithſtanding their being, as it were, ſtrained through the ſkin; as may be argued from the mercury, that we not long ſince mentioned to have been found in the form of quickſilver in the bodies of ſome men, that had been too frequently anointed with mercury, mixed up with unctuous things into an ointment; by which the patient may be as long and violently ſalivated, as if he had ſwallowed a bolus or pills with mercury.

AND ſo I have divers times obſerved, as I doubt not but others have oftner done, that a little opium, mixed up with other ingredients for plaiſters, did by outward application take off the acute pains of inward parts, though moderately remote from the plaiſter.

3. AND that the corpuſcles of a ſpecific may on divers occaſions act more powerfully, by getting in at the pores of the ſkin, than if the remedy, that afforded them, had been taken in at the mouth; becauſe if it had, the particles might be divided, or pehaps on other accounts, (as by dilution, compoſition with thoſe of the chyle, *&c.*) much altered, by the ferment or the menſtruum of the ſtomach, by their filtration through the guts, and their long and winding paſſage through them and the lymphiducts, before they arrive at the heart to be mingled with the blood: whereas the corpuſcles of the external ſpecific, preſently after they are paſt the ſkin, get into the capillary veſſels of the blood, that lie under it, and by their means are ſpeedily mixed with the circulating maſs of that liquor, and ſo eſcape the formerly mentioned alterations, that other medicines are ſubject to before they are admitted into the maſs of blood. By which it may appear, that thoſe phyſicians are much miſtaken, that think a topical medicine can at beſt relieve but the part it is applied to, becauſe its corpuſcles cannot be ſuppoſed to reach beyond that part of the body, that lies very near the medicine they iſſue from. But though this reaſoning might be excuſable enough, if not allowable, before the circulation of the blood was diſcovered; yet now it is

* See this at large proved by the learned *Diemerbroeck de Peſte, lib. 2. cap. 11. in Annot.*

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circulation, come to be quickly mingled with the maſs of blood, and by it may be eaſily conveyed to all the parts of the body: as it has been oftentimes obſerved, * that arſenical amulets worn upon the breaſt, did, though they ſcarce touched the ſkin, produce threatning diſtempers in the heart, and ſeveral miſchievous ſymptoms in other parts of the body. And I find it recorded in good authors, that cantharides, even when but held in the hand, nay ſometimes though but carried in one's pocket, tranſmitted their hurtful effluvia as far as the bladder, and excited great pain and other bad ſymptoms there.

As for the ſecond ground, on which ſpecific remedies are rejected, that though they could get entrance into the body, yet it would be but by their effluvia, and theſe are no way likely to prove efficacious enough to have any conſiderable effect upon an internal diſeaſe; to remove this difficulty, I ſhall briefly obſerve,

1. THAT the number of the corpuſcles, that may paſs from the outward medicine into the body, may be far greater, and therefore make them more conſiderable, than moſt men are apt to think. This may be rendered probable by the great multitudes of odorous, and conſequently ſenſible expirations, that are continually emitted for a very long time together by ambergreaſe, muſk, civet, and much more by ſkilfully made compoſitions of them. And that alſo ſubtil effluvia, even without the aſſiſtance of heat, may quickly penetrate membranes ſo plentifully, as to act on ſtable bodies contained in them, I have intimated a little above, and have experimentally made appear to divers curious men.

2. THAT the corpuſcles of a medicine may retain their nature, and not loſe their power of operating, notwithſtanding their being, as it were, ſtrained through the ſkin; as may be argued from the mercury, that we not long ſince mentioned to have been found in the form of quickſilver in the bodies of ſome men, that had been too frequently anointed with mercury, mixed up with unctuous things into an ointment; by which the patient may be as long and violently ſalivated, as if he had ſwallowed a bolus or pills with mercury.

AND ſo I have divers times obſerved, as I doubt not but others have oftner done, that a little opium, mixed up with other ingredients for plaiſters, did by outward application take off the acute pains of inward parts, though moderately remote from the plaiſter.

3. AND that the corpuſcles of a ſpecific may on divers occaſions act more powerfully, by getting in at the pores of the ſkin, than if the remedy, that afforded them, had been taken in at the mouth; becauſe if it had, the particles might be divided, or pehaps on other accounts, (as by dilution, compoſition with thoſe of the chyle, *&c.*) much altered, by the ferment or the menſtruum of the ſtomach, by their filtration through the guts, and their long and winding paſſage through them and the lymphiducts, before they arrive at the heart to be mingled with the blood: whereas the corpuſcles of the external ſpecific, preſently after they are paſt the ſkin, get into the capillary veſſels of the blood, that lie under it, and by their means are ſpeedily mixed with the circulating maſs of that liquor, and ſo eſcape the formerly mentioned alterations, that other medicines are ſubject to before they are admitted into the maſs of blood. By which it may appear, that thoſe phyſicians are much miſtaken, that think a topical medicine can at beſt relieve but the part it is applied to, becauſe its corpuſcles cannot be ſuppoſed to reach beyond that part of the body, that lies very near the medicine they iſſue from. But though this reaſoning might be excuſable enough, if not allowable, before the circulation of the blood was diſcovered; yet now it is

* See this at large proved by the learned *Diemerbroeck de Peſte, lib. 2. cap. 11. in Annot.*

known,

known, how great an intercourſe that liquor maintains between diſtant parts of the body, the argument is not ſeaſonable.

And on this occaſion I ſhall add an advertiſement, that I remember not I have met with in authors: which is, that bodies outwardly applied may prove ſpecifics for ſome diſeaſes or diſtempers, that one would not think them very good for by the bare knowledge of their effects when taken in at the mouth. Thus camphire ſwallowed is, in the doſe of a very few grains, a great heater of the blood, and is, in ſome countries, perhaps not altogether without reaſon, extolled by phyſicians in ſome kinds of ill conditioned fevers; but outwardly it is applied to take off thoſe redneſſes of the face, that are thought to proceed from heat of blood; and it is uſed in ointments againſt burns. So ſpirit of wine, that is ſo hot when drank, is a very good remedy to take out the fire, as they ſpeak, in burns, eſpecially if the part be early moiſtened with it. Bread, that is counted ſo moderate and well tempered an aliment, when eaten, if it be chewed and outwardly applied, hath conſiderable virtues in ſeveral external affections. And I know an ancient and experienced phyſician, that uſes to purge children, that will not eaſily be brought to ſwallow medicines, by applying ſomething to their navels, that does not offend them by colour, ſmell, or griping; and this himſelf more than once confeſſed to me is but an ordinary aliment, that moſt men, and I among others, have frequently taken unprepared, which he freely named to me, but which I have not yet had opportunity to make trial of.

That what we have been ſaying about the poſſible efficacy of external ſpecifics, may appear the leſs improbable, it will be fit to take notice of ſome obſervations, that comport very well with our doctrine. And though the inſtances to be brought will not be all of them of remedies, that deſerve the name of ſpecifics; yet beſides that ſome of them may perhaps have a title to it, they will all conduce to ſhew, that ſimples or drugs, externally applied, may have conſiderable operations againſt internal diſtempers of the body.

It were eaſy for me to mention a great many external ſpecifics out of phyſicians books; but I purpoſely forbear it, becauſe, to ſpeak freely, I ſuſpect, that moſt of thoſe remedies, though greatly extolled, have been but little examined by the deliverers of them; and it may ſuffice, for my preſent purpoſe, to alledge a few inſtances, that have been recommended to me, either by my own experience, or that of ſome friends: only there is one obſervation, that is ſo ſolemnly and expreſsly delivered by *Galen*, upon his own knowledge, and ſo well backed by other eminent phyſicians, that I ſhall let it lead the way. This memorable ſtory, that is related by *Galen*, is of a piony root, which having been worn, as an appenſum, about a boy, that had been epileptic for divers months, kept him from his diſeaſe as long as he wore it about him; but when, by an accident, he ceaſed to do ſo, the diſeaſe invaded him again, and yet, by applying the remedy again, he was the ſecond time freed from it; which *Galen* obſerving, did, for curioſity, make the root be laid aſide; but finding the fits to return, he employed it again with the former ſucceſs.

I lived in the ſame houſe with a learned and judicious perſon, that was ſubject to be paralytic, who being frequently tortured by violent cramps, was ordinarily and ſpeedily relieved by wearing or handling the tooth of a true hippopotamus, or river-horſe; and he affirmed to me, that upon leaving off the uſe of it for any conſiderable time, either out of curioſity, or to accommodate ſome friend, the fits would return with violence upon him. I remember alſo, that having myſelf been for ſome years frequently ſubject to cramps, and complaining of it to a phyſician, that had been a traveller into cold countries, he told me, that he had brought home with him ſome rings made of the true elk's hoof, from a place, where theſe animals are uſually employed,

and that with theſe he had cured many of the cramp; and there-withal preſented me one to make trial of, which I the more willingly accepted, becauſe he confeſſed to me, that divers rings, that were ſold for ſuch as his, and looked like them, were either counterfeit, or of no efficacy: and though I did not find, that if the cramp ſeized me in the calf of the leg, the ring would much relieve me, yet when the fits were but moderate, and in other parts, eſpecially the hands, I found myſelf eaſed ſo often and ſo ſoon, that I was at firſt ſurprized at it, and uſed to have the remedy laid every night by my bed-ſide, to have it ready, when occaſion ſhould require. And that, which I thought ſomewhat ſtrange, was, that ſeveral times, when the cramp ſeized my foot or my toes, the pain was quickly removed, though I applied the ring but to my finger; which made me much regret the loſs of it.

AN eminent phyſician ſpeaking to me one day of a patient of his, that was ſubject to a nocturnal *incontinentia urinæ*, that was very inconvenient, as well as ſhameful; I told him of an empirical remedy, which is mentioned in another paper, whoſe ſucceſs I neither would warrant, nor did altogether deſpair of, and which, at leaſt, ſeemed ſafe, though it ſhould not prove effectual. This was only a ſimple ſubſtance (belonging to the animal kingdom) that was to be worn in a fine ſarſenet-bag between the ſhift and the ſkin; for which, a good while after, the phyſician gave me great thanks, telling me, that he was ſurpriſed at the effect of it, and that he obſerved, that when the patient had worn it ſo long, that probably the virtue began to decay, that is, in my ſenſe, the effluvia were almoſt ſpent, the patient found need to take a freſh remedy, to continue the benefit ſhe had found by the former.

I DO not affirm or expect, that the three forenamed appenſa, nor the other remedies I am about to mention, will always ſucceed; and I think one may aſſign ſome, not improbable, reaſons, of the want of uniformity in their effects; but for my preſent argument, it ſuffices, that they do ſometimes ſucceed, ſince that is enough to ſhew it poſſible, that outward medicines may operate upon inward diſtempers.

HAVING one day given a viſit to one of the ſkilfulleſt and candideſt phyſicians of the famous college of *London*, I obſerved in his chamber a fine new-faſhioned clock; and having taken notice of it to him, as a thing I had not ſeen there before, he deſired me not to think he was rich and vain enough to purchaſe ſo dear a rarity; but that it belonged to a courtier, whom he named to me, of whoſe daughter he told me this ſtory: this young lady had a great tumor in her neck or throat, which being apprehended to be of a ſcrophulous nature, made her father fear it would oblige him to increaſe her portion more than his eſtate could conveniently bear: wherefore at length he addreſſed himſelf to my relator, who judging the caſe to be difficult, and being unwilling to torment the lady with a long courſe of phyſic, told the courtier, that if he could animate her to ſuffer a remedy he would propoſe, and would aſſiſt him to procure it, he hoped to remove this tumor, without weakening her, or putting her to pain. Soon after, all parties being agreed, and the deſired conveniency procured, the patient was brought into a room, where there was yet in bed the body of a man, that had died of a lingering diſeaſe; this man's hand the doctor took, and laid it upon his patient's tumor, keeping it there till ſhe either complained or confeſſed, that ſhe felt the coldneſs of it penetrate to the innermoſt parts of her tumor. This application was afterwards repeated more than once, whilſt the body continued without ſmelling; and by this courſe the tumor was diſpelled, and the patient ſo relieved, that her father, by way of gratitude, knowing how much the phyſician was a lover of curioſities, made him a preſent of that clock.

THE learned doctor aſcribed this odd remedy to *Helmont*, who is indeed to be thanked for having mentioned and recommended a medicine, that was unlikely to be good, beſides that it was not in uſe: but the knowledge of it ſeems to me to have been,

been, for the main, very much ancienter than our age; ſince there is mention made of one very like it by ſo ancient a phyſician as *Pliny*: though, ſince his time, till *Helmont*'s, it hath been generally forgotten or diſbelieved, ſave that one phyſician (*Franciſcus Ulmus*) who, though no ill obſerver, has not had the fortune to be famous, takes notice of a caſe very like that of our courtier's daughter, affirming, that by that one remedy, after others had been fruitleſsly employed, he knew a noble virgin to have been perfectly cured.

I WAS one ſummer, to my great ſurprize, obnoxious to frequent bleedings at the noſe; for which I ſometimes uſed one remedy, and ſometimes another, for the moſt part with good, but not ſtill with quick ſucceſs: but falling once unexpectedly into a fit, whoſe violence ſomewhat alarmed me, I reſolved to try an unuſual remedy; and having eaſily obtained of my ſiſter, in whoſe houſe this accident happened, ſome true moſs of a dead man's ſcull, which had been ſent her by a great perſon, for a preſent, out of *Ireland*, in which country I found it leſs rare and more eſteemed than elſewhere, I was going to employ it after the uſual manner, which is to put it up into the patient's noſtrils; but before I did it, I had the curioſity to try, notwithſtanding the briſkneſs of my hæmorrhagy, whether the medicine would produce its effect by being only held in my hand; and therefore covering a piece of the moſs with my fiſt, that the warmth might a little actuate the medicine, I found, to the wonder of the by-ſtanders, that the blood ſpeedily ſtopped, nor, thanks be to GOD, have I been troubled with a hæmorrhagy for ſome years from that very time. But this is far leſs ſtrange, than what was affirmed to have happened to one of the eminenteſt members of the Royal Society: this learned gentleman, who was of a very ſanguine complexion, found himſelf much affected by the uſe of the moſs of a human ſcull, [pieces of which I have ſeen ſticking to the roots of the vegetable, when it was genuine] which had ſo ſtrange an operation upon him, that ſometimes, when he was let blood, if, for curioſity's ſake, he held a quantity of this moſs in his hand, the efflux of the blood would ceaſe, till he laid it by again; which was not only ſolemnly averred to me by himſelf, but confirmed to me by his ingenious phyſician, with both whom I had a particular acquaintance, which otherwiſe I ſhould have thought ſcarce credible, unleſs imagination, a faculty very ſtrong in that gentleman, contributed to the ſtrange effect of the remedy.

THE hitherto mentioned external ſpecifics are afforded by vegetables and animals, which, being bodies of a ſlighter texture, may be ſuppoſed to have their parts more effluviable; and therefore I ſhall now add two or three examples afforded by the mineral kingdom, which conſiſting of bodies, that never were living, and which are, for the moſt part, very cloſe and compact, are generally thought to have their parts indiſpoſed to emit effluvia.

I KNEW a perſon of great learning, and, by profeſſion, a phyſician, who enjoyed a health good enough, ſave that uſually after a few hours ſleep, he waked in the night with great terrors, followed, for a long time, with ſuch violent palpitations of the heart, as were very troubleſome, and ſometimes frightful to him. To remove this diſtemper, he tried all that his art ſuggeſted to him, but without ſucceſs; whereupon he complained of it to ſeveral of his acquaintance, and mentioning it one day among a company of merchants, whereof ſome frequented very remote countries, one of them told him, he would eaſily relieve him by a remedy, that had been found efficacious, both upon himſelf and others. This he told him was, to take divers flat and ſmooth Cornelian ſtones, ſuch as they bring from the *Eaſt-Indies*, to cut rings out of; and to ſew eight or ten of them to a piece of ſcarlet or flannel, to be hung about his neck, ſo as that the ſtones may immediately touch the ſkin over-againſt the heart, and the mouth of the ſtomach. This remedy the phyſician procured, and, in no long time, found the

the great benefit of it, inſomuch that he thought he might now ſecurely leave off the uſe of theſe ſtones, which he did once or twice out of curioſity, as well as for his eaſe; but finding the diſtemper to return each time, within very few weeks after he had laid aſide his remedy, he reſolved to keep it always on, as he had long ſucceſsfully done, when he told me the ſtory; and, to convince me, preſented me with ſome of the Cornelians, that he had, for fear of wanting them, procured in greater number than he needed at once. But ſince I have not yet had occaſion to make trial of them, I ſhall not conclude, that the remedy will always ſucceed, but only (which is enough for my preſent purpoſe) that it is at leaſt poſſible, that ſuch an external remedy may be very effectual.

I AFTERWARDS thought (which I here note, to add to the probability of what I have been relating) that poſſibly thoſe, that firſt made uſe of the fore-mentioned remedy, may have had a hint from what *Galen* ſaith of the jaſper; which ſtone we obſerve to be various in point of colour, and I have ſeen in the green mixtures of red almoſt as deep, as that of Cornelians. Of this ſtone *Galen* relates, that ſome made rings, in which were graven a dragon, having beams iſſuing from him, and commended it as very friendly to the ſtomach, being applied to the mouth of it: and though he omitted (and found he ſafely might do it) the ſculpture, he yet approves the ſtones upon his own frequent experience, applying them almoſt as our merchant did; *Sane hujus* (ſays he) *ego quoque lapidis abunde feci periculum, torquem enim ex hujuſmodi lapillis confectum collo ſuſpendi, ita ut lapides os ventriculi contingerent; apparebant autem nihilominus prodeſſe; etiamſi ſculpturam non haberent, &c.* "I have made myſelf a frequent trial "of this ſtone, having carried ſeveral of thoſe little ſtones tied together about my neck "in ſuch a manner, that the ſtones did touch the mouth of my ſtomach; yet they "were beneficial, though they had nothing graven upon them, &c. Galen. *de ſimpl. Med. Fac. lib. nono. Tit. de Lapid.*

I HAVE lately mentioned the efficacy of a cramp ring upon ſome parts of the *genus nervoſum*; but ſome will perhaps think it more conſiderable, if a ſtone ring, worn on the finger, ſhall be able to work on the maſs of blood, and particularly that depraved portion of it, that nature relegates to ſuch diſtant parts, as the hemorrhoidal veins: and yet the experienced *Monardes*, having deſcribed the blood-ſtone, that is brought from *New Spain*, and repreſented it as a jaſper, not only commends it againſt hemorrhages, being applied to the bleeding part, but adds the following words, which declare, that he ſpeaks upon experience; *Vidimus nonnullos hæmorrhoidum fluxu afflictos remedium ſenſiſſe, annulos ex hoc lapide confectos in digito continue geſtando: necnon et menſtruum fluxum ſiſti.* "We have ſeen ſometimes the hemorroids cured, as likewiſe the "copious monthly iſſues, by wearing rings made of this ſtone." Nic. Monard. *Simp. Med. Hiſt. cap.* 36. *p.* 329.

I KNOW you will expect here, that I ſhould not on this occaſion petermit the *Lapis Nephriticus*; of which ſort of ſtones, though many have been found ineffectual againſt the diſeaſe, that gives them their name, and though it be ſcarce poſſible to chuſe thoſe few, that are good, without having particularly and actually tried them; yet that ſome of them are of great virtue, we have the teſtimony of the inquiſitive and judicious *Boetius*, and that other learned writer about gems, *Johannes de Laet*, whoſe praiſes are confirmed by the hiſtorical teſtimonies of *Monardes* and others. But none, that I have met, ſpeaks more home to our purpoſe than a conſiderable merchant of *Leipſick*, whoſe, rare obſervations are recorded by a man of very great reading, the learned * *Untzerus*, to whom I refer you, contenting myſelf to mention, in this place, two of the ten remarks he ſets down; the firſt, that the merchant affirmed to our author, that by wearing this ſtone for ſome days, the calculous matter was ſo powerfully proſcribed, that a multitude of ſmall grains of ſand were expelled, even at the corners of his eyes. The like effect to which he often obſerved of that remedy in divers other perſons. The Untzer. *de Nephrit. lib.* 1. *cap.* 24.

ſecond, that by wearing the ſame ſtone, his wife, who was troubled with a great catarrh, found it conſiderably cathartic, inſomuch that the firſt day ſhe was thereby purged fourteen or fifteen times, the next nine or ten times, and afterwards had her body kept very open. And he adds, that he found alſo this ſtone to operate like a purge, though not ſo ſtrongly, upon himſelf.

But enough, if not more than enough, of the virtues of periapta and appenſa, eſpecially ſince more inſtances of them may be met with in ſome other papers; and even without them, or at leaſt with them, thoſe particulars, I come from mentioning, may furniſh a ſufficient anſwer to the objection, that has occaſioned them.

The CONCLUSION.

And now, Sir, you have what the conſideration of the nature of the things I treat of ſuggeſted to me, about the principal ways, by which I conceive ſpecific medicines may cure diſeaſes, or at leaſt much leſſen them. I ſaid, the principal ways, becauſe I am far from denying, that there may be many others, that muſt not here be mentioned, leſt I ſhould too much tranſgreſs the limits, that become an epiſtle; eſpecially this being already far more prolix than I at firſt intended; though I purpoſely omitted the authorities and arguments of divers phyſicians and chymiſts, that maintain, that there are ſpecific medicines, becauſe they proceed upon principles, (ſuch as ſubſtantial forms, real qualities, ideas or chaoſſes, and the like,) which I could not fairly employ, becauſe I do not admit them. But though I forbore to lengthen my diſcourſe, by improper, and, I hope, needleſs tranſcriptions out of others: yet it is long enough to prompt me now, at the cloſe of it, to remind you of two or three things, that I declared at the beginning.

As firſt, that I did not pretend, that a ſpecific medicine, or nature by a ſpecific, does commonly effect the cure by one of the particular ways, that I propoſed, excluſively to the reſt: ſince I rather think, that oftentimes two, and ſometimes more, concur to the effect. Secondly, that I propoſed to myſelf, to explicate the ways of working of ſpecific remedies, only in general. And thirdly, that I did not aſſert, that the ways I pitched upon were the true and genuine ones, by which the medicine does act, but only propounded them, as ways, by which it may act. So that, without being dogmatical, I offer you my explications, but as poſſible, and perhaps not improbable; and that may ſuffice for the occaſion and ſcope of this letter, in which, I preſume, you remember I aimed but at ſhewing you, that the operations of ſpecific medicines are not irreconcileable to the principles of the corpuſcular philoſophy; which I hope you will, without reluctancy, grant, if, by my good fortune, the difficulties, that made you heſitate, ſeem to you to be leſſened by ſo barren an intellect as mine, diſcourſing of an abſtruſe ſubject, which belongs to a profeſſion, that I am not of. Upon which account it may be juſtly preſumed, that you, who have ſo much more ſagacity, and are ſo much more concerned, than I, in the ſubject I have been treating of; and who, being a profeſſed phyſician, have much more opportunity to diſcover the various courſes, that nature does, or may, take in curing diſeaſes, will be able to give yourſelf far more ſatisfaction, than you could hope to receive from me, who have therefore propoſed to you my conjectures very diffidently, though I am very poſitive in aſſerting myſelf to be,

SIR, your moſt, &c.

ROBERT BOYLE.

THE ADVANTAGES
Of the USE of
SIMPLE MEDICINES,
PROPOSED
By Way of INVITATION to it.

SECT. I.

To the very learned Dr. *F.*

SIR,

SINCE ſpecific medicines, to deſerve that name, muſt be very efficacious, and yet are, for the moſt part, either ſimple, or very little compounded; what has been ſaid about them in the foregoing tract, concerning ſpecifics, may afford me a not improper riſe to invite you, and thereby others of your profeſſion, on whom your authority and example may juſtly have much influence, to ſeek after and employ, more than they are wont to do, ſuch remedies, as are either ſimple, or, when there happens a neceſſity to compound, are made up of no more ingredients, than are abſolutely requiſite to anſwer the indications, and the phyſician's ſcope.

THIS ſort of ſimple, or but lightly compounded, remedies, I am induced to prefer before thoſe pompous compoſitions, wherein men ſeem to have hoped to ſurmount diſeaſes by the multitude of the ingredients, upon the following reaſons; in all which I deſire the advantages aſcribed to ſimple medicines, above others, may be underſtood, not in an abſolute and indefinite ſenſe, but, as they ſpeak, *cæteris paribus*, which I here give you notice of once for all.

AND the firſt advantage, that I ſhall mention, is, that it is much leſs difficult to foreſee the operation of a ſimple, than of a very compounded medicine; ſo that phyſicians may proceed more ſecurely in employing the former, than the latter ſort of remedies. And indeed, if I do not greatly miſtake, we often preſume too much of our own abilities, when we believe, that we know before-hand, what the qualities and effects of a mixture of many ingredients of differing natures will be; ſince many bodies, by compoſition, and the change of texture, conſequent thereupon, do receive great and unexpected alterations in their qualities. Several manifeſt inſtances of this truth may be met with in our hiſtory of colours; in divers of whoſe experiments, the colour produced upon the mixture of bodies is quite different from that of any of the ingredients; as, when a blue ſolution of copper, made in ſpirit of urine, does with ſyrup of violets, which is alſo blue, produce a fair green: and even ſince I began to write this ſection, a trial purpoſely made, has afforded me a new inſtance of the ſame import.

FOR having put together ſome tincture of iron, made with good ſpirit of vinegar, and a volatile tincture of ſulphur, (which I elſewhere ſhew how to make) from a confuſion

fuſion of theſe two very red liquors, there emerged, in a trice, a very dark and almoſt inky mixture, that retained nothing at all of redneſs.

THE like notable changes I have ſeveral times produced by mixtures, in divers other qualities of bodies than their colours, as in their odours, taſtes, *&c.* and why ſuch alterations may not be alſo effected by compoſition in ſome of the medicinal qualities of bodies, I do not yet ſee? Quickſilver itſelf, inwardly taken, does uſually cauſe, either no manifeſt evacuation, or one, that is made at the mouth; but if it be diſſolved in ſpirit of nitre, and precipitated with ſea-ſalt, this white precipitate being edulcorated, if it be warily given in a juſt doſe, doth (as far as I can yet learn) ſeldom work by ſalivation, but by ſiege. On the other ſide, glaſs of antimony (made *per ſe*) whereof a very few grains, given in ſubſtance, are wont to work violently upwards and downwards, being diſſolved in ſpirit of vinegar, (which is not eaſily and quickly done) will not uſually either vomit or purge, though the menſtruum be drawn from it, and though it be given in a larger doſe, than that of the uncompounded glaſs.

AND though, if crude antimony be fluxed with nitre and tartar, as in the ordinary way of making crocus metallorum, there is produced, as is vulgarly known, a medicine ſo emetic and cathartic, that an ounce or leſs of the wine, wherein it has been infuſed, without ſenſibly loſing its weight, is wont to work ſtrongly enough both upwards and downwards; yet I have known ſome, that would without ſcruple take ſeveral grains of crude antimony in ſubſtance, and one particularly, that continued the uſe of it long, without being vomited or purged by it. And trials purpoſely made have informed me, that if, inſtead of ſalt-petre and tartar, antimony be prepared with well dried ſea-ſalt and a little ſalt of tartar, though both theſe amount not to above half the weight of the nitre and tartar vulgarly uſed; yet the antimony well fluxed with theſe (for about an hour) is thereby ſo altered and corrected, that it affords an uſeful medicine, of which one may give from 12 or 15 grains to half a drachm, or more, in ſubſtance, without ordinarily working, either by vomit or ſiege, but uſually by ſweat, and ſometimes by urine: whence we may gather, that antimony may be either made a dangerous, or a more friendly medicine, than of itſelf it is, according to the ingredients it is aſſociated with, though theſe be in themſelves innocent, and perhaps of kin to one another. And even chymiſts, as well as other preſcribers of remedies, may be found, though leſs frequently, to add to a ſimple ſuch things, as rather deprave, than improve it: as one of their great patrons (a happy practitioner) complains, that flower of ſulphur, by being ſublimed, (as by many it is) from calcined vitriol, and one or two other things, under pretence of purifying and ſubtilizing it, does really acquire a hurtful corroſiveneſs. And, if I had here the leiſure, inſtances enough might be brought to ſhew, that chymiſts ſometimes miſtakenly produce, by their additions to a medicine, other qualities, if not alſo worſe, than they deſigned or expected.

SECT. II.

ANOTHER advantage of ſimpler medicines is, that *cæteris paribus* they are more ſafe than compounded ones, eſpecially if the patients be valetudinary perſons. It is too much the cuſtom, both of many herbariſts, and ſeveral other writers on the *Materia Medica*, to give us rather encomiums, than impartial accounts of the ſimples they treat of; enumerating and magnifying all the virtues they have, and ſometimes more than they have, without taking notice of their ill qualities, upon whoſe account nevertheleſs they may be inconvenient, if not hurtful and dangerous, to ſome conſtitutions, and in divers caſes. We know, that divers perfumes, as muſk and amber,

ber, though very grateful and refreſhing to moſt men's ſpirits, are yet very hurtful to many women, and eſpecially to thoſe, that are hyſterical. And I have known the ſmell of muſk very much diſaffect an eminent perſon, though otherwiſe of a robuſt conſtitution. I have alſo known ſeveral perſons, not all of them of the ſame ſex, very much offended by the ſmell of roſes, which yet is very moderate, as well as to moſt perſons, whether men or women, very grateful. I know a very great perſon, to whom honey, whether inwardly taken, or outwardly applied, is almoſt as hurtful as poiſon, having ſeveral times produced ſtrange and frightful ſymptoms, even when the patient knew not, that any honey had been employed, and conſequently could not be thus oddly diſtempered by the force of imagination. I think I have elſewhere taken notice of the harm, that both I and others, ſubject to diſeaſes of the eyes, have received, even by the moderate uſe of parſley.

On this occaſion I ſhall add what occurred to me long after I had dictated what I ſaid of parſley, that wormwood, though for many uſes an excellent plant, has been found by many ſo apt to diſaffect the head, and ſo unfriendly to the eyes, that I have for ſome years forborn it myſelf for fear of the head-ach, and forewarned others of it, that are ſubject to weak eyes. But I know a very learned man, whoſe elegant pen has made him deſervedly be taken notice of by many, who, though he have naturally very good eyes, found upon an obſtinate trial, that his curioſity ſeduced him to make, of the plentiful uſe of wormwood-wine and beer, that within leſs than three weeks his ſight was by degrees brought to be ſo weak, that he could not read a *Gazette* without ſpectacles; but by totally leaving off wormwood, he quickly recovered the vigour of his ſight, without the uſe of any of the helps, that his profeſſion, which is phyſic, would have plentifully ſuggeſted to him. This relation I had from himſelf, ſoon after the thing happened, on occaſion of what I told him about parſley, *&c.*

And to ſpeak more generally, I doubt not, but if men were not ſo prepoſſeſſed with the praiſes, that authors give to ſimples, that they overlook the inconveniencies they may on divers occaſions produce, we ſhould find in many medicines bad qualities, that are not yet taken notice of. And I have more than once hit but too well in the prognoſtics I made of the hurt ſome patients would receive by the uſe of applauded medicines, preſcribed them even by conſiderable and learned men, when upon their authority my warnings were neglected, and the uſe of the medicines unhappily perſiſted in. I remember I once ſaw, in the hands of a learned and curious traveller into the eaſtern parts of the world, an Arabic manuſcript about the *Materia Medica*, which made me regret the loſs of the moſt part of the little ſkill I once had in that language; for beſides that it was written in a delicate hand, and the letters in fit places curiouſly adorned with gold and azure, the method ſeemed to be more accurate, than any thing I had ſeen on that ſubject: and that, which pleaſed me not a little, was, that the author had been ſo wary, that after the columns, wherein he taught, beſides many other things, the virtues, doſes, *&c.* of every drug he treated of, he had a diſtinct column for the bad qualities of it, and the conſtitutions and diſeaſes, wherein the uſe of it may be dangerous or inconvenient. I think it therefore not unreaſonable to ſuſpect, that, where a great many ingredients are blended into one medicine, one or other of them may have other operations, beſides that deſigned by the phyſician: it may awaken ſome ſleeping ferment, and, if not produce a new diſtemper, may excite and actuate ſome other hoſtile matter, that lay quiet in the body before, and perhaps would have been little by little ſubdued by nature, if it had not been unſeaſonably rouſed and aſſiſted by ſome ingredient, that perhaps was needleſsly put into the medicine. I have had ſo many unwelcome proofs of this in myſelf, that it engages me to be the more careful to caution others againſt the like inconvenience.

SECT.

SECT III.

ANOTHER benefit accruing from the uſe of ſimpler medicines is, that thereby the patient may, without burthening his ſtomach, or nauſeating the remedy, take a larger doſe of the medicine, or of that ingredient of it, wherein the virtue chiefly reſides. For, whereas phyſicians are obliged to ſtint themſelves in the doſe of the medicine, for fear of diſguſting the patient, or oppreſſing his ſtomach; when there are many things heaped together in a moderate doſe of one compounded medicine, theſe ingredients that are either ſuperfluous, or at leaſt are leſs efficacious, muſt neceſſarily take up a conſiderable part of that determinate doſe, and conſequently leave much the leſs of the more appropriated or uſeful ingredients.

To ſay, that all the ingredients, that are thruſt into a great compoſition, are proper and conduce unto the ſame purpoſe, I doubt is not always true; and however is not a ſufficient anſwer, ſince it does not avoid the inconvenience I have been objecting.

IF a baker, being to make the beſt bread he can, eſpecially for a perſon of a weak ſtomach, ſhould, to wheaten flour add the meal of rye, of barley, and of oats; though all theſe ingredients be good and nouriſhing, and each of them is by many uſed to make bread, yet none will take him for a ſkilful baker, and few would prefer this compounded bread, to that more ſimple one made of wheat alone. And ſo to make good gunpowder, a ſkilful man would not to ſalt-petre, brimſtone, and charcoal, add wax, roſin, and camphire, though theſe be very inflammable ſubſtances as well as ſulphur. And thus if one would make an *aqua vitæ*, whereof but one ſmall cup were to be given for the quick recovery of fainting perſons, he would not with ſpirit of wine, or good brandy, mix mead or cyder, and ſtrong beer or ale, though each of theſe be itſelf a ſpirituous liquor.

GUM Arabic (whereof I prefer that, which is tranſparent and colourleſs) is preſcribed in ſeveral compoſitions, as a drug proper to mitigate the ſharpneſs of urine; but by the quantity of the other ingredients, that it is mixed and clogged with, no more than a ſmall proportion of it uſually comes to be given in one doſe: but when I have had the curioſity, leaving out all the other things, to give about a drachm, or perhaps more of it at one time, reduced by long pounding (for the beſt is very tough) to fine powder, in a large draught of beer, or ſome other convenient vehicle, I found very conſiderable effects of it. And I remember, that a gentleman of great note coming to bid me farewel, becauſe of a long and troubleſome journey he was taking to mineral waters, which he intended to drink for many weeks, to eaſe him of a very painful ſharpneſs of urine; I, that knew it was not venereal, nor from the ſtone of the bladder, (for when thoſe are cauſes of the ſtrangury, the medicine is not near ſo powerful) deſired him, before he went, to make uſe of this powder, once, or (if there ſhould be need) twice a day; which when he had done, it ſo relieved him, that he thought himſelf quite cured, and forbore his intended journey, not only that year, but the next. For the chin-cough, as they call it in children, whoſe odd ſymptoms do uſually frighten the parents and attendants, and oftentimes fruſtrate the endeavours of phyſicians ſkilful in curing other coughs, I have not known any magiſterial compoſition ſo effectual, as the ſimple juice of pulegium (by many called penny-royal) ſweetened a little with ſugar-candy, and given long enough from time to time, in the quantity of a child's ſpoonful. (This plant may be alſo made to afford a ſyrup, that will keep, and is uſeful in coughs, but which I doubt is not ſo efficacious as the ſimple juice.) There are many and obvious experiments of the great efficacy of ſo ſimple a remedy as aſſes milk, (which yet in ſome caſes, I think inferior to goat's milk,)

it be given in a ſufficient quantity, and for a competent time. There are alſo many inſtances of dangerous and ſtubborn diſeaſes, that have been cured even by common cow's milk, when it has been very plentifully taken, and for a long continuance of time: and perhaps, it is no leſs remarkable, that in a far leſs time, now and then, not extending to very many days, fluxes, as diarrhæas, and though more ſeldom, even dyſenterical ones, are happily and eaſily cured, as I have ſometimes known, by the bare uſe of ſo ſlight a remedy as milk, wherein, whilſt it is gently boiling, an equal quantity of fair water is little by little put, till at laſt there remains but as much liquor, as the milk alone amounted to at firſt. This ſimple alimentous medicine being liberally taken (for it ſhould be uſed inſtead of all other drinks, whilſt the diſeaſe continues) has been very frequently found to cure fluxes, not all of one ſort, in *Ireland* itſelf, where that kind of diſeaſe is endemical. And, though I have formerly in another paper recommended the uſe of *Paronychia foliis rutaceis*, againſt that ſad and ſtubborn diſeaſe, the king's-evil; yet I preſume you will allow me, by the mention of a trial, that was ſince made with it, to give a notable confirmation of the utility of giving an alterative ſimple, if need require, in conſiderable quantity. A phyſician, that I knew, was ſent for to a ſcrophulous patient, in whoſe throat there was a tumor, ſo big and ſo unluckily ſeated, that, much compreſſing the œſophagus, it rendered deglutition exceeding difficult; ſo that being likewiſe ſo hard and ſtubborn, that though the phyſician was alſo a famous chirurgeon, he could neither diſcuſs it, nor bring it to ſuppuration; the patient, though rich, was in imminent danger of being ſtarved. In this ſtrait the phyſician remembering the character I had given of paronychia, or whitlow graſs, ſent about the country to get all that could be procured; and at firſt gave a little of it, in form of infuſion, in ſuch liquid aliments, as the patient was able, by little and little, to get down: and having by this means, after ſome time, made the deglutition leſs difficult, he gave the remedy more and more plentifully, to imbue the whole maſs of blood and juices of the body with the virtue of the herb; whereby the tumor was at length reſolved, and the patient ſecured, ſo much to the phyſician's reputation as well as profit, that, as he ſaid, he thought gratitude obliged him to give me a circumſtantial account of his ſucceſs; as he very civilly did in a long letter, whereof I have given you the ſubſtance.

And though I might here entertain you with the virtues of ſome other ſimple remedies plentifully given, yet for brevity's ſake I ſhall rather obſerve in general, that I doubt not but ſeveral ſimple medicines (I ſpeak of alterative, not evacuating ones) would be found far more effectual, than they are commonly thought, if they were given in a much larger doſe, and continued for a competent time. And probably ſo many phyſicians (eſpecially of the old ſchool,) would not be ſo forward to reject either ſpecific or ſimple remedies, as having found ſome of them not to anſwer expectation, if they would allow them as fair a trial, as they give to their own preſcriptions; ſuch as the chalybeats of the ſhops, the Spaw, or Tunbridge waters, the decoctions of guajacum, *&c.* which they often give with divers intermediate helps for a month or ſix weeks, and ſometimes for two months together, without expecting, that in a few weeks, much leſs in a very few days, they ſhould perform the cure.

SECT. IV.

THE fourth thing, that may recommend the uſe of ſimple medicines, is, that *cæteris paribus* they are more eaſy to be procured than compounded ones. This aſſertion needs little proof. And where ſeveral ſimples are required, one or more of them

them may oftentimes be difficult to be got; and all of them will ſtill be troubleſome to be fetched, and to be made up into a compoſition. How uſeful the knowledge of parable remedies may be, I have endeavoured to ſhew in a diſtinct paper: and therefore ſhall not diſcourſe of it here, but only add this one obſervation, that ſome medicines are ſo parable, that without reſorting for them to apothecaries ſhops (which are not every where at hand, nor always furniſhed with them) we may find them in thoſe of other tradeſmen. Thus among maſons and bricklayers, we moſt commonly meet with quicklime; whoſe bare infuſion in common water [about a pound of the former, as it is more or leſs ſtrong, to about three or four quarts of the latter,] is of itſelf a good medicine in divers caſes, and, as experience has perſuaded me, may be made the baſis of ſeveral good remedies, both inward and outward; among the latter of which may be reckoned an ointment, that I uſually kept by me for burns, and made only by beating up ſtrong lime-water with as much good linſeed oil, as could be made thoroughly to incorporate with it into a very white unguent.

AND I ſhall add concerning linſeed oil, (ſince I have mentioned it) which is to be had in the ſhops of varniſhers and painters; that of itſelf, being exhibited in a large doſe, as of ſeveral ounces at a time, I have known it anſwer the commendations given it by eminent phyſicians, for breaking of pleuritical empyemas. Simple oil of turpentine alſo, that may be uſually had in the ſhops of the ſame tradeſmen, is in reality a noble remedy in divers affections, not only inward, in which chymiſts commend it, but outward too. And I have had great thanks, both from phyſicians and chyrurgeons, for recommending the uſe of it to them in wounds, and particularly, where one would expect little from it, in the ſtanching of blood, if it be ſeaſonably applied very hot to the wounded parts, where it alſo much promotes a good digeſtion. And I am confirmed in the good opinion I have long had of this oil, by the information, that is given me, that a very experienced chirurgeon has lately been ſo charitable, as to publiſh a little book, conſiderable for the uſeful obſervations it contains, of notable cures done by him in chirurgical caſes, chiefly with oil of turpentine. And I ſhall add, that a chirurgeon to a great monarch, and one of the ſkilfulleſt men I ever met with of his profeſſion, confeſſed to me, that in an admired cure, that he had then lately done of a deſperate gangrene in an eminent perſon, very aged and almoſt bed-rid, the medicine he aſcribed moſt to, was the oil we were ſpeaking of. And, becauſe both he and others make much and good uſe of ſpirit of wine in gangrenes, which yet is thought to be unmingleable with oil of turpentine, becauſe if it be ſhaken with it, it will quickly ſeparate again from it; I thought it might do practitioners ſome ſervice, to make for them a mixture of oil of turpentine, and ſpirit of wine, that might probably be more penetrant than the former, and leſs fugitive than the latter, which of itſelf does not ſtay long enough upon the parts it is applied to: which mixture I eaſily made, by digeſting for a while, and ſtrongly ſhaking from time to time, about equal parts by gueſs of good oil of turpentine and thoroughly dephlegmed ſpirit of wine, till this liquor, by imbibing or diſſolving great ſtore of the oleaginous parts, have attained a yellow colour, for which reaſon I call it the tincture of oil of turpentine.

AND ſince my ſubject has led me into the ſhops of colour-ſellers, I will, before I leave them, take notice of one ſimple, that is wont to be found there, which if it were not very offenſive to the taſte, and ſomewhat diſagreeable to the ſtomach, would be perhaps preferable for its antinephritic virtue to the moſt pompous compoſitions of the ſhops, and ſome of the celebrated arcana of the (vulgar) chymiſts. I procured it, not without ſome difficulty, from a ſpagyriſt, very well verſed in the ſchool of *Paracelſus* and *Helmont*, who though a ſparing commender of remedies, extolled this, as the beſt he had ever met with, to cure the ſtone, where it was too big to paſs, and to prevent the

increaſe

increaſe of it where it was. I have known it uſed in clyſters, with very good ſucceſs, in a fit of that diſeaſe; but inwardly I had no occaſion to try it but upon myſelf; and judging it innocent enough (as indeed I found it rather anodyne than driving) I took it now and then, mixed with oil of ſweet almonds chiefly to allay the taſte (for otherwiſe I had long found that alone inſufficient) as a preſervative from gravel. And thanks be to God, I divers times thought it more manifeſtly effectual to that purpoſe, by leſſening either the bulk of the grains, or the quantity of the ſand, or both, than any of the remedies I had taken for ſeveral years before: and yet I ſcarce took a quarter of the doſe preſcribed by the ſpagyriſt, that communicated the medicine to me; which in ſhort is (for I preſume you would gladly know it) to take from time to time, by itſelf or in ſome convenient vehicle, two or three ounces of the expreſſed oil of walnuts, which, if the great ſtaleneſs of it he requires be neceſſary, (which I mean to examine by trials) is ſcarce to be had but at the ſhops of artificers, becauſe he would have it at leaſt a year old, and judged it the elder the better.

BEFORE I quite leave the ſhops of tradeſmen, I ſhall take notice of one medicine more, that ſeems to have been firſt lodged there, and from thence tranſlated into the ſhops of apothecaries. The medicine I mean is Caſtile or elſe Venetian ſoap, (for either is often employed inſtead of the other) which being a body abounding with alcaliſite ſalts and oleaginous parts well combined, invited me to make ſome experiments with it, as a ſubſtance, that may be applicable to good uſes, not only mechanical but medical. Of ſome of the former ſort I elſewhere make mention; and as to its medicinal virtues, I take notice in another paper of its efficacy againſt the jaundice; for which I have ſince been informed, that, as nauſeous a medicine as it is, it is in great requeſt among ſome ſkilful men in *Holland*; and ſome freſh, but not ſufficient, experience has recommended it to me againſt the ſtone. But that virtue of it, which I as yet moſt prize it for, and now intend to communicate to you, you will beſt gather from the following ſtory. Having had ſome dealings with a conſiderable merchant of *Cork* in *Ireland*, he ſadly complained to me, that he was afflicted with a neceſſity of making bloody water to that degree, that he feared he muſt ſoon quit his profeſſion, being already unable to ride about his buſineſs, and ſcarce able to walk a foot the length of a ſtreet, without ſtooping to make red water. Hereupon I told him I had a medicine, that, if he could digeſt the unpleaſantneſs of it, would, I thought, by the bleſſing of God, do good even in this caſe; and it was only to ſcrape with a knife as much Caſtile ſoap into a ſpoon, as it would conveniently hold without being preſſed, *i. e.* near a dram; and having filled the vacant part with ſmall ale, or ſome other convenient drink, to facilitate the ſwallowing ſo nauſeous a remedy, waſh it down with a ſomewhat large draught of the ſame liquor, or other fit vehicle, repeating the doſe twice or thrice a day if need required. The manifeſt relief he found by this ſeemingly deſpicable medicine, within (if I miſremember not) two or three days, invited him to continue the uſe of it a while longer, and afterwards to return me ſolemn thanks for it; declaring, that now for four years together he had lived quite free from his diſtemper, without ſcrupling to ride journeys on horſeback, as his occaſions required. To which he added, that in regard I had not confined him to ſecrecy, he preſumed I intended the medicine ſhould do as much good as might be, and therefore ſcrupled not to give it to ſeveral others, who were likewiſe happily cured by the uſe of the ſame remedy. Which account was therefore the more welcome to me, becauſe in the place where I lived, I had not opportunity to make further trials of its efficacy. And on this occaſion I ſhall beg leave to advertiſe you once for all, in reference to the remedies delivered by me, either in this paper, or in my other writings; that I am as ſenſible

as another of the almoſt inſuperable difficulty of making any certain experiments in phyſick; and that having of a long time (for reaſons given in due place) ſtudiouſly, though not unreſervedly, declined the occaſions of giving (and conſequently of reiterating) medicines; I juſtly deſire, that none of my readers, and eſpecially that Dr. F. would too much rely upon them, till they have been more competently tried, than perhaps ſome of them, for want of opportunity, have been; and adminiſtered to patients of differing complexions, ages, and other circumſtances.

You may find other inſtances of the virtue of parable, and ſome of them unpromiſing medicines, in one of my eſſays *of the uſefulneſs of experimental philoſophy*; to which I the leſs ſcruple to refer you, becauſe I do not remember what I have there written many years ago ſo perfectly, as not to fear, that I might, by enlarging this ſection, put you to the trouble of reading ſome things here, that you have met with there already. And yet I am ſomewhat encouraged both to mention to you that book, and to preſent you ſome other receipts in this paper, becauſe it has pleaſed God ſo far to bleſs divers of the medicines I have there recommended, or do there mention, that they have been proſperous to many patients, and not altogether unuſeful to ſome noted phyſicians; and have procured me from both more thanks, than I pretended to, beſides inviting encouragements to further communications.

SECT. V.

THE laſt thing in order, but not in importance, that induces me to wiſh, that phyſicians would employ ſimpler medicines as much as conveniently may be is, that it is one of the likelieſt ways, (and perhaps little leſs than abſolutely neceſſary) to promote the practical knowledge of the *materia medica*. For, whilſt in one receipt a multitude of ingredients are mingled, if not confounded, it is almoſt impoſſible to know with any certainty, to which of the ſimples the good or bad effect of the remedy is to be attributed, or whether it be not produced by a power reſulting from the particular qualities of all of them, united into one temperament, and by its means acting conjointly, and, as the ſchoolmen ſpeak, *per modum unius*. So that by this way of heaping up or blending ſimples into one compounded remedy, I ſee not, how in many ages men will be able to diſcover the true qualities good and bad of the particular bodies, that are comprized under the name of the *materia medica*; whereas, when a phyſician often employs a ſimple, and obſerves the effect of it, the relief or prejudice of the patient may very probably, if not with medical certainty, be aſcribed to the good or bad qualities of that particular remedy.

And this difficulty of diſcerning, what ingredient it is of a very compounded medicine, that helps or hurts the patient, is much increaſed to thoſe, who affect to write bills, wherein ſomething is preſcribed, which, though, becauſe it goes under one name, it paſſes but for one ingredient, is yet a very compounded body; as is evident in thoſe many pompous receipts, wherein are treacle, (that alone conſiſts of above ſixty ſeveral ſimples) mithridate, and divers other famous ancient compoſitions, that each of them conſiſts of good ſtore of ingredients. I had once thoughts of drawing up a diſcourſe of the difficulties of the medicinal art, and had divers materials by me for ſuch a work, which afterwards I laid aſide, for fear it ſhould be miſemployed to the prejudice of worthy phyſicians. But among the difficulties, that occurred to me, I ſhall on this occaſion mention one; which was, that it is a harder work, than moſt men think, to diſcover fully the nature, or the good and bad qualities, in reference to phyſick, of this or that ſingle plant, or other ſimple, that has a place

a place in the *materia medica*; for beſides the great difference, that there may be in plants of the ſame denomination, according to the climate, ſoil, the goodneſs of the ſeeds, that produce it, the culture, or the want of it, the time of the year, the ſeaſonableneſs or intemperateneſs of the weather, the time and manner of gathering it, how it has been kept, the parts of it, that are, and thoſe, that are not made uſe of, together with other circumſtances too many to be here enumerated; beſides all theſe, I ſay, the unheeded textures of parts, that are thought of an uniform nature, and the length of time, during which they have been kept, without being ſuſpected to be ſuperanuated, and indeed without being ſo, may ſo much vary the Nature of a plant, that I have ſometimes, almoſt in a trice, ſhewn the curious a notable diſparity in the parts of the ſame freſh leaf of a common plant: and (NB.) I have found by trial purpoſely made, that ſome ſeeds of common uſe in phyſick (and not putrefied) will, being diſtilled at one time of the year, afford an acid ſpirit or liquor; but at another time of the year, though diſtilled the ſame way without any addition, afford not an acid, but a kind of urinous ſpirit, that contains a volatile ſalt, which in ſmell, taſte, and divers operations, I found to be of great affinity to the volatile ſalt of urine, or that of hartſhorn. And indeed ſo many things may be pertinently and uſefully propoſed to be enquired into, about this or that particular plant made uſe of by phyſicians, that perhaps they would be leſs inclined to compound numbers of them in one receipt, if they were aware, how much uſeful employment the indagation of the qualities of ſo much as a few ſingle plants would give them: and yet without the knowledge of the properties of the ſeparated ingredients a phyſician preſcribes, it will be ſcarce poſſible for him to know, with ſufficient certainty, how the compound made up of them will be qualified and operate; which reflection I the leſs ſcruple to propoſe, becauſe I am confirmed in it by *Galen* himſelf, which very book, where he largely treats *de medicamentorum compoſitione*, hath this aſſertion; *in univerſum, nemo probe uti poſſit medicamento compoſitio, qui ſimplicium vires prius non accurate didicerit.* *Galen. de Comp. Sec. Geu. lib. 1.*

I preſume you will eaſily allow, that much of what has been ſaid in favour of thoſe ſimple medicines we owe to nature's (or rather to its Author's) bounty, may be extended to many of the remedies, that are afforded us by the chymiſt's art. For without now entering into the queſtion, whether the ſpirits, oils, and ſalts, that are obtained by what ſpagyriſts call analyſes by the fire, are principles in the ſtrict ſenſe of the word; it will ſcarce be doubted, but that the ſpirit, or the oil, or the ſalt of a mixed body chymically reſolved, is ſo ſlightly or unequally compoſed, that the ingredient, whence it takes its name, is far more predominant, than it was, when combined with others in the entire or not yet analyſed concrete. And that ſuch ſuppoſed principles, or medicines of a ſimpler order, may be very efficacious remedies, may be juſtly argued from the great and beneficial effects of ſuch as oil of vitriol, ſpirit of urine, (NB.) a medicine of great uſe both inward and outward, ſpirit of hartſhorn, ſpirit of nitre, ſpirit of wine, and oil of turpentine: of which laſt named liquor I ſhall add, that, beſides the virtues already aſcribed to it in this paper, whilſt it retains its ſimplicity, it may in many caſes be employed as a menſtruum, and, by being combined with an ingredient or two, be made to afford divers medicines, which, though but little compounded, are not of little virtue; for I have found it readily enough to diſſolve camphire, maſtick, and ſome other gums, of which balſams may be made, and others may be obtained, by the help of the ſame liquor, even from divers mineral and metalline bodies. I will not inſiſt on ſo known a medicine, as the common terebinthinate balſam of ſulphur; though this be a remedy, which as much as it is peculiarly extolled for diſeaſes of the lungs, (wherein yet

its heat requires, that it be very warily given to patients of ſome complexions) has virtues, that are not confined to the diſtempers of thoſe parts; ſince both I, and ſome I commended it to, have found it very effectual (outwardly applied) in troubleſome hæmorroidal pains and tumors: and (NB.) ſome experience inclines me to think its virtues may not be much greater in pulmonick, than in paralytick diſtempers; in which (laſt) it may be uſed not only outwardly, but chiefly inwardly; and that in a pretty large doſe with a cephalick, and, in ſome caſes, an antiſcorbutick vehicle. But I ſhall rather take notice to you, that perhaps it will be found worth while to try, at leaſt in external effects, the uſe of divers tinctures, and conſequently balſams, that may be obtained by the help of oil of turpentine from divers ſolid mineral bodies, upon which I have found by trial, that this liquor may be tinged (though not of the ſame colour on all of them;) among which I ſhall name, beſides crude zink, crude antimony, and even crude copper (in filings;) a noble ſubject, antimonial cinnabar, from which, though I found I could (but not haſtily) draw a fine tincture, I had not opportunity to make trial of that promiſing medicine.

SECT. VI.

AND as for thoſe other medicines, that are not made by bare analyſis, but by ſyntheſis or compoſition; though I think an experienced chymiſt may, in many caſes, with leſs uncertainty than a Galeniſt (who employs crude ingredients of a more compounded nature) foreſee what quality the produced mixed body may have; yet I could wiſh, that even the ſpagyriſts themſelves were more ſparing, than many of them are, in the number of the ingredients they employ to compoſe one medicine: for moſt of the arguments, upon which I grounded my invitation to the uſe of ſimple remedies, are applicable to chymical ones, as well as others; and on this occaſion I ſhall repreſent two things.

FIRST, that, in many caſes, preparations ſkilfully diverſified may be uſefully ſubſtituted to compoſition; ſince one body, dexterouſly expoſed to differing operations, may acquire as various, or as conſiderable, qualities, as would accrue to it by the addition of ſuch other bodies, as an ordinary chymiſt would in probability aſſociate with it. Thus, not to mention quickſilver, antimony alone, whether prepared without addition, as when flowers of ſeveral ſorts are made of the more volatile, and true antimonial glaſs of the more fixed part, or being aſſociated but with one or two ingredients, may afford a ſkilful ſpagyriſt medicines numerous and various enough, almoſt to furniſh a ſhop; or at leaſt to anſwer the phyſician's ſcope, where he would employ an emetic, a cathartic, a diaphoretic, a deobſtruent, a diuretic, a bezoardic, or cordial medicine; to name now no other qualities, that may be found in ſome antimonial preparations in a degree conſiderable enough to ennoble them: which inſtances, and others of the like nature, I preſume you will allow me to make uſe of in this diſcourſe, becauſe, though I do commonly, yet I do not always, employ the term ſimple medicine or remedy in the ſtrict and abſolute ſenſe, but in a comparative one, that excludes compoſitions of more than two or three, or at the utmoſt a very few, ingredients.

SECONDLY, without bringing together a chaos, or ſo much as a conſiderable, number, of ingredients, one or two, or at moſt three auxiliary ones, if judiciouſly choſen and ſkilfully managed, may oftentimes produce more efficacious remedies, than the admirers of pompous proceſſes would expect, or perhaps be able to make thoſe proceſſes vie with. The violently emetic and purgative virtue of glaſs of antimon

timony made *per ſe* may be, as I elſewhere ſhew, more powerfully corrected by mere diſtilled vinegar, than by many famous ſtomachic and cordial elixirs, and other elaborate preparations; and ſometimes a ſeemingly improper addition may not only correct, but give new and unexpected virtues to a drug. Thus, though *ſublimatum corroſivum* be a mercurial concrete ſo fretting, that a very few grains of it may be able to kill a man; yet, by adding, and carefully uniting to it about an equal weight of running mercury, there is obtained, when they are well united by ſublimations, a compound, that is ſo free from being corroſive, that chymiſts call it *mercurius dulcis*; which though ſome unwary practitioners, as well Galeniſts as chymiſts, have too often, by their miſemployment of it, diſcredited, yet experience ſhews, that in ſkilful hands it may be uſefully employed, not only in ſome venereal affections, but in divers other diſtempers: and I ſhall now add, that being carefully prepared, and well given, it may not only be freed from corroſiveneſs, but much allay the ſharpneſs both of ſome emptying medicines, and of ſome peccant humours. To countenance the latter part of which obſervation, I ſhall acquaint you with one uſe of it, that perhaps you have not yet made. I remember, I had an opportunity to obſerve the efficacy of *mercurius dulcis*, in a ſtubborn dyſentery, that had baffled the remedies of an ancient phyſician. But though a reflection on the virtue I knew this medicine to have of allaying ſharp humours, and reſiſting putrefaction, may juſtly increaſe my favourable opinion of it; yet not thinking my experience competent, I imparted it to an ancient and expert chirurgeon, that was the chief of thoſe, that belonged to a famous and judicious general of an army; who thereupon frankly confeſſed to me, that this was his great arcanum, wherewith he had cured many ſcores, or rather hundreds of ſoldiers in this general's army; only, whereas my way is to give from 8, or 10, to 12, or at moſt 15 grains of *mercurius dulcis* for a doſe, made up with ſome little rhubarb, *&c.* or other ingredient, that would make it work once, twice, or thrice with another patient, (for the dyſentery itſelf helps to carry off the medicine;) he, both to diſguiſe it, and to make it more eaſily takeable, made it up with ſugar and mucilage of gum-dragon into lozenges, whereof one might contain from near a ſcruple to half a drachm of the *mercurius dulcis*, of which he ordered the ſoldiers to take one at a time, without hindering their march, only bidding them have a great care, that nothing ſhould ſtick between their teeth, or in their throats.

3. But the efficacy of this ſimple preparation of mercury is much inferior to that more ſimple, although more tedious, preparation of gold, which was made the ſame way in two differing countries, by two dexterous phyſicians, both of them of my acquaintance. For though I had long been prejudiced (not without ſpecious grounds) againſt pretended *aurum potabiles*, and other boaſted preparations of gold, (for moſt of which I have ſtill no over-great eſteem,) yet, I ſaw ſuch extraordinary and ſurprizing effects of the tincture of gold I ſpeak of, upon perſons of great note, that I was particularly acquainted with both before they fell deſperately ſick, and after their ſtrange recovery, that I could not but change my former opinion for a very favourable one of ſome preparations of gold; and I ſhould have thought, that this medicine (as little compounded as it is,) could ſcarce be paid by a great ſtore of the noble metal, that afforded it, if it could have been made in great quantity, or without a great deal of pains and time. I can ſpeak thus circumſtantially, becauſe by the kindneſs of the artiſts, and the pains I had ſpent in working on the ſame ſubject they make their menſtruum of, I ſo far knew, and partly (by themſelves invited) ſaw, the preparation of it, that (to bring home what has been ſaid to the preſent occaſion) I can tell you, that there is no ingredient aſſociated to the gold, ſave one, that comes from above, and is reputed one of the ſimpleſt bodies in nature,

and of which one may take two or three ounces altogether unprepared, without the leaſt inconvenience; and yet the doſe of this almoſt inſipid medicine, that was given to an old courtier, even in a violent apoplexy, wherein other remedies had by ſkilful men been uſed in vain, was but ſix or eight drops.

IN another very antient and corpulent perſon the doſe was greater, becauſe the tincture was more unripe and diluted; but the effect was as ſudden, though the patient was not bled, and though there was not in either of theſe two caſes any notably ſenſible evacuation made. [Both theſe recovered perſons are yet alive.] The ſame medicine awhile after ſaved the life of another gentleman I know, who, having lain above two and twenty days ſick of an ill conditioned fever, was condemned by three phyſicians, whereof one told me with great grief, that he would not out-live the next morning; and yet upon the taking of a large doſe of this tincture, he was preſently relieved, and from that time found a ſenſible amendment towards a recovery, which he now enjoys, though he were then reputed to be about, if not above, fourſcore years old. Some other odd effects of this remedy I could tell you of; but it has already much ſwelled this ſection; and yet I thought it not amiſs to relate theſe things to you, both becauſe they are very pertinent to the ſcope of it, and becauſe you may be, as I long was, prejudiced againſt medicines made of ſo fixed, and, as is ſuppoſed, unalterable a metal as gold.

4. THIS is not the only medicine made of that noble body, of which I have known very notable effects: but, becauſe they belong to another paper, I ſhall not particularly mention them in this; but paſs on to tell you, that the preparation of ſilver, that I have long ſince delivered in another book, though it may ſeem but ſlight, has been found very effectual, and much uſed by one of the eminenteſt phyſicians of this nation, to whom I recommended it, and who acknowledged to me, that he gave it to patients of very high quality, though diſguiſed, to avoid alarming thoſe, that are fearful of chymical medicines. And ſince that I gave it to a great lady, that was hydropical, and judged to be dangerouſly ill, with notable ſucceſs; and the cure has already for ſome years held good. But I confeſs to you, that I look upon copper, and its magiſtery blue vitriol, as a much nobler ſubject to make remedies of, than ſilver, and perhaps than gold itſelf. And if I were to make phyſic my profeſſion, there is no metal, which I ſhould ſo willingly beſtow pains upon, as copper, induced thereunto by the excellent and very extraordinary effects, (not all of them to be mentioned in this paper) that I have had opportunity to ſee of ſome remedies, which, though I could never learn how to make, I knew were made of that metal, or vitriol abounding in it, but firſt freed from all cruelticle violence. And for appeaſing pains, produced even by inveterate maladies, the laudanums, and other opiate preparations, that are preſcribed and praiſed in phyſicians and chymiſts books, and much uſed (oftentimes with good ſucceſs) in their practice, ſeem to me becauſe of the ſtupor, and ſome other inconvenient ſymptoms they are wont more or leſs to be followed by, far inferior to the ſulphureous parts, as a chymiſt would call them, of ſkilfully prepared Venus; theſe being much more harmleſly and friendly anodynous. And I remember, that an empirick, to whom, at his requeſt, I taught a very uncertain way (for it rarely hits) of making a kind of ſulphur of vitriol alone, in the form of a brick coloured powder, came purpoſely to give me ſolemn thanks for the reputation he had gained by that medicine, of which, the firſt time he had the good luck to make it, he gave, as he was inſtructed, four or five grains of it to a woman, that could not ſleep, but had been for divers months raving mad, [maniaca;] which ſingle doſe not only gave her a good night's reſt, but brought her to talk ſenſe, when ſhe waked in the morning. I knew alſo a chymiſt,

The uſefulneſs of experimental philoſophy.

miſt, that was much courted, even by learned doctors, for an internal anodyne he uſed, and could ſell at almoſt what rate he pleaſed, to take off inveterate pains in the heads and ſhins of venereal patients; and the ſame perſon cured venereal ulcers in a very ſhort time, only by ſtrewing on them an indolent powder: and though he was ſo ſhy, that he would not let even the phyſicians I recommended to him ſee his medicine, yet having one day been told of a kindneſs I had done him, unknown to him; he took it ſo well, that he not only allowed me to ſee and handle his medicine, but when I gueſſed, by the ponderouſneſs and effects of it, that it was ſome preparation of mercury fixt with ſulphur of Venus, he frankly acknowledged to me, that, though it would indure not only ignition, but a ſtrong and laſting fire, that in the former part of my conjecture (that the body of it was mercurial) I was in the right, and in the latter part I ſhot very near the mark; but added, that the true ſulphureous parts of Venus were in his way ſo difficult to be obtained, and required ſo much time, that he could ſeldom prevail with himſelf, (who indeed was voluptuous enough) to go through ſo troubleſome a work. And in effect I found, upon various trials, the conſtituent parts of that metal to be much more ſtrictly united, than the generality even of chymiſts imagine. For the extraordinary effects of this medicine I can refer you to the teſtimony of very ingenious men of your own profeſſion, (and probably acquaintance too.) And ſince I know you ſtudy *Helmont*, I preſume you will the more readily believe them, if I put you in mind of that notable paſſage, where he ſays: *Nihil æque victorioſe in humidum radicale agit atque primum ens cupri, vel ad vitam longam ſulphure vitrioli eſt benignius; ideoque ſulphur philoſophorum indigitat.* But my intended brevity forbids me to inſiſt longer on this metal, or to take notice of more than one other metal. And becauſe that of ſteel phyſicians as well as chymiſts make great variety of remedies, ſome of which are produced by preparations ſlight enough; and the like may be made of mercury, witneſs the remedy formerly commended againſt the worms, made of nothing but crude quickſilver barely decocted in common water: for this reaſon, I ſay, I ſhall pitch upon lead, whoſe calx diſſolved in ſpirit of vinegar affords, as you know, *Saccharum Saturni*; which, though ſo eaſy and ſimple a preparation, is a magiſtery, that has more virtues, than every phyſician knows, or perhaps ſo much as ſuſpects; eſpecially in mortifying ſharp humours in the eyes, which I have known or made it do ſometimes almoſt in a trice: but I do not think it ſafe to make the plantain or roſe-water it is to be diſſolved in, conſiderably ſtrong of it. And for burns, I have ſeldom ſeen any thing equal to it, and therefore have often uſed it upon myſelf, barely diſſolved in common, or elſe plantain water. But I fear it is not ſo ſafe as effectual in ſome inward diſtempers of the bowels, that are judged to be cauſed by acid humours, unleſs it be very warily and ſkilfully given. But as to its external uſe, I preſume I need not tell ſo ſkilful a doctor as you (NB.) how great it is in healing, and in the mean time appeaſing, the pains of divers ſorts of ulcers. And therefore, I ſhall mention but one particular, which it is like you have not met with; namely, that I know a very ancient and experienced perſon, who, beſides a vaſt practice otherwiſe, was chirurgeon to a great hoſpital; who profeſſing much kindneſs, and owning ſome obligation to me, confeſſed to me, that amongſt all the medicines he has tried to ſtop bleeding, and prevent accidents in amputations, that which he oftener uſed, and moſt relied on, is a ſolution of *Saccharum Saturni* in plantain water (or for a need in pure common water:) for having diſſolved ℥i. of the former in about a pint or pound of the latter, as ſoon as ever the limb or other part is taken off, he immediately applies ſtupes drenched in this liquor, as hot as the patient can well endure; and having bound them carefully on, he makes no haſte to take them off, but allows the medicine time enough to

perform its operation: to countenance this I would tell you an odd experiment of mine, of the efficacy of a Saturnine liquor to reſiſt putrefaction in the bodies of animals, but that the relation would take up too much time.

5. PERHAPS I need not tell you, that I could here mention divers other experiments, as well upon Saturn, as upon the other metals I have named above: but that my ſcope confines me to ſuch preparation, as wherein the metalline ſubject is compounded but with very few others; and alſo, that of thoſe, that are more remote from ſimplicity, you may meet with ſeveral in ſome of my other papers, which I am not in this to defraud.

WHAT has been above noted about metals, may be extended to minerals; namely, that when there is need to compound them, it may oftentimes be ſufficient to aſſociate them with one or two, or at moſt a very few auxiliary ingredients, if I may ſo call them. This is apparent in ſeveral uſeful preparations of antimony, that are vulgarly enough known, to which divers may be added, that are made of common ſulphur by ſlight additions. Of which ſort, becauſe I elſewhere deliver ſeveral, I ſhall now mention but one, which though I have many years ago deſcribed in the hiſtory of colours I ſhall not ſcruple to take notice of here, becauſe I there conſider not its medicinal virtues, which yet are very great, eſpecially in aſthmas and coughs, in which I do not remember, that I ever gave it without benefit to the patient; nor was it leſs ſucceſsful in the hands of phyſicians, that were willing to try it for me, eſpecially in thoſe of a perſon, who, though well furniſhed with choice remedies of his own, often came to me for a ſupply of this ſpirituous and penetrating tincture, with which he aſſured me he did notable things in aſthmatical caſes; and particularly in one, that was very obſtinate, and had laſted many years. But not having had quite ſo many opportunities, as I wiſhed, of giving it myſelf, I ſhall be glad, that further trial may be made of it by ſo ſkilful an adminiſtrator as you; and therefore, leſt you ſhould not have the book lately referred to at hand, I ſhall here repeat, that our medicine is made of flowers of ſulphur, exactly mixed with an equal weight of finely powdered ſal armoniac, and ſomewhat more than an equal weight of good quick lime, ſeparately reduced to a ſubtile powder; for theſe three ingredients being diligently and nimbly mixed, and put into a retort, to be placed in a ſand furnace, and fitted with a large receiver very well luted to it: this mixture, I ſay, being duly diſtilled in ſuch veſſels, will afford a blood-red and ſmoking ſpirit, exceeding ſulphureous both in ſmell and even mechanical operations. And in this diſtillation the ſulphureous parts ſometimes came over accompanied with ſuch ſtore of ſaline ones, that a good part of what paſt into the receiver ſhot into the form of a volatile ſulphureous ſalt. And I remember, that having, for curioſity's ſake, added to the fluid tincture a due proportion of an ardent ſpirit (ſuch as that of wine) exactly dephlegmed, I had a mixture (whether in the form of a coagucum or not) which afforded me ſome odd phænomena not here to be mentioned, and which we ſubled with a gentle fire to unite them into a compoſition, that may for diſtinction ſake be called *ſal trium regnorum*, becauſe it contains urinous particles, vinous ones, (and perhaps ſome of ſoot) and ſulphureous ones; whereof the firſt belongs to the animal, the ſecond to the vegetable, and the laſt to the mineral kingdom, as chymiſts are wont to ſpeak. But what virtues this ſalt (that would preſently gild ſilver,) and the ſpirit, that may be made to accompany it, may have in phyſic, I had not occaſion to try; but yet I have mentioned it upon the by, that you make uſe of it, if you think it worth while to do ſo; to which I ſhall here preſent you with no inducements, ſince I perceive, that the particulars abovementioned about ſimple preparations of gold and other metals have already made this ſection enormouſly great:

and

nd yet I hope you will not be diſpleaſed at it; ſince to ſo ſagacious a perſon as Dr. *F.* theſe paſſages may afford ſome not altogether uſeleſs hints; and at leaſt it is an encouragement to induſtry, to know, that the ſubjects a man works on are capable of affording excellent things.

SECT. VII.

1. I Foresee it may be objected againſt the frequent uſe of ſimple medicines, that oftentimes it happens, that a diſeaſe, or a morbific matter, is not the effect of a ſingle cauſe, but is produced by the concurrence of two, or perhaps more, cauſes; which producing ſeveral ſymptoms, it is not probable, that one ſimple drug will be able to anſwer thoſe different indications. This objection I confeſs is conſiderable, and there are caſes, wherein I acknowledge it to be ſo weighty, as to invite and warrant a phyſician to employ in them a medicine conſiſting of more ingredients than one or two; which I can admit without prejudice to my deſign, ſince I formerly declared I did not intend to perſuade you to confine yourſelf to ſimple remedies (ſo much as in the late ſenſe above intimated of that term,) but only to employ them, where they may ſuffice; and where they cannot, to make uſe of medicines, as little compounded as the caſe will permit.

2. But having premiſed this advertiſement, I preſume I may offer you two or three conſiderations, that may leſſen the force of the lately propoſed objection. And firſt, though I readily grant, that there are diſeaſes, whereof each may proceed from differing cauſes, and that a remedy may be available againſt it, when it is produced by one of thoſe cauſes, without being ſo, when it flows from another; yet, it may alſo eaſily happen, that in one caſe the diſeaſe may be cured by one ſimple medicine, and in another by a remedy not compounded: nay, it may alſo happen, that the ſame ſimple may cure a diſtemper, by which ſoever of the two cauſes it is produced. This I have in another paper endeavoured to make out. And what we ſee of the effects of the Jeſuit's powder, as they call it, in different kinds of agues, as tertians, quartans, *&c.* and of pacating medicines (moſt of which indeed owe their virtue to opium, but ſome are mineral, and have nothing of the poppy in them) in appeaſing pains produced by humours, and other cauſes very differing; may keep what has been ſaid from appearing improbable: and, if I miſtake not, it may divers times happen, that whatever it were, that at firſt produced a portion of morbific matter, that firſt produced matter is the cauſe of the continuance of the diſeaſe, by virtue of ſome peculiar texture or noxious conſtitution, which if a generous medicine can deſtroy, the diſeaſe will, at leaſt little by little, ceaſe.

3. It not unfrequently happens, that ſeveral ſymptoms, that ſeem very differing, may ſo depend upon the primary or principal cauſe of the diſeaſe, that if a medicine, how ſimple ſoever, be capable to deſtroy that cauſe, all the various ſymptoms will, by degrees at leaſt, vaniſh of themſelves; as we often ſee, that when mercury, though perhaps but crude, is ſkilfully applied, and raiſes a kindly ſalivation, a great variety of inconveniencies, that afflicted a Venereal patient, and ſeemed to require many differing and topical applications, are removed by the ſame remedy, inſomuch that not only frightful ulcers, but ſuch nodes, as one would think ſcarce poſſible to be diſſipated by the ſtrongeſt plaiſters, are ſometimes happily cured by well prepared quickſilver, taken in at the mouth, as I have been aſſured by more than one eminent phyſician upon his own experience: and though not unfrequently there be ſeveral, and ſometimes very different ſymptoms, that accompany that diſeaſe of children, that in *England* we call the rickets (and of which there die ſeveral almoſt every week in *London* alone); yet that medicine, which I have elſewhere deſcribed under the name of *Ens (primum) Veneris*

[made of ſtrongly calcined and well dulcified colcothar of Dantzic vitriol, and elevated with ſal armoniac into the form of a reddiſh ſublimate] has proved, by God's bleſſing on it, ſo ſucceſsful, that partly by a ſiſter of mine, (to whom I communicated it) and partly by myſelf, and thoſe I directed to take it, or to give it, I think I may ſafely ſay, that two or three hundred children have been cured by it, and that almoſt always without the help of any other inward medicine, or uſing any topical application at all.

4. BUT the main thing, that I intended, by way of anſwer to the foreſeen objection, was, that in a ſimple medicine nature herſelf does oftentimes ſo well play the apothecary, as to render the compoſitions made in his ſhop unneceſſary. For though we are wont to look upon this or that plant or mineral, as an entire and ſimple body, yet we may much miſtake, if we look upon it as a homogeneous one. In ſeveral plants, that are organical bodies, this truth is manifeſt; as for inſtance, in oranges the ſucculent part is ſour and cooling, but the yellow rind conſiderably bitter and hot: and ſo in lemons the pulp, the yellow part of the rind, and the ſeeds have their differing qualities and medicinal virtues. And even in ſuch vegetable ſubſtances, as are homogeneous as to ſenſe, there may be parts, whoſe operations may be not only differing, but contrary; as is manifeſt in the root we call rhubarb, which affords as well notably aſtringent, as laxative and purgative parts. And ſo in minerals themſelves, good and clean lead ore, for inſtance, though an uniform body as to ſenſe, conſiſts of very diſſimilar parts, and affords ſulphureous, and perhaps other excrements, beſides malleable lead, which is itſelf a compounded body. Thus alſo ſhining marcaſites, though they appear homogeneous, will, by barely being expoſed for a competent time to the moiſt air, afford an effloreſcence, that is perfectly vitriolate, and conſequently contains an acid ſalt, two kinds of ſulphur, a terreſtrial ſubſtance, and at leaſt one metal, (for oftentimes it holds both copper and iron, though one predominate,) which laſt named ſubſtances themſelves are neither of them ſimple bodies.

5. AND if we admit the chymical analyſis of mixts to be genuine, we ſhall find, that almoſt all thoſe, that belong to the vegetable kingdom, or to the animal, and many that are referred to the mineral kingdom, how uniform ſoever they may appear to the eye, do each of them contain ſeveral different, and ſometimes hoſtile ſubſtances. Thus hartſhorn, though it appears a dry and homogeneous ſubſtance, will in diſtillation afford a volatile ſalt, an urinous ſpirit, a wateriſh liquor, or phlegm, a ſwimming oil and a ſinking one, a white and porous earth, or *terra damnata*, and perhaps ſome, though but very little, fixt ſalt. Thus alſo in the vegetable kingdom, tartar, for inſtance, may without addition, be made to afford, as experience hath aſſured me, a volatile ſalt very like that of urine, a phlegm, an acid ſpirit, another ſpirit; to which I have elſewhere given the name of *Adiaphorous*, two fœtid oils, whereof one will ſink in water, and the other ſwim on it, an earth, or *terra damnata*, and a fixt lixivial ſalt, upon which the newly mentioned acid ſpirit manifeſts ſuch a hoſtility, that when they are put together, they tumultuate with noiſe and bubbles, and in the conflict mortify each other. And thus likewiſe in the mineral kingdom, not to repeat what I lately ſaid of the compoundedneſs of vitriol, not confidently to urge the opinion of divers eminent phyſicians, that *Mars* (as they call ſteel and iron) affords parts, whereof ſome are aſtringent, and others operative, becauſe I am not yet ſure theſe contrary qualities do not proceed from the differing degrees of fire, and other circumſtances of the preparations of the metal; we ſee, that native cinnabar affords, by diſtillation, beſides running mercury, a dry ſubſtance, whence I have obtained a ſulphur, that would preſently gild ſilver, and a terreſtrial ſubſtance, whoſe nature I had not occaſion to examine. And I the rather take notice of theſe differing parts in native cinnabar, becauſe it is a

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mineral, that I much eſteem; and though here in *England* it is very rarely, or ſcarce at all employed as an inward medicine, yet I know ſome foreign phyſicians of ſeveral nations, that look upon it, as one of their chief arcanums, and both uſe it, and conceal it, accordingly. But I do not willingly employ it, till it has been prepared, by grinding it exactly upon a porphyry, or other fit ſtone, as a painter would do to make a pigment of it, and by freeing it from certain ſalts, that often undiſcernedly adhere to it, and ſometimes may be hurtful; which is done by firſt waſhing it very carefully with boiling water, and then, after it has been thoroughly dried, by burning upon it ſeveral times, one after another, ſome vinous ſpirits perfectly dephlegmed. The doſe, if it be to be long continued, may be three, four or five grains; but when it is to be given but ſeldom, and, for an urgent caſe, it may be from ſix or ſeven to ten or twelve grains.

SECT. VIII.

1. WHAT has been ſaid in the foregoing diſcourſe, to manifeſt, that a ſimple, whether organical or not, may, notwithſtanding its intireneſs, or its ſeeming homogenity, contain or afford very diſſimilar parts, may help us to conceive, that being really a compounded body, it may afford parts differing enough to anſwer differing indications, or attain ſeveral ſcopes, that are wont to be looked on by phyſicians as neceſſary, or at leaſt very uſeful to the cure of this or that diſeaſe; as in many diarrhœas, or fluxes of the belly, whereas it is judged requiſite firſt to evacuate the peccant matter, and then to give aſtringents to hinder the immoderate evacuation, wherein the diſeaſe is thought to conſiſt; rhubarb anſwers both theſe indications, by its purgative and its more terreſtrial parts, whereof the former diſpatch their work firſt, which makes the aſtringent operation of the latter ſeaſonable and ſafe.

2. I HAVE divers times obſerved, that ſo common and deſpicable a ſimple, as ground-ivy, has performed things, whoſe variety ſeemed to argue, that it contains parts of very differing virtues, (as of opening, contemperating, healing, *&c.*) and is thereby capable of anſwering differing intentions, eſpecially in diſtempers of the lungs and breaſt; and indeed partly by the ſyrup of it, partly by the infuſion of the leaves, and partly by medicines made of them in a conſiſtent form; the happy effects of this ſimple have procured me the thanks of divers conſiderable perſons, ſome of which had before unſucceſsfully uſed many preſcriptions of learned men. And I remember I knew an ingenious perſon, who being maſter of a conſiderable manufacture, which was gainful to him, whilſt his ſervants continued tolerably well, was very much incommodated and perplexed to find them ſo obnoxious to violent cholicks, (which he imputed to the copious ſteams of the vinegar his art required) that he was forced, almoſt weekly, to allow them ſome days of ceſſation from working, to preſerve or recover themſelves; and I remember, that from this inconvenience, he was at length, as himſelf confeſſed to me, in great part freed, by making his workmen frequently uſe a ſtrong infuſion, or tincture of the leaves of our ground-ivy, made with (not pure or dephlegmed ſpirit of wine, but) good unrectified *Nantes* brandy.

I COULD here add divers other uſes, both internal and external, of this ſeeming deſpicable plant, there being ſcarce any one Engliſh herb known to me, of which, for its manifeſt virtues, the experience of others and my own have given me a greater eſteem. And I am apt to think, that the efficacy, which this and ſome other ſimples, that the fear of prolixity makes me ſilently paſs by, would be found greater and more various, than they are commonly thought, if phyſicians, in preſcribing medicines, would more often either ordain ſimple ones, or, at leaſt, aſſociate but very few together, and compenſate the ſmall number of ingredients by the greater quantity of thoſe, that

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are the moſt appropriated or operative, and by perſiſting in their uſe for a competent time.

THOUGH it is not every efficacious ſimple, or but lightly compounded remedy, that can fitly be employed about the proof of what I am now endeavouring to ſhew, yet I ſhall ſubjoin ſuch inſtances, as will, I hope, ſuffice for the preſent occaſion.

MINERAL waters, as well *acidulæ*, as the German Spa, our *Tunbridge*, *&c.* as *thermæ*, ſuch as thoſe of *Bath*, *&c.* though but natural medicines, and ſome of them but outwardly adminiſtered, are notoriouſly known in their native ſimplicity to be able, one of them ſingly, frequently to cure diſeaſes, and conſequently to take off a good number of differing ſymptoms, that afford various indications. It may help much to make it probable, that the ſame ſimple may compriſe qualities fit to anſwer differing ſcopes, and thereby cure differing ſymptoms, if it be conſidered, that there are ſeveral poiſons, that do each of them produce ſymptoms, not only very frightful, but very various, and yet all theſe have been oftentimes conquered by a ſpecific antidote, that is perhaps but a ſimple herb, or other uncompounded drug. I had once (and but once) the opportunity of making a trial, whereof I ſhall now give you a brief account, of the virtue of a ſtone taken out of the head of an enormouſly great *African* ſerpent; which ſtone was affirmed to the poſſeſſor of it, governor of the famous Engliſh *Eaſt India* company, to be highly available againſt the bitings of all venomous animals. The ſubſtance of the experiment (to give it you in ſhort) was this: I cauſed a young cat to be bitten by a fierce and highly irritated viper, which ſo inraged the cat, that, in revenge, he endeavoured to bite off her head, which he took in his mouth, and did not let go, till, as the ſpectators concluded, ſhe had bit him again, at leaſt by the tongue: ſoon after which venomous hurt, the cat's head ſwelled very much, and though he ſoon grew ſo weak, that he was not able to ſtand on his legs, but lay along on the ground, yet he ſeemed to be grown quite mad, for he foamed at the mouth, and ſnapped at the end of a wand, or ſuch like things, that were but held near him; and, which was more, in his rage bit one of his own legs, that lay not far from his mouth, much to the ſurprize of the ſpectators: but, though in this deſperate condition it ſeemed in vain to attempt any thing for his reſcue, becauſe one could make him take nothing, and every one was afraid to come near him; yet having mixed a little of the powdered ſtone with ſome ſpoonfuls of fair water, it was, by the help of the neck of a glaſs retort, that we employed inſtead of a funnel, poured, by degrees, upon the cat's mouth, which lying open, though he endeavoured to ſhake it off, yet ſome of it was concluded to have got in; and within one hour or two after, if not leſs, he did, to the no ſmall wonder of the by-ſtanders, get upon his legs again, and not only ſeemed to have loſt much of the tumidneſs of his head, but readily enough took the medicine I cauſed to be given him; and would probably have eſcaped very well, if, whilſt I was at dinner with the company, ſome unruly people had not hurt him more mortally than the viper had done.

PHYSICIANS and others have obſerved in the plague a great variety of ſymptoms, among which there are divers, whereof each, if ſingle, would paſs for a particular diſeaſe. And this diverſity of ſymptoms may be not unfrequently obſerved, not only in peſtilences that happen at times, or in countries, diſtant from one another, but in the ſame plague reigning in the ſame place: and yet it is poſſible, that a ſimple remedy may be available againſt this ſo multifarious, or manifold (if I may ſo call it) and violent a diſeaſe. Of which obſervation (to omit what might be alledged out of ſome other authors) I ſhall give one inſtance out of *Galen* himſelf, who treating at large of the *terra Samia*, takes occaſion to bring in the virtues of bolarmony *(bolus Armena)* which I ſhould gueſs, by his manner of mentioning it, to have been little, if at all, known

known to phyſicians, till his time. This earth, that appears a body ſo ſimple and uniform, he not only commends for ſeveral diſeaſes, as ſpitting of blood, fluxes of the belly, dyſenteries, catarrhs, defluxions from the head upon the breaſt, difficulty of breathing thence enſuing, and even ulcers of the lungs; but adds, what makes very much and directly for our purpoſe, in the following words: *in magna hac peſte*, (whereof he had ſpoken before) *cujus eadem facies fuit atque ejus quæ Thucydidis memoria graſſabatur, quotquot hoc bibere, celeritur curati ſunt.* The way of giving it (which I add by the bye, becauſe it may ſometime or other be of uſe) was this; *bibere*, ſays he, *conſiſtentiâ tenui modice diluto, ſi aut planè febri careat, aut leviter eâ teneatur; ſin gravius febriat, admodum aqueo.* And ſo excellent a medicine did this ſimple one prove in that terrible plague, that our author ſays, *Quibus non profuit, omnes interiere*; ſcil. *nec alio quovis medicamine, juvarentur: unde colligiter*, concludes he, *quod iis duntaxat non fuerit auxilio qui plane erant incurabiles.*

Galen. de Simpl. Med. Fac. lib. 9. Tit. de Terra Samia.

3. THERE are few diſeaſes, that put on ſo many forms, or are attended with greater variety of ſymptoms, than that, which phyſicians call *affectio hyſterica*, and whoſe paroxyſms, or effects, are vulgarly known in *England* by the name of fits of the mother. And yet we have often removed, and not ſeldom in a quarter of an hour, or leſs, hyſterical paroxyſms and ſymptoms, and ſometimes ſuch, as made the patient ſwoon, or lye along as almoſt dead, by the bare odour of well rectified ſpirit of harts-horn, or the mere pungent and powerful ſmell of a ſpirit of ſal-armoniac, which, by a peculiar way, I made very ſtrong, purpoſely for external uſes. And if I had not, out of the experienced *Monardes*, phyſician to the viceroy of the *Spaniſh Indies*, already mentioned in another treatiſe an antiſcorbutical gem, I would here add another remedy againſt the ſame diſeaſe, more conſiderably to my preſent purpoſe, ſince it is only a ſimple ſtone outwardly applied.

See *Nicol. Monard. Simpl. Med. Hiſt. c. 36. p. m.* 329.

4. BUT, becauſe I think not fit in this place, to inſiſt on a teſtimony already alledged, though its credibility, as well as that of the thing to be confirmed by it, may be much favoured by what has been related, concerning the virtues of ſtones outwardly applied, in the latter part of the diſcourſe about ſpecifics: for this reaſon, I ſay, I ſhall add a couple of other remarkable inſtances, of the efficacy of even dry and ſolid bodies, though but externally applied in diſeaſes attended with ſeveral, and divers of them uncommon ſymptoms, whereof, whatever many think of the harmleſsneſs of our Engliſh vipers, I have here known ſeveral inſtances, in men as well as brutes. And yet in theſe dangerous caſes, many, that come from *Eaſt India*, extol the efficacy of ſome of thoſe ſtony concretions, that are ſaid to be found in the heads of a certain kind of ſerpents about *Goa*, and ſome other Eaſtern countries: for though moſt phyſicians reject or queſtion the power aſcribed to theſe ſtones, for curing the bitings of vipers; and though I do not wonder at their diffidence, becauſe, in effect, many of the ſtones brought from *India* are but counterfeit, and of thoſe, that were really taken out of ſerpents, ſeveral, for a reaſon I muſt not ſtay to mention, are inſignificant, (and ſuch perhaps were thoſe, that the learned and curious *Redi* made his trials with) yet there are others, whoſe virtues are not well to be denied. For, not to build on vulgar traditions, which are but too often deceitful, one of the eminenteſt doctors of the *London* college aſſured me, that he had, with one of theſe ſtones done, though contrary to his expectation, a notable cure, which he related to me at large. And one of our chief Engliſh chirurgeons affirmed to me, that he had done the like upon another perſon; both of theſe cures being performed by the bare application of the ſtone to the place bitten by the viper or adder. And a very intelligent perſon, who had the direction of a conſiderable company of traders in *Eaſt India*, where he long lived, aſſured me, that he had

with this ſtone, cured ſeveral perſons of the hurts of venomous animals. But this teſtimony is much leſs conſiderable, as to the number of cures, than that of a great traveller into the Southern parts of the ſame *India*, who, though he was bred by a famous Carteſian philoſopher, and were forward enough to diſcredit vulgar traditions about the countries he had long lived in; yet being for thoſe reaſons aſked by me, what I might ſafely believe of the ſtones I ſpeak of, ſeriouſly affirmed to me, that he had cured above threeſcore perſons of the bitings or ſtings of ſeveral ſorts of poiſonous creatures; and that he performed moſt of thoſe cures by the outward application of one ſtone, becauſe, finding it excellent, he was invited to keep to it, eſpecially in difficult caſes. And this ſame experience of my own made with a genuine ſtone of this kind, upon the bodies of brutes, much inclines me to give credit to it. But, becauſe this ſtone is afforded by an animal, I ſhall add the virtues of another, that properly belongs to the mineral kingdom, in a diſeaſe, whoſe ſymptoms, though not ſo various, are ſometimes dangerous, and too often mortal.

To ſhew you then, that in ſpite of great cloſeneſs and hardneſs, a ſimple remedy outwardly applied may be a very effectual one, I ſhall inform you, that though the ſtone I am ſpeaking of paſt for a bloodſtone, yet by its colour, and ſome other viſible qualities, I ſhould rather have taken it for an agat. It was but about the bigneſs of a ſmall nutmeg, and had in it a perforation, by which a ſtring paſt through it, to faſten it to the part affected. This ſtone had been long kept in the family, that poſſeſſed it, when I ſaw it, being, for its rare virtues, left by one to another. But, to omit the reports, that went of it, the notable caſe, that makes it pertinent for me to mention it here, was this: An ingenious gentleman, that was a man of letters, and, when I ſaw him, was in the flower of his age, and of a complexion ſo highly ſanguine, as is not uſually to be met with, was, from time to time, ſubject to hæmorrhages at the noſe, ſo profuſe and ſo difficult to be reſtrained, that his phyſician, though a perſon famous, and very well ſkilled in his art, told me he often feared he ſhould loſe his patient, and that he would be carried away by this unbridled diſtemper. But when good method and variety of remedies had been tried, without the deſired ſucceſs, this ſtone was at length obtained from an antient kinſwoman of the gentleman's, to tie about his neck, ſo as to touch his naked ſkin. This when he did in the fits, it would ſtop the bleeding; and if he wore it for ſome conſiderable time together, he all that while continued well, as both his learned phyſician and himſelf informed me. And, becauſe I was apt to aſcribe ſomewhat of this effect to imagination, the patient told me, that, a while before, one of the chief women in the city, (whom he named to me) fell into ſo violent a bleeding, that, though it brought her into a ſwoon, yet that itſelf, which is ſomewhat ſtrange, did not hinder her to bleed on, till the ſtone, having been tied about her neck, made her ceaſe to do ſo, though ſhe knew nothing of its having been applied to her. And this itſelf is leſs ſtrange, than what the gentleman affirmed to me of the power of this gem, as it may deſervedly be called: for his complexion inclining him, as was above intimated, to breed great ſtore of blood, his doctor thought fit to order him, for prevention, to breath a vein from time to time; which when he was about to do, he was obliged to lay aſide the ſtone for a while, becauſe, whilſt he kept it on, the blood would not iſſue out, at leaſt, with the requiſite freedom.

But how far have I already paſt beyond the deſigned limits of this little tract! wherein I at firſt intended but to lay before you the five chief advantages, I had obſerved mere ſimple remedies to have of very compounded ones; and briefly to propoſe the main grounds, on which I aſcribed thoſe advantages to ſuch remedies. But though the better to keep this writing from being prolix, I deſigned, that it

ſhould conſiſt of ſuch particulars, as I could beſt ſpare from other papers; and though, for that reaſon, I have purpoſely omitted many parable, and other but little compounded or elaborate medicines; yet I now perceive, that ſo many new particulars having offered themſelves, on ſeveral occaſions, whilſt I was writing, my pen has ſlipt into the mention of many more receipts, and hiſtorical paſſages, than were at firſt intended: but believing the ſubject to be very uſeful, and not deſpairing but that the things delivered on it may not be altogether uſeleſs, I dare hope you will pardon ſuch faults, as only my deſire of making the parts of this ſmall writing rather ſerviceable, than methodical, or well proportioned, drew me unawares into. But whatever were the cauſe of my prolixity, the bulk, which I ſee this paper has already ſwelled to, admoniſhes me, that I ought to put a ſpeedy period to it, without ſpending time ſolicitouſly to declare in what ſenſe I commend the medicines delivered in this invitation. For by recalling to mind what I have formerly wrote (in a treatiſe you have been pleaſed to peruſe*) about the limitations, with which I would have the praiſes I give of ſome remedies underſtood, and the cautions, with which I would have them adminiſtered; you will eaſily be perſuaded, that looking upon them but as fit tools in a ſkilful workman's hands, I do not pretend, that any of them ſhould do the offices both of phyſic and phyſician too; and that I propoſe not the medicines mentioned in this ſhort paper, as ſure ſpecifics, but as inſtances, that there are remedies, which, notwithſtanding their being but ſimple ones, may be very good ones.

I am, S I R,

Your moſt, &c.

R. B.

* See the Appendix to the firſt ſection of the ſecond part of the *Uſefulneſs of Experimental Philoſophy.* p. 389. 390. and of the ſecond edition.

OF THE

HIGH VENERATION MAN'S INTELLECT owes to GOD,

PECULIARLY FOR

His WISDOM and POWER.

ADVERTISEMENT.

THE abrupt beginning of the following paper will not (it is hoped) be wondered at, when it is declared, that the whole excurſion is to be looked upon as a fragment of a diſcourſe, from which, for certain reaſons, it has been ſeparated in its preſent form; in which it ought to paſs but for a rough draught, the nobleneſs, ſublimity, and ſacredneſs of the ſubject, not allowing the author to preſume, that the firſt thoughts he committed to paper about it, might be for good and all parted with by him, till he ſhall have heedfully reviſed and corrected them, and left in them as few faults, as the diſproportion of ſo vaſt and ſublime a ſubject to his ſlender abilities will permit. The looſe ſheets this paper conſiſt of having been written at ſomewhat diſtant times and places, and haſtily tacked together, ſo that when the latter ſheets were penning the former were often not at hand; it is hoped, that if ſome few things ſhould chance to be either miſplaced or repeated, the fault will be thought venial, and be more eaſily excuſed, than it could in the author's circumſtances be avoided. And laſtly, notice is to be given, that thoſe other long paſſages, that are included in * parentheſes, may, with the author's conſent (or rather by his deſire) be ſkipped over, being but conjectural thoughts, written and inſerted for the ſake of a virtuoſo, that is a great friend to ſuch kind of adventurous ſpeculations.

* Such figures as theſe [ ]

Of the High Veneration MAN'S INTELLECT owes to GOD.

1. UPON this occaſion I ſhall take leave to declare, that it is not without ſome indignation, as well as wonder, that I ſee many men, and ſome of them divines too, who little conſidering what God is, and what themſelves are, preſume to talk of him and his attributes as freely and as unpremeditately, as if they were talking of a geometrical figure, or a mechanical engine: ſo that even the leſs preſumptuous diſcourſe, as if the nature and perfections of that unparalled Being were objects, that their intellects can graſp: and ſcruple not to dogmatize about thoſe abſtruſe ſubjects, as freely as about other things, that are confeſſedly within the reach of human reaſon, or perhaps are to be found among the more familiar objects of ſenſe.

2. THE preſumption and inconſiderateneſs of theſe men might be manifeſt by divers conſiderations, if I had leiſure to inſiſt on them; but at preſent I ſhall employ but theſe

theſe two: firſt, that it is probable, that God may have divers attributes, and conſequently perfections, that are, as yet, unknown to us: and ſecondly, that of thoſe attributes, that we have already ſome knowledge of, there are effects and properties, whoſe ſublimity or abſtruſeneſs ſurpaſſing our comprehenſion, makes the divine cauſe, or author of them, deſerve our higheſt wonder and veneration

3. To begin with the firſt of theſe: whereas there are two chief ways to arrive at the knowledge of God's attributes; the contemplation of his works, and the ſtudy of his word; I think it may be doubted, whether either or both of theſe will ſuffice to acquaint us with all his perfections.

4. For, firſt, though philoſophers have rationally deduced the power, wiſdom and goodneſs of God, from thoſe impreſſes of them, that he hath ſtamped upon divers of his viſible works; yet ſince the divine attributes, which the creatures point at, are thoſe, whereof themſelves have ſome, though but imperfect, participation, or reſemblance; and ſince the fœcundity (if I may ſo ſpeak) of the divine nature is ſuch, that its excellencies may be participated or repreſented in I know not how many ways; how can we be ſure, that ſo perfect and exuberant a Being may not have excellencies, that it hath not expreſſed or adumberated in the viſible world, or any parts of it, that are known to us?

5. This will be the more eaſily granted, if we conſider, that there are ſome of thoſe divine attributes we do know, which, being relative to the creatures, could ſcarce, if at all, be diſcovered by ſuch imperfect intellects as ours, ſave by the conſideration of ſome things actually done by God. As ſuppoſing, that juſt before the foundations of the viſible world were laid, the angels were not more knowing than men now are; they could ſcarce think, that there was in God a power of creating matter, (which few, if any at all of *Peripateticks*, *Epicureans*, to omit others of the antient philoſophers, ſeem ever to have dreamed of) and of producing in it local motion; eſpecially conſidering the puzzling difficulties, that attend the conception of the very nature and being of the one and of the other: and much leſs (as far as we can conjecture) could the angels ſpoken of have known, how the rational ſoul and human body act upon one another. Whence it ſeems probable, that if God have made other worlds, or other vortices, than that which we live in, and are ſurrounded by, (as who can aſſure us that he hath not? he may have diſplayed in ſome of the creatures, that compoſe them, divers attributes, that we have not diſcovered by the help of theſe works of his, that we are acquainted with. But of this more hereafter.

6. I readily grant, (that I may proceed now to the ſecond help to acquire the knowledge of the divine attributes) that the revelations God hath vouchſafed us in the holy ſcriptures (which we owe to that ſpirit, which *ſearcheth all things*, *even* τὰ Βάθη τοῦ Θεοῦ, *the depths of God*) have clearly taught us divers things, concerning their adorable Author, which the mere light of nature either would not have ſhewn us at all, or would have but dimly diſcovered to us. But the ſcripture tells us indeed, that the promulgators of the goſpel declared to men *the whole counſel of God* (as far as was neceſſary for their ſalvation) but never ſays, that they diſcloſed to them *the whole nature of God*, who is ſaid *to inhabit an unapproachable light*, which human ſpeculations cannot penetrate. Upon which ſcore perhaps it was, that the Jews would have the proper name of God to be ineffable, to ſignify, that his nature is incomprehenſible. And, though I will not adopt their opinion, yet I cannot but take notice, that it is, at leaſt, no mere Talmudical tradition, ſince we find not, that either our Saviour himſelf, or his apoſtles (who are introduced ſo frequently making mention of God in the new teſtament) expreſſed in ſpeaking either to him, or of him, the *nomen tetragrammaton* (or four-lettered name!) But not to inſiſt on conjectures; the ſcripture itſelf, that brings ſo much light

1 Cor. ii. 10.

Acts xx. 27.

1 Tim. vi. 16.

1 Cor. xiii. 12. Job. xi. 7. Rom. xi. 33.

to things divine, that the goſpel is called *light*, in the abſtract; the ſcripture, I ſay, informs us, that in this life *we know but in part, and ſee things but darkly, as in a glaſs*, and we are ſo far from being able *to find out God to perfection*, as to his nature and attributes, that even the *ways* of his providence are to us *untraceable*.

7. THESE are ſome of the conſiderations, that inclined me to think, that God may have attributes, that are not known to us. And this opinion perhaps will appear the more allowable, becauſe of what I am going to add in anſwer to a weighty objection: for I know it may be alledged, that beſides the two ways I have mentioned of attaining to the knowledge of God's attributes, there may be a third way preferable to both the others, and that is, by conſidering the idea of a Being ſupremely or infinitely perfect; in which idea it may be alledged, that all poſſible perfections are contained; ſo that no new one can be added to it. But though I readily grant, that this idea is the moſt genuine, that I am able to frame of the Deity, yet there may be divers attributes, which, though they are indeed in a general way contained in this idea, are not in particular diſcovered to us by it. It is true, that, when by any means whatſoever, any divine perfection comes to our knowledge, we may well conclude, that it is in a ſenſe compriſed in the comprehenſive notion we have of a Being abſolutely perfect; but it is poſſible, that that perfection would never have come to our knowledge by the bare contemplation of that general idea, but was ſuggeſted by particularities; ſo that ſuch diſcoveries are not ſo much derived from, as referred to, the notion we are ſpeaking of.

THE paſt conſiderations have, I preſume, perſuaded you, that God may have, as divers attributes, ſo divers excellencies and perfections, that are not known to us. It will therefore now be ſeaſonable to endeavour to ſhew you, that of divers of the attributes, we know that he hath, we men have but an imperfect knowledge, eſpecially in compariſon of what he has of them; which is not to be wondered at, ſince he poſſeſſes them in a manner or a degree peculiar to himſelf, and far tranſcending that, wherein we men poſſeſs them, or rather ſome faint reſemblances of them.

IT would be very unſuitable to my intended brevity, and more diſproportionate to my ſmall abilities, to attempt the making this good, by inſiſting particularly on all the divine excellencies, that we are in ſome meaſure acquainted with. I therefore hope it may ſuffice to inſtance in a couple of the moſt known ones; God's power and his wiſdom. Which two I pitch upon, as being thoſe that men are wont to look on as the principal, and for which they have the greateſt admiration and reſpect, becauſe we are not able to confer them on ourſelves, as we think we can divers other virtues and perfections. For every man eaſily believes, that he may be as chaſte, as temperate, as juſt, and, in a word, as good, as he pleaſes, thoſe virtues depending on his own will; but he is ſenſible, that he cannot be as knowing, as wiſe, and as powerful, as he would; and thence he not irrationally concludes, that power and wiſdom flow from, and argue, an excellency and ſuperiority of nature or condition. The power and wiſdom of God diſplay themſelves by what he does in reference both to his corporeal and his incorporeal creatures.

AMONG the manifold effects of the divine power, my intended brevity will allow me to mention only two or three, which, though to diſcerning eyes they be very manifeſt, are not wont to be very attentively reflected on: the immenſe quantity of corporeal ſubſtance, that the divine power provided for the framing of the univerſe; and the great force of the local motion, that was imparted to it, and is regulated in it.

AND firſt; the vaſtneſs of that huge maſs of matter, that the corporeal world conſiſts of, cannot but appear ſtupendous to thoſe, that ſkilfully contemplate it. That part of the univerſe, which has been already diſcovered by human eyes, aſſiſted with dioptrical

optrical glaſſes, is almoſt unconceivably vaſt; as will be eaſily granted, if we aſſent to what the beſt aſtronomers, as well modern as antient, ſcruple not to deliver. The fixt ſtars of the firſt magnitude, that to vulgar eyes look but like ſhining ſpangles, are by artiſts affirmed to exceed, each of them, above a hundred times in bigneſs the whole globe of the earth: and as little as theſe twinkling ſtars appear to our naked eyes, they do (which probably you will think ſtrange) appear much leſſer through our teleſcopes, which, taking off thoſe falſe lights, that make them look to our maimed ſight as they are wont to be painted, ſhew them little otherwiſe, than as ſpecks or phyſical points of light. And the ſun, which is granted to be ſome millions of miles nearer to us than the other fixt ſtars are, though it ſeems at this leſſer diſtance not to be half a foot broad, is by the generality of mathematicians believed to be above a hundred and threeſcore times bigger than the earth; nay, according to the more recent calculations of ſome more accurate modern artiſts, it is eſtimated to be eight or ten thouſand times as big as the terraqueous globe, and by farther obſervation may perhaps be found yet much vaſter. And it plainly appears by the parallaxes and other proofs, that this globe of earth and water, that we inhabit, and often call the world, though it be divided into ſo many great empires, and kingdoms, and ſeas, and though, according to the received opinion, it be 5400 German leagues in circuit, and conſequently contain 10,882,080,000 cubic miles in ſolid meaſure, and according to the more modern obſervations have a greater circumference (amounting to above 26,000 miles;) yet this globe, I ſay, is ſo far from being, for its bulk, a conſiderable part of the univerſe, that without much hyperbole we may ſay, that it is in compariſon thereof but a phyſical point: nay, thoſe far greater globes of the ſun and other fixt ſtars, and all the ſolid maſſes of the world to boot, if they were reduced into one, would perhaps bear a leſs proportion to the fluid part of the univerſe, than a nut to the ocean. Which brings into my mind the ſentence of an excellent modern aſtronomer, that the ſtars of the ſky, if they were crouded into one body, and placed where the earth is, would, if that globe were placed at a fit diſtance, appear to us no bigger, than a ſtar of the firſt magnitude does. And after all this I muſt remind you, that I have been hitherto ſpeaking but of that part of the corporeal univerſe, that has been already ſeen by us: and therefore, I muſt add, that as vaſt as this is, yet all that the eye, even when powerfully promoted by proſpective tubes, hath diſcovered to us, is far from repreſenting the world of ſo great an extent, as I doubt not but more perfect teleſcopes hereafter will do. And even then the viſible part of the world will be far enough from reaching to the bounds of the univerſe; to which the Carteſians and ſome other modern philoſophers will not allow men to ſet any; holding the corporeal world to be (as they love to ſpeak) indefinite, and beyond any bounds aſſignable by us men.

FROM the vaſt extent of the univerſe, I now proceed to conſider the ſtupendous quantity of local motion, that the divine power has given the parts of it, and continuually maintains in it. Of this we may make ſome eſtimate by conſidering, with what velocity ſome of the greater bodies themſelves are moved; and how great a part of the remaining bodies of the univerſe is alſo, though in a ſomewhat differing way, indowed with motion.

As for the firſt of theſe; the leaſt velocity, that I ſhall mention, is that, which is afforded by the Copernican hypotheſis; ſince, according to that, it is the earth that moves from Weſt to Eaſt about its own axis, (for its other motions concern not this diſcourſe) in four and twenty hours. And yet this terraqueous globe, which we think ſo great, that we commonly call it the world, and which, as was lately noted, by the recenter computations of mathematicians is concluded to contain ſix or ſeven and twenty thouſand miles in circuit; ſome part of this globe, I ſay, moves at ſuch a rate, that the learned *Gaſſendus* confeſſes, that a point or place, ſituated in the æquator of the earth,

earth, does in a ſecond minute move about two hundred toiſes or fathoms; that is, twelve hundred feet; ſo that a bullet, when ſhot out of a cannon, ſcarce flies with ſo great a celerity.

9. BUT, as I was ſaying, the motion of the earth is the leaſt ſwift, that I had to mention; being indeed ſcarce comparable to the velocity of the fixt ſtars, if, with the generality of aſtronomers, we ſuppoſe them to move in four and twenty hours about the earth. For ſuppoſing the diſtance aſſigned by the famous *Tycho* (a more accurate obſerver than his predeceſſors) between us and the firmament to be fourteen thouſand ſemi-diameters of the earth, a fixt ſtar in the æquator does, as *Mullerius* calculates it, move 3,153,333 miles in an hour, and conſequently in a minute of an hour, fifty two thouſand five hundred fifty-five miles, and in a ſecond (which is reckoned to be near about a ſingle pulſation or ſtroke of the artery of a healthy man) 875 miles; which is about, if not above, three thouſand times faſter, than a cannon bullet moves in the air. It is true, that according to the Ptolomean hypotheſis, a fixt ſtar in the equinoctial doth in a ſecond move at moſt but three ſemi-diameters of the earth: but according to the learned and diligent *Ricciolus*, this velocity (of our fixt ſtars) is fifty times greater than in the Ptolomean hypotheſis, and threeſcore and ten times greater than in the Tychonian hypotheſis; for according to *Ricciolus*, ſuch a fixt ſtar as we ſpeak of, moves in a ſecond minute (or one beating of the pulſe) 157282 German leagues, which amount to ſix hundred twenty-nine thouſand one hundred twenty-eight Engliſh miles.

See Ricciol. Al. mag. nov. *Lib.* ix. *Sect.* iv. *Cap.* vi.

AND now I ſhall add (what poſſibly you have not obſerved) that that portion of the univerſe, which commonly paſſes for *quieſcent*, and yet has motion put into it, is ſo great, that, for aught I know, the quantity of motion diſtributed among theſe ſeemingly quieſcent bodies, may equal, if not exceed, the quantity of motion, the firſt mover has communicated to the fixt ſtars themſelves, though we ſuppoſe them whirled about the earth with that ſtupendous ſwiftneſs, that the Ptolemeans and Tychonians attribute to them. For I reckon, that the fixt ſtars and planets, or, if you pleaſe, all the mundane globes, whether lucid or opacous, of which laſt ſort is the earth, do all of them together bear but a ſmall proportion to the interſtellar part of the univerſe. And though I ſhould allow all theſe globes to be ſolid, notwithſtanding that it can ſcarce be proved of any of them; and the Carteſians think the ſun (which they take to be a fixt ſtar, and therefore probably of the ſame nature with the reſt) to be extremely fluid: though I ſhould, I ſay, grant this, yet it muſt be confeſſed, that each of theſe ſolid globes ſwims in an ambient fluid of very much greater extent, than itſelf is: ſo that the fluid portion of the univerſe will in bulk almoſt incomparably exceed the ſolid. And if we conſider, what is the nature of a fluid body, as ſuch, we ſhall find, that it conſiſts in having its minute parts perpetually and variouſly moved, ſome this way and ſome that way; ſo that though the whole body of a liquor ſeems to be at reſt, yet the minute parts, that compoſe that liquor, are in a reſtleſs motion, continually ſhifting places amongſt themſelves, as has been amply ſhewn in a late tract, intituled, the *hiſtory of fluidity and firmneſs*.

10. AND becauſe the quantity of motion ſhared by the corpuſcles, that compoſe fluid bodies, is not uſually reflected on even by philoſophers, it will not be here amiſs to add, that how great and vehement a motion the parts of fluid bodies (perhaps when the aggregates of thoſe particles appear quieſcent) may be endowed with, we may be aſſiſted to gueſs, by obſerving them, when their ordinary motions happen to be diſturbed, or to be extraordinarily excited by fit conjectures of circumſtances. This may be obſerved in the ſtrange force and effects of boiſterous winds and whirlwinds, which yet are but ſtreams and whirlpools of the inviſible air, whoſe ſingly inſenſible parts are by

by accidental cauſes determined to have their motion made either in a ſtraight or almoſt ſtraight line, or, as it were, about a common centre: but an inſtance, much more conſpicuous, may be afforded by a mine charged with gunpowder, where the flame, or ſome ſubtile æthereal ſubſtance, that is always at hand in the air, though both one and the other of them be a fluid body, and the powder perhaps be kindled but by one ſpark of fire, exerts a motion ſo rapid and furious, as in a trice is able to toſs up into the air whole houſes and thick walls, together with the firm ſoil, or perchance ſolid rocks, they were built upon.

11. BUT ſince the velocity of theſe diſcharged flames may be gueſſed at by that, which the flame of gunpowder impreſſes on a bullet ſhot out of a well charged gun, which the diligent *Merſennus*, who made ſeveral trials to meaſure it, defines to be about 75 toiſes, or fathoms (that is, 450 foot) in a ſecond, being the 60th part of a minute; if we admit the probable opinion of the Carteſians, that the earth and divers other mundane globes, as the planets, are turned about their own axes by the motion of the reſpective æthereal vortices or whirlpools, in which they ſwim, we ſhall eaſily grant, that the motion of the celeſtial matter, that moves, for inſtance, upon the remote confines of the earth's vortex, is by a vaſt exceſs more rapid, than that of the ſurface of the earth: and yet we formerly obſerved, that a place ſituated under the æquator does (if the earth turns about its own axis) move as ſwiftly as a bullet ſhot out of a cannon. But if we chuſe rather the Tychonian hypotheſis, which makes the firmament, with all the vaſt globes of light that adorn it, to move about their common centre in 24 hours, the motions of the celeſtial matter muſt be allowed a far greater, and indeed a ſcarce imaginable rapidity.

THESE things are mentioned, that we may have the more enlarged conceptions of the power as well as wiſdom of the great creator, who has both put ſo wonderful a quantity of motion into the univerſal matter and maintains it therein, and is able, not only to ſet bounds to the raging ſea, and effectually ſay to it, hitherto ſhalt thou come, and no farther, and here ſhall thy proud waves be ſtay'd, but, (what is far more) ſo to curb and moderate thoſe ſtupendouſly rapid motions of the mundane globes and intercurrent fluids, that neither the unwieldineſs of their bulk, nor celerity of their motions, have made them exorbitate or fly out, and this for many ages; during which no watch for a few hours has gone ſo regularly; the ſun, for inſtance, moving, without ſwerving, under the ſame circular line, that is called the ecliptick. And if the firmament itſelf, whoſe motion in the vulgar hypotheſis is by much the moſt rapid in the world, do fail of exactly completing its revolution in 24 hours, that retardation is ſo regulated, that ſince *Hipparchus*'s time, who lived 2000 years ago, the firſt ſtar in Aries, which was then near the beginning of it, is not yet come to the laſt degree of that ſign.

12. AFTER what hath been diſcourſed of the power of God, it remains, that I ſay ſomething about his wiſdom; that being the attribute, to which thoſe, that have elevated underſtandings, are wont to pay the higheſt veneration, when they meet it even in men, where yet it is ſtill but very imperfect.

THE wiſdom of God which ſaint *Paul* ſomewhere juſtly ſtiles πολυποίκιλος manifold or multifarious, is expreſſed in two differing manners or degrees. For ſometimes it is ſo manifeſtly diſplayed in familiar objects, that even ſuperficial and almoſt careleſs ſpectators may take notice of it. But there are many other things, wherein the treaſures of wiſdom and knowledge may be ſaid to be hid; lying ſo deep, that they require an intelligent and attentive conſiderer to diſcover them. But though I think I may be allowed to make this diſtinction, yet I ſhall not ſolicitouſly confine myſelf

Eph. iii. 10.

Col. ii. 3.

myſelf to it; becauſe in ſeveral things both theſe expreſſions of the divine wiſdom may be clearly obſerved.

THOSE objects of this wiſdom, that we ſhall at this time conſider, are of two ſorts; the material and viſible, and the inviſible and immaterial creatures of God.

IN the firſt of theſe, whoſe aggregate or collection makes up the corporeal world, commonly called univerſe, I ſhall briefly take notice of the excellent contrivance of particular bodies; of the great variety, and conſequently number, of them; of their ſymmetry, as they are parts of the world; and of the connexion and dependance they have in relation to one another. And though under the two firſt of theſe heads I might, as well as under the other two, take notice of many inanimate bodies as well as of thoſe, that are endowed with vegetative and ſenſitive ſouls, (as naturaliſts commonly call them;) yet, for brevity's ſake, I ſhall here take notice only of that more perfect ſort of living creatures, that we call animals.

13. I. THE contrivance of every animal, and eſpecially of a human body, is ſo curious and exquiſite, that it is almoſt impoſſible for any body, that has not ſeen a diſſection well made and anatomically conſidered, to imagine or conceive, how much excellent workmanſhip is diſplayed in that admirable engine. But of this having diſcourſed elſewhere more fully, I ſhall here only tell you in a word (and it is
1 Cor. i. 25. no hyperbole) that as St. *Paul* ſaid on another occaſion, *that the fooliſh things of God are wiſer than men, and the weak things of God ſtronger than men*; ſo we may ſay, that the meaneſt living creatures of God's making are far more wiſely contrived, than the moſt excellent pieces of workmanſhip, that human heads and hands can boaſt of; and no watch nor clock in the world is any way comparable, for exquiſiteneſs of mechaniſm, to the body of even an aſs or a frog.

14. II. BUT God's wiſdom is recommended as well by the variety, and conſequently the number of the kinds of living creatures, as by the fabrick of each of them in particular. For the ſkill of human architects and other artiſts is very narrow, and for the moſt part limited to one or to a few ſorts of contrivements. Thus many an architect can build an houſe well, that cannot build a ſhip; and (as we daily ſee) a man may be an excellent clock-maker, that could not make a good watch, and much leſs contrive well a fowling-piece, or a wind-mill.

15. BUT now the great author of nature has not only created four principal ſorts of living engines, namely beaſts, birds, fiſhes, and reptiles, which differ exceedingly from one another, as the ſeveral regions or ſtages, where they were to act their parts, required they ſhould do; but under each of theſe comprehenſive genders are comprized I know not how many ſubordinate ſpecies of animals, that differ exceedingly from others of the ſame kind, according to the exigency of their particular natures. For not only the fabrick of a beaſt (as a lion) is very differing from that of a bird, or a fiſh, (as an eagle or a whale;) but in the ſame ſpecies the ſtructure or mechaniſm of particular animals is very unlike: witneſs the difference between the parts of thoſe beaſts, that chew the cud, and thoſe that do not; and between the hog and the hare, eſpecially in their entrails; and ſo between a parrot and a batt, and likewiſe between a whale, a ſtar-fiſh, a lobſter, and an oyſter, (to mention now no other inſtances.) And if with divers philoſophers both ancient and modern we admit vegetables into the rank of living creatures, the number of theſe being ſo great, that above ſix thouſand kinds of vegetables were many years ago reckoned up; the manifold diſplays of the divine mechaniſm, and ſo of its wiſdom, will by that great variety of living engines be ſo much the more conſpicuous.

16. III. THAT, which much enhances the excellent contrivances to be met with in theſe automata, is the ſymmetry of all the various parts, that each of them con-

ſifts of. For an animal, though, conſidered in his ſtate of intireneſs, he is juſtly looked upon as one engine; yet really this total machine (if I may ſo call it) is a complex thing made up of ſeveral parts, which, conſidered ſeparately, may paſs each of them for a ſubordinate engine excellently fitted for this or that particular uſe: as an eye is an admirable optical inſtrument to enable a man to ſee; and the hand is ſo well framed for a multitude of mechanical uſes, that *Ariſtotle* thought fit to call it the organ of organs, (or inſtrument of inſtruments.) It ought therefore highly to recommend the wiſdom of the great *yotſer hakkol*, *former of all things* (as the ſcripture ſtiles him,) that he has ſo framed each particular part of a man (or other animal) as not to let the ſkill beſtowed on that hinder him from making that part or member itſelf, and every other, neither bigger nor leſs, nor (in a word) otherwiſe conſtituted, than was moſt expedient for the completeneſs and welfare of the whole animal. Which manifeſts, that this great artiſt had the whole fabrick under his eye at once, and did at one view behold all, that was beſt to be done, in order to the completeneſs of the whole animal, as well as to that of each member and other part, and admirably provided for them both at once. Whereas many an excellent artificer, that is able to make a ſingle engine very complete, may not be able to make it a commodious part of a complex or aggregate of engines: as it is not every one, that can make a good pump, that can make a good ſhip-pump; nor every chymiſt, that can build an oven for a bakehouſe, that can make one fit to be ſet up in a ſhip: and we ſee, that our pendulum clocks, that are moved with weights, and go very regularly a-ſhore, cannot yet be brought to perform their office (of conſtantly meaſuring of time) when ſet up in a ſailing ſhip. Jer. x. 16.

17. IV. THE fourth way, by which God manifeſts his wiſdom in his corporeal creatures, is, their mutual uſefulneſs to one another, in a relation either of dependency or of co-ordination. This ſerviceableneſs may be conſidered, either as the parts of the animal have a relation to one another, and to the whole body they make up; or as intire and diſtinct bodies have reference to or dependency on each other. To the firſt ſort of utility belong the uſes of the parts of the human body, for inſtance, which are ſo framed, that beſides theſe publick offices or functions, that ſome of them exerciſe for the good of the whole, as the ſtomach for concocting aliments, the brain for ſupplying animal ſpirits to move the limbs, and other parts, the kidneys to ſeparate the ſuperfluous ſerum of the blood; there are many other particular parts, that have that ſubſerviency to one another, that no deſpicable portion of the books of anatomy is employed in the mention of them. And divers conſents of parts and utilities, that accrue from one to the other, are farther diſcovered by diſeaſes, which primarily affecting one part or member of the body, diſcover that this or that other part has a dependence on it, or a particular relation to it, though perhaps not formerly taken notice of. To the ſecond part of utility belong thoſe parts, that diſcriminate the ſexes of animals, which (parts) have ſuch a relation one to another in the male and the female, that it is obvious they were made for the conjunction of both in order to the propagation of the ſpecies. I cannot here ſpend time to conſider the fitneſs of the diſtance and ſituation of the ſun, the obliquity of its motion under the ecliptick, and (eſpecially) the compenſations, that nature makes by one thing for another, the exceſs of whoſe qualities would elſe be noxious to men, as the great heats and dryneſs, that reign in many parts of the torrid zone and ſome neighbouring climates, would render thoſe countries barren and uninhabitable, as the ancients thought them, if they were not kept from being ſo, by the Eteſians and the trade-winds, which blow regularly (though not always the ſame way) for a great part of the hotteſt ſeaſons of the year, and are aſſiſted by the length

of the nights, by the copious and laſting rains, that fall at ſet times, by the greatneſs of the rivers, (ſome of them periodically overflowing their banks to great diſtances) and by the winds, that in many places blow in the night from the land ſeaward, and in the morning from the ſea towards the land; for theſe, and ſome other ſuch things, do ſo moiſten and refreſh the ground, and contemperate the air, that in many of thoſe climates, which the ancients thought parched up and uninhabitable, there are large kingdoms and provinces, that are both fruitful and populous; and divers of them very pleaſant too. But, as I was ſaying, I cannot ſtay to proſecute what might be repreſented to ſhew the uſefulneſs of many of God's other ſenſible works to the nobleſt kind of them, men. But I ſhall rather content myſelf, by adding a few lines, to point farther at the reference, that God has been pleaſed to make many other things have to the welfare of men and other animals; as we ſee, that, according to the uſual courſe of nature, lambs, kids, and many other living creatures, are brought into the world at the ſpring of the year, when tender graſs and other nutritive plants are provided for their food. And the like may be obſerved in the production of ſilk-worms, whoſe eggs, according to nature's inſtitution, are hatched, when mulberry trees begin to bud and put forth thoſe leaves, whereon theſe precious inſects are to feed; the aliments being tender, whilſt the worms themſelves are ſo, and growing more ſtrong and ſubſtantial, as the inſects increaſe in vigour and bulk.

18. THERE is one thing, which though it might perhaps have been more properly brought in before, muſt not here be pretermitted. For beſides what was lately ſaid of the excellent fabrick of the bodies of men and other animals, we may deſervedly take notice, how much more wonderful, than the ſtructure of the grown body, muſt be the contrivance of a *ſemen animatum*; ſince all the future parts, (ſolid as well as ſoft) and the functions, and many of the actions (and thoſe to be variable *pro re nata)* of the animal to be produced, muſt be durably delineated, and, as it were, couched in a little portion of matter, that ſeems homogeneous, and is unqueſtionably fluid: and that, which much increaſes the wonder, is, that one of theſe latent impreſſions or powers, namely, the plaſtick, or prolifick, is to lye dormant perhaps above thirty or forty years, and then to be able to produce many more ſuch engines as is the animal itſelf.

What is included in Crochets, may be ſkipped.

[I HAVE hitherto, among the corporeal works of God, taken notice only of thoſe productions of his power and wiſdom, that may be obſerved in the viſible world: ſo that I may be allowed to conſider farther, that not only the Peripateticks, but the generality of other philoſophers, believe the world to be finite; and, though the Carteſians will not ſay it is ſo, but chuſe rather to call it indefinite, yet as it is elſewhere ſhewn, their opinion is rather a well-meant piece of modeſty, than a ſtrict truth. For, in reality, the world muſt every way have bounds, and conſequently be finite; or it muſt not have bounds, and ſo be truly boundleſs; or, (which is the ſame thing in other terms) infinite: and if the world be bounded, then thoſe, that believe a Deity, to whoſe nature it belongs to be of infinite power, muſt not deny, that God is, and ſtill was, able to make other worlds than this of ours. And the Epicureans, who admitted no omnipotent Maker of the world, but ſubſtituted chance and atoms in his ſtead, taught, that by reaſon the cauſes ſufficient to make a world, that is atoms and ſpace, were not wanting, chance has actually made many worlds, of which ours is but one; and the Carteſians muſt, according to their doctrine of the indefiniteneſs of corporeal ſubſtance, admit, that our viſible world, or, if they pleaſe, vortex, by which I mean the greateſt extent our eyes can reach to, is but a part, and comparatively but a very ſmall one too, of the whole univerſe, which

may

may extend beyond the utmoſt ſtars we can ſee, incomparably farther than thoſe remoteſt viſible bounds are diſtant from earth.]

Now if we grant, with ſome modern philoſophers, that God has made other worlds beſides this of ours, it will be highly probable, that he has there diſplayed his manifold wiſdom, in productions very differing from thoſe, wherein we here admire it. And even, without ſuppoſing any more than one univerſe, as all that portion of it that is viſible to us, makes but a part of that vaſtly extended aggregate of bodies; ſo if we but ſuppoſe, that ſome of the celeſtial globes, whether viſible to us, or placed beyond the reach of our ſight, are peculiar ſyſtems, the conſideration will not be very different: for ſince the fixed ſtars are many of them incomparably more remote than the planets, it is not abſurd to ſuppoſe, that as the ſun, who is the fixed ſtar neareſt to us, has a whole ſyſtem of planets, that move about him; ſo ſome of the other fixed ſtars may be each of them the centre, as it were, of another ſyſtem of celeſtial globes; ſince we ſee, that ſome planets themſelves, that are determined, by aſtronomers to be much inferior in bigneſs to thoſe fixed ſtars I was ſpeaking of, have other globes, that do, as it were, depend on them, and move about them; as, not to mention the earth, that has the moon for its attendant, nor Saturn, that is not altogether unaccompanied, it is plain, that Jupiter has no leſs than four ſatellites, that run their courſes about him. And it is not to be pretermitted, that none of theſe leſſer and ſecondary planets, (if I may ſo call them) that move about Saturn and Jupiter, are viſible to the naked eye, and therefore they were all unknown to the antient aſtronomers, who lived before the invention of teleſcopes. Now, in caſe there be other mundane ſyſtems (if I may ſo ſpeak) beſides this viſible one of ours, I think it may be probably ſuppoſed, that God may have given peculiar and admirable inſtances of his inexhauſted wiſdom in the contrivance and government of ſyſtems, that, for aught we know, may be framed and managed in a manner quite differing from what is obſerved in that part of the univerſe, that is known to us. For, beſides that here on earth, the loadſtone is a mineral ſo differing in divers affections, not only from all other ſtones, but from all other bodies, that are not magnetical, that this heteroclite mineral ſcarce ſeems to be originary of this world of ours, but to have come into it by a remove from ſome other world or ſyſtem; I remember, that ſome of the navigators, that diſcovered *America*, took notice, that at their firſt coming into ſome parts of it, though they found great ſtore of animals and plants, yet they met with few of the latter, and ſcarce any of the former, of the ſame ſpecies with the living creatures of *Europe*.

19. Now in theſe other worlds, beſides that we may ſuppoſe, that the original fabrick, or that frame, into which the omniſcient architect at firſt contrived the parts of their matter, was very differing from the ſtructure of our ſyſtem; beſides this, I ſay, we may conceive, that there may be a vaſt difference betwixt the ſubſequent phænomena, and productions obſervable in one of thoſe ſyſtems, from what regularly happens in ours, though we ſhould ſuppoſe no more, than that two or three laws of local motion may be differing in thoſe unknown worlds from the laws, that obtain in ours. For if we ſuppoſe, for inſtance, that every entire body, whether ſimple or compounded, great or ſmall, retains always a motive power, (as philoſophers commonly think, that the ſoul does, when it has moved the human body, and as the Epicureans, and many other philoſophers, think all atoms do, after they have impelled one another) this power of exciting motion in another body, without the movent's loſing its own, will appear of ſuch moment to thoſe, that duly conſider, that local motion is the firſt and chiefeſt of the ſecond cauſes, that produce the phænomena of nature, that they will eaſily grant, that theſe phænomena muſt be

ſtrangely diverſified, by ſpringing from principal cauſes ſo very differingly qualified. Nor (to add another way of varying motion) is it abſurd to conceive, that God may have created ſome parts of matter to be of themſelves quieſcent, (as the Carteſians and divers other philoſophers ſuppoſe all matter to be in its own nature,) and determined to continue at reſt, till ſome outward agent force it into motion; and yet that he may have endowed other parts of the matter with a power like that, which the atomiſts aſcribe to their principles, of reſtleſly moving themſelves, without loſing that power by the motion they excite in quieſcent bodies. And the laws of this propagation of motion among bodies may be not the ſame with thoſe, that are eſtabliſhed in our world; ſo that but one half, or ſome leſſer part, (as a third) of the motion, that is here communicated from a body of ſuch a bulk and velocity, to another it finds at reſt, or ſlowlier moved than itſelf, ſhall there paſs from a movent to the body it impels, though all circumſtances, except the laws of motion, be ſuppoſed to be the ſame. Nor is it ſo extravagant a thing, as at firſt it may ſeem, to entertain ſuch ſuſpicions as theſe; for in the common philoſophy, beſides that the notion and theory of local motion are but very imperfectly propoſed, there are laws or rules of it well, not to ſay at all, eſtabliſhed.

20. AND as for the Carteſian laws of motion, though I know they are received by many learned men, yet I ſuſpect, that it is rather upon the authority of ſo famous a mathematician as *Des Cartes*, than any convictive evidence, that accompanies the rules themſelves; ſince to me (for reaſons, that belong not to this diſcourſe) ſome of them appear not to be befriended either by clear experience, or any cogent reaſon. And for the rule, that is the moſt uſeful, namely, that which aſſerts, that there is always the ſame quantity of motion in the world, every body, that moves another, loſing juſt as much of its own, as it produces in the other: the proof he offers, being drawn from the immutability of God, ſeems very metaphyſical, and not very cogent to me, who fear, that the properties and extent of the divine immutability are not ſo well known to us mortals, as to allow *Carteſius* to make it, in our preſent caſe, an argument, *à priori*. And *à poſteriori*, I ſee not, how the rule will be demonſtrated; ſince, beſides that it may be queſtioned, whether it is agreeable to experience in divers inſtances, that might be given of communicated motions here below; I know not what experience we have of the rules, by which motion is propagated in the heavenly regions of the world, among all the bodies, that make up the ætherial, (which is incomparably the greateſt) part of the univerſe. So that the truth of the Carteſian rules being evinced neither *à priori*, nor *à poſteriori*, it appears not, why it ſhould be thought unreaſonable to imagine, that other ſyſtems may have ſome peculiar laws of motion; only becauſe they differ from thoſe Carteſian rules, whereof the greateſt part are, at leaſt, undemonſtrated.]

21. BUT though, if we allow of ſuppoſitions and conjectures, ſuch as thoſe lately mentioned, that are, at leaſt, not abſurd, they may conduce to amplify ſome of our ideas of divine things; yet we need not fly to imaginary ultra-mundane ſpaces, to be convinced, that the effects of the power and wiſdom of God are worthy of their cauſes, and not near adequately underſtood by us, if with ſufficient attention, we conſider that innumerable multitude, and unſpeakable variety of bodies, that make up this vaſt univerſe. For, there being among theſe a ſtupendous number, that may juſtly be looked upon as ſo many diſtinct engines, and many of them very complicated ones too, as containing ſundry ſubordinate ones; to know, that all theſe, as well as the reſt of the mundane matter, are every moment ſuſtained, guided and governed, according to their reſpective natures, and with an exact regard to the catholic laws of the univerſe; to know, I ſay, that there is a Being, that doth this every where, and every

every moment, and that manages all things, without either aberration or intermiſſion, is a thing that, if we attentively reflect on, ought to produce in us for that ſupreme Being, that can do this, the higheſt wonder, and the lowlieſt adoration.

THE Epicureans of old did, with ſome colour of reaſon, as well as with much confidence, urge againſt the belief of a divine Providence, that it is unconceivable, and therefore incredible, that the gods ſhould be ſufficient for ſuch differing and diſtracting employments, as, according to the exigencies of Nature's works, to make the ſun ſhine in one place, the rain ſhower down in another, the winds to blow in a third, the lightening to flaſh in a fourth, the thunderbolts to fall in a fifth; and, in ſhort, other bodies to act and ſuffer, according to their reſpective natures. Wherefore we, that, upon good grounds believe, that God really does, what theſe philoſophers thought impoſſible to be done by any agents whatſoever, are much wanting in our duty, if we do not admire an all-pervading wiſdom, that reaches to the utmoſt extent of the univerſe, and actually performing what philoſophers profeſſed they could not ſo much as conceive, highly merits, that thoſe difficulties, which they thought inſuperable, and ſo a ſufficient excuſe for their unbelief, ſhould be a powerful motive to our veneration of that tranſcendent wiſdom, that without any trouble ſurmounts them.

22. WE have ſeen ſome diſplays of God's wiſdom as well as power by what we have obſerved, in his corporeal works: but it will be eaſily granted, that ſome of the divine perfections could not be ſo well expreſſed, or copied upon corporeal creatures, as upon the rational and immaterial ſoul of man, and other intellectual beings; as the picture of an apple or a cherry, or the character of a number, is not capable of receiving or containing ſo much of an excellent painter's ſkill, as he may exhibit in a piece, wherein the paſſions of the mind, and the laws of opticks, and of decency, may be fully expreſſed. And, it may be well preſumed, that if we were as familiarly acquainted with God's incorporeal creatures, as we are with his viſible ones, we ſhould perceive, that as ſpirits are incomparably more noble than bodies, ſo the Divine Wiſdom, employed in the government and conduct of them, is more glorious than that, which we juſtly admire in the frame and management of his corporeal works. And indeed, let a portion of matter be never ſo fine, and never ſo well contrived, it will not be any more than an engine devoid of intellect and will, truly ſo called, and whoſe excellency, as well as its diſtinction from other bodies, even the groſſeſt and imperfecteſt, can conſiſt but in mechanical affections, ſuch as the ſize, ſhape, motion and connexion of its parts; which can neither excite themſelves into motion, nor regulate and ſtop the motion they once are in: whereas true ſpirits (by which I here mean immaterial ſubſtances) have, by God's appointment, belonging to their nature, underſtanding, will, and an internal principle, both of acting ſo and ſo, and of arbitrarily ceaſing from action. And though God, as the ſole creator of all ſubſtances, has, and, if he pleaſe, may exerciſe an abſolute dominion over all his creatures, as well immaterial as corporeal; yet ſince he has thought fit to govern ſpirits according to the nature he has given them, (which comprehends both underſtanding and will) to create ſuch intelligent, free and powerful beings, as good and bad angels, (to ſay nothing now of men) and to govern them on thoſe terms, ſo as effectually to make them (however they behave themſelves) inſtruments of his glory, which multitudes of them do as ſubtily, as obſtinately oppoſe; to do theſe things, I ſay, requires a wiſdom and providence tranſcending any, that can be diſplayed in the formation and management of merely corporeal beings: for inanimate engines may be ſo contrived, as to act but as we pleaſe; whereas angels and human ſouls are endowed with a freedom of acting, in moſt caſes, as themſelves pleaſe.

pleaſe. And it is far eaſier for a ſkilful watch-maker to regulate the motions of his watch, than the affections and actions of his ſon.

23. AND here give me leave to conſider, that angels, whether good or bad, are very intelligent and active beings; and that each of them is endowed with an intellect capable of almoſt innumerable notions and degrees, or variations of knowledge, and alſo with a will, capable of no leſs numerous exertions or acts; and of having various influences upon the underſtanding, as (on the other ſide) it is variouſly affected by the dictates of it: ſo that (to apply this conſideration to my preſent purpoſe) each particular angel being ſucceſſively capable of ſo many differing moral ſtates, may be looked upon, as, in a manner, a diſtinct ſpecies of the intellectual kind: and the government of one dæmon, may be as difficult a work, and conſequently may as much declare the wiſdom and power of God, as the government of a whole ſpecies of inanimate bodies, ſuch as ſtones or metals, whoſe nature determines them to a ſtrict conformity to thoſe primordial laws of motion, which were once ſettled by the Great Creator, and from which they have no wills of their own to make them ſwerve.

THE ſcripture tells us, that in the œconomy of man's ſalvation there is ſo much of the manifold wiſdom of God expreſſed, that the angels themſelves deſire to pry into thoſe myſteries. When our Saviour having told his apoſtles, that the day and hour of his future coming to judgment (whether of the Jewiſh nation or the world, I now inquire not) was not then known to any, ſubjoins, *no, not to the angels of heaven, but to his Father only:* he ſufficiently intimates them to be endowed with excellent knowledge, ſuperior to that of men; and that perhaps may be one of the reaſons, why the ſcripture ſtyles them angels of light. It alſo teaches us, that the good angels are vaſtly numerous, and that as they are of differing orders, ſome of them being arch-angels, and ſome princes of particular empires or nations; ſo God aſſigns them very differing and important employments both in heaven and in earth; and ſometimes ſuch as oblige them, in diſcharge of their reſpective truſts, to endeavour the carrying on of interfering deſigns. The ſame ſcripture by ſpeaking of the devil and his angels, and of the great dragon, that drew down with his tail the third part of the ſtars from heaven to earth, and by mentioning a whole legion of devils, that poſſeſſed a ſingle man, and by divers other paſſages, that I ſhall not now inſiſt on, giving us ground to conclude, that there is a political government in the kingdom of darkneſs; that the monarch of it is exceeding powerful, whence he is ſtyled the prince of this world, and ſome of his officers have the titles of principalities, powers, rulers of the darkneſs of this world, *&c.* that the ſubjects of it are exceeding numerous; that they are deſperate enemies to God and men, whence the devil is ſtiled the adverſary, the tempter, and a murtherer from the beginning; that they are very falſe and crafty, whence the devil is called the *father of lies*, the *old ſerpent*; and his ſtratagems are ſtiled the *wiles, and depths of Satan*; that their malice is as active and reſtleſs, as it is great, whence we are told, that our adverſary the devil, *walks about like a roaring lion, ſeeking whom he may devour.* Theſe things being taught us in the ſcripture itſelf, though I ſhall not now add any of the inferences that may be drawn from them to my preſent purpoſe, we may rationally ſuppoſe, that if we were quick-ſighted enough to diſcern the methods of the divine wiſdom in the government of the angelical and of the diabolical worlds, or great communities, if I may ſo call them; we ſhould be raviſhed into admiration, how ſuch intelligent, free, powerful, and immortal agents, ſhould be, without violence offered to their nature, made in various manners to conſpire to fulfil the laws, or at leaſt accompliſh the ends, of that great theocracy, that does not alone reach to all kinds of bodies, to men, and to this or that rank of ſpirits, but compriſes the whole creation, or the great aggregate of all the creatures of God. And indeed to make the voluntary, and perhaps

Mat. xxiv. 36.

Eph. vi. 12.

1 Pet. v. 8.

haps the moſt crafty actions of evil men, and of evil ſpirits themſelves, ſubſervient to his wiſe and juſt ends, does no leſs recommend the wiſdom of God, than it would the ſkill of a ſhip-wright and pilot, if he was able to contrive and ſteer his ſhip ſo, as to ſail to his deſigned port, not only with a ſide-wind, or very near a wind, as many do; but with a quite contrary wind, and that a tempeſtuous one too.

24. PERHAPS you will think it allowable, that on this occaſion I antedate, what in due time will infallibly come to paſs; and now briefly take ſome notice, as if it were preſent, of the diffuſed and illuſtrious manifeſtation of the divine wiſdom, (as well as juſtice and mercy,) that will glorioufly appear at the day of the general judgment, when every good Chriſtian's eyes ſhall be vouchſafed a much larger proſpect, than that, which his Saviour himſelf had, when he ſurveyed in a trice, and, as it were, at one view, *all the kingdoms of the world*; and ſhall behold a much more numerous (not to ſay numberleſs) aſſembly, than that, which is ſaid to have conſiſted of *all people, nations and languages*, that flocked in to the dedication of *Nebuchadnezzar*'s golden image. Luke iv. 5. Dan. iii.

At that great decretory day, when the whole off-ſpring of *Adam* ſhall, by the loud voice and trumpet of the arch-angel, be called together from the remoteſt ages and the diſtanteſt climates in the world: when, I ſay, beſides the fallen angels, all the human actors, that ever lived, ſhall appear upon the ſtage at once; *when the dead ſhall be raiſed, and the books ſhall be opened*, (that is, the records of heaven and of conſcience;) then the wiſdom of God will ſhine forth in its meridian luſtre, and its full ſplendor. Not only the occurrences, that relate to the lives and actions of particular perſons, or of private families, and other leſſer ſocieties of men, will be there found not to have been overlooked by the divine providence; but the fates of kingdoms and commonwealths, and the revolutions of nations and of empires, will appear to have been ordered and over-ruled by an incomparable wiſdom: and thoſe great politicians, that thought to out-wit providence by their refined ſubtilties, ſhall find themſelves taken in their own craftineſs, ſhall have their deepeſt counſels turned into fooliſhneſs, and ſhall not be able to keep the amazed world from diſcovering, that whilſt they thought they moſt craftily purſued their own ends, they really accompliſhed God's: and thoſe ſubtile hypocrites, that thought to make pretended religion the inſtrument of their ſecular deſigns, ſhall find thoſe deſigns both defeated, and made truly ſubſervient to that advancement of religion, which they really never aimed at. Rev. xx. 12.

25. To employ and keep in order a very complicated engine, ſuch as the famous *Straſburgh* clock, or a man of war, though all the parts of it be inanimate and devoid of purpoſes and ends of their own, is juſtly counted a piece of ſkill; and this taſk is more difficult, and conſequently does recommend the conduct of the performer, in proportion to the intricate ſtructure, and the number of pieces, whereof the engine conſiſts: at which rate, how aſtoniſhing and raviſhing will appear that wiſdom and providence, that is able to guide and over-rule many thouſand millions of engines endowed with wills, ſo as to make them all be found, in the final iſſue of things, ſubſervient to purpoſes worthy of divine providence, holineſs, juſtice and goodneſs.

In ſhort, when all the actors, that had their parts in this world, ſhall appear at once upon the ſtage, when all diſguiſes ſhall be ſtript off, all intrigues diſcovered, all hearts and deſigns laid open; then to find, that this whole amazing opera, that has been acting upon the face of the earth, from the beginning to the end of time, has been ſo contrived and carried on by the great author of the world and of men, that their innumerably various actions and croſs deſigns are brought, (commonly with-

out, and often againſt their wills,) to conſpire to the accompliſhment of a plot worthy of God, will appear an effect of ſo vaſt and ſo all-pervading a wiſdom, as human intellects will admiringly confeſs, that nothing but a divine and omniſcient one could compaſs.

26. IT is like you may have taken notice, that among the ſeveral inſtances I have given of the wiſdom of God, I have not, (unleſs perhaps incidentally and tranſiently,) mentioned the œconomy of man's ſalvation by *Jeſus Chriſt*: and therefore I think myſelf obliged to advertiſe you, that though, for reaſons to be given you, if you deſire it, by word of mouth, I have thought fit that ſubject, which has been already handled by ſo many profeſſed divines, ſhould be left untreated of by me, who am a layman; yet I did not pretermit it, upon the ſcore of thinking it at all inferior to thoſe other manifeſtations of God's wiſdom, that I expreſly diſcourſe of.

FOR I think, that in the redemption of mankind more of the divine attributes, than are commonly taken notice of, have their diſtinct agencies; and that their cooperation is ſo admirably directed by the divine wiſdom, that an apoſtle may very juſtly call it the *great myſtery of godlineſs*; and that it no leſs deſerves our wonder than our gratitude.

1 Tim. iii. 16.

27. I AM not ignorant, that many learned divines have largely, and ſome of them laudably treated of this ſubject. But I confeſs I doubt whether moſt of them have not been more happy in their care to avoid errors about it, than ſkilful in their attempts to unveil the myſteries couched in it. There are in the great work of man's redemption ſome characters and footſteps of the divine wiſdom, ſo conſpicuous, not to ſay ſo refulgent, that a believer endowed but with a mediocrity of parts may eaſily enough diſcern them; but there are alſo in this ſublime and comprehenſive work ſome *depths of God*, (to uſe a ſcripture phraſe) and ſo much of the *wiſdom of God in a myſtery*, (that is, of the myſterious wiſdom of God) that I cannot think it an eaſy matter to have a mental eye ſo enlightened and ſo piercing, as to treat largely and worthily of ſo vaſt and abſtruſe a ſubject. And indeed when I conſider, that a man muſt know much of the nature of ſpirits in general, and even of the father of them God himſelf; of the intellect, will, *&c.* of the ſoul of man; of the ſtate of *Adam* in paradiſe, and after his fall; of the influence of his fall upon his poſterity, of the natural or arbitrary vindictive juſtice of God; of the grounds and ends of God's inflicting puniſhments, as a creditor, a ruler, or both; of the admirable and unparalled perſon of Chriſt the mediator; of thoſe qualifications and offices, that are required to fit him for being lapſed man's redeemer; of the nature of covenants, and the conditions of thoſe God vouchſafed to make with man, whether of works, or grace; of the divine decrees, in reference to man's final ſtate; of the ſecret and powerful operations of grace upon the mind, and the manner, by which the ſpirit of God works upon the ſouls of men, that he converts, and brings by ſanctification to glory: to be ſhort, there are ſo many points (for I have left divers unnamed) moſt of them of difficult ſpeculation, that are fit to be diſcuſſed by him, that would ſolidly and fully treat of the world's redemption by *Jeſus Chriſt*, that when I reflect on them, I am ready to exclaim with St. *Paul*, *who is ſufficient for theſe things?* and I am ſo far from wondering, that the generality of divines, and other writers on this ſubject, have not fully diſplayed the wiſdom, that God has expreſſed in this great work, that to have been able to accompliſh it in ſo admirable a way, as God has actually contrived and made choice of, is one of the chief reaſons of my admiration of the wiſdom itſelf. And I am perſuaded, that for God to reconcile his inflexible juſtice, his exuberent mercy, and all thoſe other things, that ſeemed to claſh inevitably about the the de-

Βάθη τοῦ Θεοῦ 1 Cor. ii. 10. ii. 7.

ſigned ſalvation of men, and make them co-operate to it, is a ſtupendous manifeſtation of wiſdom; there being no problem in *Diophantus*, *Alexandrinus*, or *Apollonius Pergæus*, in algebra, or in geometry, near ſo difficult to be ſolved, or that requires, that a greater number of proportions and congruities ſhould be attended to at once, and made ſubſervient to the ſame ends, as that great problem propounded by God's infinite goodneſs to his divine wiſdom; *the redemption of loſt and perverſe mankind, upon the terms declared in the goſpel*, which are admirably fitted to promote at once God's glory and man's felicity.

28. THOUGH what has been ſaid of the greatneſs of God's power and wiſdom, may juſtly perſuade us, that thoſe attributes are divine and adorable; yet I muſt not deny, that the repreſentation, that I have made of them, is upon ſeveral accounts very diſadvantageous. For firſt, there has not been ſaid of them in this paper all, that even I could have mentioned, to ſet forth their excellency; becauſe I had elſewhere treated of that ſubject, and was more willing to preſent you with ſome things I had not ſaid before, than trouble you with many repetitions: but if, inſtead of ſo unfit a perſon as I, the manifeſtation of the divine wiſdom had been undertaken by the knowingeſt man in the world, or perhaps even by an angel, he would find himſelf unable fully to make out the matchleſs excellency of it. For how much wiſdom has been exerciſed by an omniſcient being, cannot be fully comprehended, or conſequently deſcribed, but by an infinite underſtanding: beſides, I have conſidered the wiſdom diſplayed by God in the works of his creation and providence, with reſpect to them, not to us; for they are excellent, abſolutely, and in their own nature, and would ſimply upon that account deſerve the wonder and the praiſes of rational beings, as they are rational; as *Xeuxes* juſtly celebrated the ſkill of *Apelles*, and modern geometers and mechanitians admire *Archimedes*. But in this irrelative contemplation of God's works, a man's mind being intent only upon the excellencies he diſcovers in them, he is not near ſo much affected with a juſt ſenſe of the inferiority of his to the divine intellect, as he would be, if he heedfully conſider, how much of the vaſt ſubjects he contemplates are undiſcovered by him, and how dim and imperfect the knowledge is, which he has of that little he does diſcover. And now, laſtly, to the other diſadvantages, with which I have been reduced to repreſent (and ſo to blemiſh) the divine attributes, I muſt add, that I have inſiſted but upon two of them, God's power and his wiſdom; whereas we know, that he has divers other perfections, as (beſides thoſe incommunicable ones, his ſelf-experience, ſelf-ſufficiency, and independency) his goodneſs to all his creatures, his mercy to ſinful men, his juſtice, his veracity, *&c.* And, as I long ſince noted, we may rationally conceive, that he may have divers attributes, and conſequently divers perfections, whereof we have at preſent no knowledge, or perhaps ſo much as particular conjecture; the inexhauſtible fecundity of the divine nature being ſuch, that, for aught we know, we are acquainted with but a ſmall part of the productions of an almighty power, accompanied with an infinite wiſdom, and excited to communicate itſelf by an exuberant goodneſs. And indeed I ſee not, why we may not ſay, that by the notion or idea we have of him, and by the help of ſome attributes we already know he has, we may in general conceive, that he has other perfections, that we yet know not in particular; ſince of thoſe attributes, that we do already know, though the irrelative ones (if I may ſo call them) ſuch as his ſelf-exiſtence, eternity, ſimplicity, and independency, may be known by mere ſpeculation, and, as it were, all at once, by appearing to us as comprehended in the notion of a being abſolutely perfect; yet there are divers relative attributes or perfections, that come to be known ſucceſſively, and as it were by experience of what he has actually done in relation to ſome of his creatures: as the

mercy of God was not known by *Adam* himſelf before his fall; and God's fidelity or faithfulneſs to his promiſes, as particularly that of ſending the *Meſſias* in the fulneſs of time, was not, (not to ſay could not be) known but in proceſs of time, when ſome of them came to be fulfilled: and therefore, ſince ſome of God's perfections require or ſuppoſe the reſpective natures and conditions of his creatures, and the actings of ſome of them towards him, as well as ſome of his towards them; we, that cannot be at all ſure, that he may not have made many ſorts of creatures, and have had divers relations to them, according to their ſeveral ſtates and conditions, that we are altogether unacquainted with, cannot know, but that ſome of the attributes of God exerciſed towards theſe creatures may remain unknown to us.

29. BUT whether the attributes, known and unknown, be thought to be more or fewer, it will not be denied, but that the natural and genuine reſult of all theſe divine perfections, (which we conceive under diſtinct notions, becauſe we are not able to ſee them at one view, united in God's moſt ſimple eſſence) muſt be a moſt glorious majeſty, that requires the moſt lowly and proſtrate venerations of all the great creator's intelligent works: and accordingly we may obſerve (from ſome of the formerly cited texts) that the angels, who of all his mere creatures are the moſt excellent and knowing, are repreſented in the ſcripture as aſſiduouſly employing themſelves, not only in obeying and ſerving, but in praiſing and adoring the divine majeſty. The very name of angel in the original languages of the Old and New Teſtament, is a name of miniſtry, the Hebrew *Malach*, and the Greek Ἄγγελος, ſignifying properly a meſſenger. And our Saviour intimates in his moſt excellent pattern of prayer, that the will of God is done moſt obſequiouſly and chearfully in heaven; ſince Chriſtians are directed to wiſh, that their obedience there paid him might be
Rev. xix. 10. imitated upon earth. And as they ſtile themſelves the apoſtles fellow-ſervants, ſo theſe celeſtial envoys (if I may ſo call them) make no ſcruple of going upon the meaneſt errands, as we would think them; conſidering rather by whom, than to whom, or about what, they are ſent. So the firſt angel, that we read of, to have
Gen. xxi. 17, &c. been ſent to a particular perſon, was employed to *Hagar*, a wandering and fugitive female ſlave, ready to periſh for thirſt in a wilderneſs, to direct her to a well of water, and tell her ſomewhat, that concerned her child: and another angel is repre-
Num. xxii. 33. ſented as taking the part of an aſs againſt a falſe prophet; nay, of this glorious order of creatures in general the ſcripture tells us, that *they are all miniſtring ſpirits, ſent*
Heb. i. 14 *forth to miniſter for them, who ſhall be heirs of ſalvation.*

THOUGH the angels are creatures ſo glorious in their apparitions here below, that they uſe to ſtrike amazement and veneration, if not terror, even into the excellent
Dan. x. 9. 11, 17. perſons they appear to, (as we may learn from divers paſſages of the ſcripture, where
Luke i 29. we are told, that their preſence was accompanied with a ſurprizing ſplendor, and one
Rev. xviii. 1. of them is repreſented in the apocalypſe, as *inlightening the earth with his glory*; and though their multitude be ſo great, that ſometimes the myriads of them and ſometimes the legions, are mentioned, and elſewhere we are told of *thouſand thouſands, and ten thouſand times ten thouſand of them:* yet theſe celeſtial courtiers, that, in compariſon of us men, are ſo glorious, as well as intelligent and ſpotleſs, when they appear in multitudes about the throne of God, (according to that viſion of the prophet, who told the two Kings of *Judah* and *Iſrael*, that he ſaw the *Lord ſitting on his*
1 Kings xxii. 19. *throne*; *and all the hoſts of heaven ſtanding by him on his right hand and on his left,*)
Dan. vii. 10. they ſtand not to gaze, but, as the prophet *Daniel* expreſsly ſays, to miniſter. And
Iſa. vi. 2. in *Iſaiah*'s viſion, the ſeraphims themſelves are repreſented, as covering their faces before their great maker ſeated on his elevated throne. And we may eaſily gueſs, that their employment is moſt humbly to adore and celebrate ſuch dazzling majeſty,

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by what we are told of their crying one to another, *Holy, holy, holy, is the Lord of hoſts, the whole earth is full of his glory.* This profound reſpect of the angels is not to be marvelled at; ſince, where eſteem ſprings not from ignorance but knowledge, the greater the ability and opportunities are of having the knowledge clear and heightened, the greater veneration muſt be produced in an intelligent being for the admired object, whoſe perfections are ſuch, that even an angelical intellect cannot fully reach them; ſince, as a line, by being never ſo much extended in length, cannot grow a ſurface, ſo neither can created perfections be by any ideas ſo ſtretched, as to be amplified into divine ones, (or ideas equal to them.) And indeed, ſpeaking in general, the creatures are but umbratile (if I may ſo ſpeak) and arbitrary pictures of the great creator; of divers of whoſe perfections though they have ſome ſignatures, yet they are but ſuch, as rather give the intellect riſes and occaſions to take notice of and contemplate the divine originals, than they afford true images of them: as a picture of a watch or man, or the name of either of them written with pen and ink, does not exhibit a true and perfect idea of a thing (whoſe internal conſtitution a ſurface cannot fully repreſent) but only gives occaſion to the mind to think of it, and to frame one. And what I have ſaid of the creatures in general, holds true of the angels themſelves, who by ſeveral prerogatives do indeed much ſurpaſs the reſt of their fellow creatures, but yet are but creatures, and therefore of a nature infinitely inferior to God's; as, though a thouſand is a far greater number than ten, and a million than a thouſand, yet the latter as well as the two former is beyond computation diſtant from a number ſuppoſed to be infinite; ſince otherwiſe a finite number (that by which the leſſer differs from the greater) would be able by its acceſſion to make a finite number become infinite. But to return to what I was ſaying of the angels: I thought fit to mention both the nobleneſs of their nature, the ſplendidneſs of their apparitions, and the profound veneration and ardent devotion, which they paid to their creator, becauſe we are wont to eſtimate remote things by compariſon; as modern philoſophers tell us, that we judge the riſing or ſetting ſun and moon to be greater and more diſtant from us, than when they are nearer the meridian; becauſe, when they are in the horizon, we conſider them as placed beyond mountains, or long tracts of land or ſea, that we know to be great objects, and look upon as remote ones, and yet ſee them interpoſed, and conſequently nearer than the celeſtial globes. For thus, ſince the ſcripture propoſes the angels to our imitation, the awful reverence paid to the ſupreme Being by thoſe excellent ſpirits, who, as St. *Peter* tells us, *are greater in power and might than we*, ought to admoniſh us of the ecſtatic reſpect we mortals owe him, and teach us, that whenſoever we ſpeak either to God or of him, we ought to be inwardly affected (and in our outward expreſſions appear to be ſo) with the unmeaſureable diſtance there is between a moſt perfect and omnipotent creator, and a mere impotent creature, as well as between a moſt holy God, and a moſt ſinful man.

Jude 9.

2 Pet. ii. 11.

[30. IF the conjectures formerly propoſed about worlds differing from ours may paſs for probable, then it will be ſo too, that God in theſe other ſyſtems may have framed a multitude of creatures, whoſe fabric and motions, and conſequently whoſe properties and operations, muſt be very differing from what is uſually met with in our world. And the various contrivances, wherein thoſe differences conſiſt, will be ſo many peculiar inſtances, as well as productions, of the *manifold wiſdom* of the great *former of all things*; or (as the original expreſſion *yetſer hakol* will bear,) *Maker of the whole* (univerſe.) But to add ſomething now of nearer affinity to what was laſt ſaid about God's government of ſpirits, how much will this architectonic wiſdom (if I may ſo call it) exerted in framing and regulating an innumerable company of differ-

Jer. li. 19.

ing creatures, be recommended; if the other worlds or vortexes we not long ſince ſpoke of, and the inviſible part of ours, (as we may call the air and æther) be peopled with intelligent, though not viſible inhabitants? For, though the ſcripture ſeems not to ſpeak expreſly of any more ſorts of ſpirits, than thoſe good ones, that retain the name of (the whole genus) angels, and the apoſtates, that are commonly called devils, becauſe theſe are the two ſorts of ſpirits, that it moſt concerns us men to be informed of; yet the ſcripture, that in the hiſtory of the creation does not clearly ſo much as mention the production of angels, and elſewhere repreſents them, as well the bad as the good, of very differing orders, (as far as we can gueſs by the ſeveral names it gives them;) the ſcripture, I ſay, does not deny, that there are any other ſorts of ſpirits, than thoſe it expreſly takes notice of: ſo that, without any affront to it, we may admit there are ſuch, if any probable arguments of it be ſuggeſted to us either by reaſon or experience. And it ſeems not very likely, that while our terraqueous globe, and our air, are frequented by multitudes of ſpirits, all the celeſtial globes, (very many of which do vaſtly exceed ours in bulk) and all the ætherial or fluid part of the world, (in compariſon of which, all the globes, the celeſtial and terreſtrial put together, are inconſiderable for bulk) ſhould be quite deſtitute of inhabitants. I have not time to ſet down the opinions of the antient as well Eaſtern as Grecian writers, eſpecially the Pythagoreans and Platoniſts, to whoſe maſter this ſentence is aſcribed concerning the multitudes of dæmons, (a name by them not confined to evil ſpirits) that lived in the ſuperior part of the world, Δαίμονες ἀήρειον γένος. I will not preſume to be poſitive in declaring the ſenſe of thoſe two expreſſions, which the ſcripture employs, where ſpeaking of the head of the ſatanical kingdom, it calls him *the prince of the power of the air*, (and the word air is, among the Hebrews, taken in a great latitude, and ſeveral times uſed for the word heaven) and where ſpeaking of the grand adverſaries of the goſpel, it ſtyles them *ſpiritual wickedneſſes*, or rather (as the Syriac reads it, *ſpirits of wickedneſs*, that is) *wicked ſpirits*, not in high places, as our tranſlators have it, but in heavenly. But though, as I was ſaying, I will not be poſitive in giving theſe two texts ſuch a ſenſe, as may make them direct arguments for my conjecture; yet it ſeems, that if they do not require, at leaſt they may well bear, an interpretation ſuitable to my preſent purpoſe. And whatever become of the aſſertions of heathen philoſophers and poets, it is very conſiderable what is noted by the excellent *Grotius*, (who quotes ſeveral Hebrew authors for it) that it was the opinion of the *Jews*, that all places from earth to heaven, even the ſtarry heaven, are full of ſpirits. If this be ſo, the wiſdom and power of God muſt reach much farther, than we are commonly aware of; ſince he has created, and does govern, ſuch an ineſtimable multitude of ſpiritual beings, of various kinds, each of them endowed with an intellect and will of its own; eſpecially ſince, for aught we know, many or moſt of them, and perhaps ſome whole orders of them, are yet in a probational ſtate, wherein they have free-will allowed them; as *Adam* and *Eve* were in *Eden*, and all the angels were, before ſome of them (as the ſcripture ſpeaks) *left their firſt* eſtate and their own manſion. And if to theſe angelical communities we add thoſe others of children, idiots, and mad-men; of whom, though all be in a ſenſe rational creatures, yet the firſt community have not attained the full uſe of reaſon, for want of age, and the two others cannot exerciſe that faculty, for want of rightly diſpoſed organs; the wiſdom and power of God in the divine government of ſuch various and numerous communities of intellectual creatures will, to a conſidering man, appear the more illuſtrious and wonderful.

Eph. vi. 12. compared with Col. i. 16.

Eph. ii. 2.

Grotius on Eph. ii. 2. On Eph. vi. 12.

Ep. Jud. 6.

31. THE diſtance betwixt the infinite creator and the creatures, which are but the limited and arbitrary productions of his power and will. is ſo vaſt, that all the di-

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vine attributes or perfections do by unmeaſurable intervals tranſcend thoſe faint reſemblances of them, that he has been pleaſed to impreſs, either upon other creatures, or upon us men. God's nature is ſo peculiar and excellent, that there are qualities, which, though high virtues in men, cannot belong to God, or be aſcribed to him without derogation; ſuch as are temperance, valour, humility, and divers others: which is the leſs to be wondered at, becauſe there are ſome virtues (as chaſtity, faith, patience, liberality) that belong to man himſelf, only in his mortal and infirm condition. But whatever excellencies there be, that are ſimply and abſolutely ſuch, and ſo may, without diſparagement to his matchleſs nature, be aſcribed to God, ſuch as are eternity, independency, life, underſtanding, will, *&c.* we may be ſure, that he poſſeſſes them; ſince he is the original author of all the degrees or reſemblances we men have of any of them. And the Pſalmiſt's ratiocination is good, *He that planted the ear, ſhall he not hear? He that formed the eye, ſhall not he ſee?* Pſal. xciv. 9, 10. *He that teacheth man knowledge, ſhall not he know?* ſince all the perfections communicated to, or to be found in the creatures, (whether men, angels, or any other) being emanations of the divine excellencies, do as much belong to God, as in a bright day all the luminous beams, that are to be found in the air, belong to the ſun; (in whom they are united, and from whom they all proceeded.) The vaſt difference then between the perfections of the great creator, and thoſe, that are analagous to them in the creatures, reaches to all the perfections, that are, though in very differing manners, to be found in both; but yet the human underſtanding, as it values itſelf upon nothing more than wiſdom and knowledge, ſo there is nothing that it eſteems and reverences more in other beings, and is leſs willing to acknowledge itſelf ſurpaſſed in: for which reaſon, as I have in the foregoing part of this paper inculcated by more than one way, the great ſuperiority of God's intellect to man's; ſo I think it not improper to proſecute the ſame deſign, by mentioning to you ſome few particulars, whereby that ſuperiority may manifeſtly appear. We may then conſider, that beſides God knows an innumerable company of things, that we are altogether unacquainted with, ſince he cannot but know all the creatures he has made, whether viſible or inviſible, corporeal or immaterial, and what he has enabled them to do, according to that of St. *James*, *Known unto God are all his works from the beginning of the world*; Acts xv. 18. nay, ſince he cannot but know the extent of his own infinite power, he cannot but know numberleſs things as poſſible, that he has not yet made, nor perhaps ever will pleaſe to make. But to confine myſelf to things actually exiſtent, beſides his corporeal and immaterial cteatures, and their faculties or powers, whereof we have ſome kind of notice, and beſides perhaps multitudes of other things, whereof we have no particular idea or conjecture; he knows thoſe things whereof we men have alſo ſome knowledge, in a manner or degree peculiar to himſelf: as what we know but in part, he knows clearly, and what we know but by fallible mediums, he knows moſt certainly.

32. BUT the great prerogative of God's knowledge is, that he perfectly knows himſelf; that knowledge being not only too wonderful for a man (as even an inſpired perſon confeſſes touching himſelf) but beyond the reach of an angelical intellect; ſince fully to comprehend the infinite nature of God, no leſs than an infinite underſtanding is requiſite. And for the works of God, even thoſe, that are purely corporeal (which are therefore the meaneſt) our knowledge of theſe is incomparably inferior to his: for though ſome modern philoſophers have made ingenious attempts to explain the nature of things corporeal, yet their explications generally ſuppoſe the preſent fabric of the world, and the laws of motion that are ſettled in it; but God knows particularly, both why and how the univerſal matter was firſt contrived into

this admirable univerſe, rather than a world of any other of the numberleſs conſtructions he could have given it; and both why thoſe laws of motion, rather than others, were eſtabliſhed; and how ſenſeleſs matter, to whoſe nature motion does not at all belong, comes to be both put into motion, and qualified to transfer it according to determinate rules, which itſelf cannot underſtand. But when we come to conſider the particular and more elaborate works of nature; ſuch as the ſeeds or eggs of living creatures, or the texture of quickſilver, poiſons, antidotes, *&c.* the ingenious confeſs their ignorance, (about the manner of their production and operations) and the confident betray theirs. But it is like we men know ourſelves better, than what is without us; but how ignorant we are at home, if the endleſs diſputes of *Ariſtotle* and his commentators and other philoſophers about the human ſoul, and of phyſicians and anatomiſts about the mechaniſm and theory of the human body, were not ſufficient to manifeſt it, it were eaſy to be ſhewn (as it is in another paper) by the very conditions of the union of the ſoul and body; which being ſettled at firſt by God's arbitrary inſtitution, and having nothing in all nature parallel to them, the manner and terms of that ſtrange union is a riddle to philoſophers, but muſt needs be clearly known to him, that alone did inſtitute it, and, (all the while it laſts) does preſerve it. And there are ſeveral advantages of the divine knowledge above that of man, that are not here to be pretermitted; for firſt, we men can perceive and ſufficiently attend but to few things at once; according to the known ſaying,

The Title of this Paper is, *The Imperfection of Human knowledge manifeſted by its own light.*

Pluribus intentus minor eſt ad ſingula ſenſus.

AND it is recorded as a wonder of ſome great men among the ancients, that they could dictate to two or three ſecretaries at once. But God's knowledge reaches at once to all, that he can know; his penetrating eyes pierce quite through the whole creation at one look; and, as an inſpired penman declares, *there is no creature, that is not manifeſt in his ſight, but all things are naked,* and (if I may ſo render the greek word) *extraverted to his eyes.* He always ſees incomparably more objects at one view, than the ſun himſelf endued with ſight could do; for God beholds at once all, that every one of his creatures, (whether viſible or inviſible to us) in the vaſt univerſe, either does or thinks. Next, the knowledge of God is not a progreſſive or diſcurſive thing, like that acquired by our ratiocinations, but an intuitive knowledge; ſince, though we men, by reaſon of the limitedneſs and imperfections of our underſtandings, are fain to make the notice we have of one thing a ſtep and help to acquire that of another, which to us is leſs known; as may eaſily be obſerved even in the forms of ſyllogiſms; yet God, whoſe knowledge, as well as his other attributes are infinitely perfect, needs not know any one thing by the help of another: but knows every thing in itſelf (as being the author of it;) and all things being equally known to him, he can, by looking, if I may ſo ſpeak, into himſelf, ſee there, as in a divine and univerſal looking-glaſs, every thing that is knowable, moſt diſtinctly, and yet all at once. *Thirdly*, God knows moſt men's ſecret thoughts and intentions; whence he is called Καρδιογνώστης, and the *ſearcher of all hearts, that underſtandeth all the imaginations of the thoughts.* Nay, he knows men's thoughts afar off, and even never vented thoughts, which the man himſelf may not know; for not only St. *John* ſays, *that if our heart condemn us, God is greater than our heart, and knows all things*; but God enabled *Daniel* to declare to *Nebuchadnezzar* the whole ſeries of the prophetick dream, whereof that monarch's own memory could not retrieve any part. And here give me leave to obſerve, (what perchance you have not minded) that even of a thing, that happens to a man's ſelf, and is of a nature capable to make the moſt vivid impreſſions on him, God's knowledge may ſurpaſs his; ſince St. *Paul* ſpeaking of his being caught up into paradiſe, after

Heb. iv. 13. Τέτρα ηλιωμένα.

1 Chron. xviii. 9. Pſalms cxxxix. 2. 1 Joh. iii. 20. Dan. ii. 5. 31.

having twice ſaid, *whether in the body I cannot tell, or whether out of the body I cannot tell*, he both times ſubjoins, that *God knows*. Our knowledge of ourſelves, as well as that of thoſe other creatures, that are without us, being ſo defective, the confidence of ſome, that dare pretend to know God fully by the light of their natural reaſon, will not hinder me from taking hence a riſe to aſk this ſhort queſtion: *How imperfect muſt mere philoſophers knowledge of God's nature be, ſince they know him but by his works, and know his works themſelves but very imperfectly?* The other and fourth conſpicuous prerogative of the divine knowledge, is the preſcience of future contingents, that depend upon the determinations and actions of free agents: for we men are ſo far from being able to ſtretch our knowledge to the diſcovery of that ſort of events, that the greateſt clerks have tried their wits in vain to diſcover, how God himſelf can foreknow them; and therefore too many, even among Chriſtians, deny, that he can, though by divers accompliſhed predictions recorded in ſcripture, it manifeſtly appears that he does. 2 Cor. xii. 3, 4.

33. WHEN I conſider the tranſcendant excellency, and the numerous prerogatives of the Deity, I cannot without wonder, as well as trouble, obſerve, that rational men profeſſing Chriſtianity, and many of them ſtudious too, ſhould wilfully, and perhaps contemptuouſly, neglect to acquire or reflect on thoſe notices, that are apt to increaſe their knowledge of God, and conſequently their veneration for him. To aſpire to a farther knowledge of God, that we may the better adore him, is a great part both of man's duty and his happineſs. God, who has put into men an innate deſire of knowledge, and a faculty to diſtinguiſh the degrees of excellency in differing notices, and to reliſh thoſe moſt, that beſt deſerve it, and has made it his duty to ſearch and inquire after God, and to love him above all things, would not have done this, if he had not known that thoſe, that make a right uſe of their faculties, muſt find him to be the nobleſt object of the underſtanding, and that which moſt merits their wonder and veneration. And indeed, what can be more ſuitable to a rational creature, than to employ reaſon to contemplate that divine being, which is both the author of its reaſon, and the nobleſt object, about which it can poſſibly be employed? The knowledge of ſome dead language, or ſome old ruſty medal, or the opinions and cuſtoms of ſome nations or ſects, that did not perhaps reaſon nor live any better, than we do now, are thought worthy of curioſity, and even of the laborious induſtry of learned men; and the ſtudy of things merely corporeal, gains men the honourable title of philoſophers. But whatever theſe objects of inquiry be in themſelves, it is certain the greateſt diſcoveries we can make of them are but trifles, in compariſon of the excellency of the knowledge of God, which does as much ſurpaſs that of his works, as he himſelf does them. And it is the prerogative of his nature, to be infinitely above all that he has made; whether we contemplate the works of nature, or thoſe of art, whereof the former are, under another name, his more immediate works; and the others the effects of one of his works; and by conſequence are originally his, though produced by the intervention of man. And though it be moſt true, that on the corporeal world God has been pleaſed to ſtamp ſuch impreſſes of his power, wiſdom and goodneſs, as have juſtly exacted the admiration even of philoſophers, yet the great author of the world is himſelf incomparably ſuperior to all his workmanſhip, inſomuch, that, though he could have made, and always will be able to make, creatures more perfect, than thoſe he has made, by incomputable degrees of perfection; yet the prerogative of his nature will keep him neceſſarily ſuperior to the excellenteſt creatures he can make, ſince the very condition of a creature hinders it from being (to name now no other of the divine attributes) ſelf-exiſtent and independent. It is therefore methinks a ſad thing, that we men ſhould grudge to ſpend now and then a few hours in the contemplation and internal worſhip of that moſt glorious and perfect being, that continually employs the devotion of Angels themſelves. This I judge probable from hence, that thoſe bleſſed

ſpirits

ſpirits are repreſented in the ſcripture, as celebrating with joyful ſongs and acclamations the nativity of the world; and I think they may well be ſuppoſed to have an ardent deſire to obtain a farther knowledge of God himſelf; ſince, as an Apoſtle aſſures us, they earneſtly deſire to look into the truths contained in the goſpel, and the diſpenſations of God towards frail and mortal men.

34. I KNOW I may be told, that *ſcrutator majeſtatis, &c.* and that it is a dangerous thing to be inquiſitive about the nature of God; but not to urge, that the Latin ſentence is taken but out of an apocryphal book, I anſwer, that the ſecret things of God, that are to be left to himſelf, ſeem to be his unrevealed purpoſes and decrees, and his moſt abſtruſe eſſence or ſubſtance, the ſcrutiny whereof I readily acknowledge not to belong to us; but I think there is a great difference between contemplating God out of a ſaucy curioſity, merely to know ſomewhat, that is not common of him, and doing it out of an humble deſire, by a farther knowledge of him to heighten our reverence and devotion towards him. It is an effect of arrogance to endeavour, or ſo much as hope, to comprehend the divine perfections ſo, as to leave nothing in them unknown to the inquirer: but to aſpire to know them farther and farther, that they may proportionably appear more and more admirable and lovely in our eyes, is not only an excuſable, but a laudable curioſity. The ſcripture in one place exhorts us *to grow* not only *in grace*, but *in the knowledge of Chriſt*; and in another, *to add to our virtue knowledge*; and when *Moſes* begged to be bleſſed with a nearer and more particular view of God, though part of his requeſt was refuſed, becauſe the grant of it was unſuitable to his mortal ſtate, and perhaps muſt have proved fatal to him, whilſt he was in it; yet God vouchſafed ſo gracious a return to his petition, as ſhews he was not diſpleaſed with the ſupplicant; no action or ſuffering of his having procured for him ſo glorious a view, as was then vouchſafed to his holy curioſity. And that we may aſpire to great degrees of knowledge, even at thoſe ſupernatural objects, that we cannot adequately know, we may learn from St. *Paul*, who prays, that his *Epheſians*, as all true Chriſtians, may be able to comprehend what is the breadth and length and depth and height, and to know the love of Chriſt, which, ſays he in the very next words, paſſeth knowledge. Suppoſing it then lawful to contemplate God, not with deſign to pry into his decrees and purpoſes, not to dogmatiſe in points controverted among the learned about his nature and attributes, but to excite in ourſelves the ſentiments, which his indiſputable perfections are by a more attentive view qualified to produce; I conſider, that the devout contemplation of God, beſides other great advantages, that it brings the mind, inſomuch that the human underſtanding, like *Moſes* in the mount, does by an aſſiduous converſe with God acquire a laſting luminouſneſs; beſides this, I ſay, and the improving influence, that this happy converſation may have upon the graces and virtues of the mind, I take it to be one of the moſt delightful exerciſes, that the ſoul is capable of on this ſide Heaven. It is generally acknowledged, that admiration is one of the moſt pleaſing affections of the mind, which ſometimes, when the object deſerves it, is ſo poſſeſt thereby, as to forget all other things, or leave them unregarded; as it often happens in maſks, and other pompous and ſurpriſing ſhews or ſpectacles; and as, upon a better ground, it happened to St. *Peter*, when being raviſhed with the glorious transfiguration of his and our maſter upon mount *Tabor*, he exclaimed, that it was good for them to be there, and talked of building tabernacles for thoſe that had heavenly manſions, being ſo tranſported with the raviſhing ſight, that the evangeliſt expreſsly notes, that *he knew not what he ſaid*. Now, the pleaſure, that admiration gives, being uſually proportionate to the uncommon nature and indearing circumſtances of the thing admired, how can any admiration afford ſuch a contentment, as that, which has God himſelf for its object, and in him the moſt ſingular and the moſt excellent of all Beings? The wonder produced in us by an humble and attentive contemplation of God has

2 Pet. iii. 18.
2 Pet. i. 5.
Exodus xxxiii. 18.
Exodus xxxiv. 5. 6, &c.
Eph. iii. 18.
Exodus xxxiv. 29, 30, &c.
Lu. ix. 23.

two main advantages, above the admiration we have for any of his works, or of our own. For firſt, when we admire corporeal things, how noble and precious ſoever they be, as ſtars and gems, the contentment, that accompanies our wonder, is allayed by a kind of ſecret reproach grounded on that very wonder; ſince it argues a great imperfection in our underſtandings, to be poſed by things, that are but creatures, as well as we, and, which is worſe, of a nature very much inferior to ours: whereas it is no diſparagement at all for a human, and conſequently for a finite intellect, to be poſſeſſed with wonder, though it were heightened to amazement or aſtoniſhment, by the contemplation of that moſt glorious and infinitely perfect Being, which muſt neceſſarily exceed the adequate comprehenſion of any created intellect. But I conſider, that there is a farther and much greater (which is the ſecond) advantage of the admiration of God above that of other things; for other objects having but a bounded nature, and commonly but ſome one thing fit to be wondered at, our admiration of them is ſeldom laſting, but, after a little familiarity with them, firſt languiſhes and then ceaſes: but God is an object, whoſe nature is ſo very ſingular, and whoſe perfections are ſo immenſe, that no aſſiduity of conſidering him can make him ceaſe to be admirable, but the more knowledge we obtain of him, the more reaſon we find to admire him; ſo that there may be a perpetual viciſſitude of our happy acqueſts of farther degrees of knowledge, and our eager deſires of new ones. Becauſe we give him but one name, we are apt to look upon him, as but one object of ſpeculation; but though God be indeed but one in eſſence or nature, yet ſuch is his immenſity, and, if I may ſo ſpeak, fecundity, that he is unſpeakably various in the capacity of an object. Thus heaven goes under one name, but contains ſo many fixed ſtars and planets, and they, by their diverſity of motions, exhibit ſo many phænomena, that though they have employed the curioſity of aſtronomers for many ages, yet our times have, in the celeſtial part of the world, made diſcoveries as conſiderable, if not as numerous, as all thoſe of the antients; and as our optick glaſſes have detected many fixed ſtars, and divers planets, that were unknown to former times, ſo our navigators, by their voyages beyond the line, have diſcovered divers whole conſtellations in the ſouthern hemiſphere: ſo that though heaven be an object, that has been perpetually and conſpicuouſly expoſed to men's view and curioſity for ſome thouſands of years, yet it ſtill affords new ſubjects for their wonder; and I ſcarce doubt, but by the farther improvements of teleſcopes poſterity will have its curioſity gratified by the diſcovery both of new conſtellations, and of new ſtars in thoſe, that are known to us already. We need not therefore fear our admiration of God ſhould expire, for want of objects fit to keep it up. That boundleſs ocean contains a variety of excellent objects, that is as little to be exhauſted, as the creatures, that live in our ſublunary ocean, or lie on the ſhores, that limit it, can be numbered. To the wonderful excellency of God may be juſtly applied that notion, which *Ariſtotle* lays down as a kind of definition of infinite; namely, that it is that, of which how much ſoever one takes, there ſtill remains more to be taken. If the intellect ſhould for ever make a farther and farther progreſs in the knowledge of the wonders of the divine nature, attributes and diſpenſations; yet it may ſtill make diſcoveries of freſh things worthy to be admired: as in an infinite ſeries, or row of aſcending numbers, though you may ſtill advance to greater and greater numbers, yet all that you can do by that progreſs, is to go farther and farther from the firſt and leaſt term of the progreſſion, (which in our caſe anſwers to the ſmalleſt degree of our knowledge of God) without ever reaching, or, which may ſeem ſtrange, but is true, ſo much as approaching to an infinite number, (in caſe there were any ſuch) or even to the greateſt of all numbers; as will be acknowledged by thoſe, that have looked into the properties of progreſſions *in infinitum*.

35. THE two advantages I come from mentioning, which the admiration of God has, in point of delightfulneſs, joined to the other advantages of our contemplation of him, have, I hope, perſuaded you, that they are very much wanting to themſelves, as well as to the duty they owe their Maker, that refuſe or neglect to give their thoughts ſo pleaſing, as well as noble an employment. And I am apt to think, upon this account in particular, that reaſon is a greater bleſſing to other men, than to atheiſts, who, whilſt they are ſuch, cannot employ it about God, but with diſbelief or terror; and that on this very ſcore *Epicurus* was far leſs happy than *Plato*; ſince whereas the latter was oftentimes, as it were, ſwallowed up in contemplation of the Deity, the former had no ſuch glorious object to poſſeſs him with an equally rational and delightful admiration.

36. BUT now, (to apply this to the ſcope of this whole diſcourſe) though ſo pure and ſpiritual a pleaſure is a very allowable attractive to elevate our thoughts to the moſt glorious and amiable of objects; yet it ought to be both the deſign and the effect of our admiration of God, to produce in us leſs unworthy ideas, and more honourable and reverent thoughts of that wonderful and unparalleled Being; of whom the more we diſcover, the more we diſcern him to be ſuperior to all his works, and particularly to ourſelves, who are not of the higheſt order of them, and who, as mere men, are ſcarce in any thing more noble, than in the capacity and permiſſion of knowing, admiring and adoring God; which he that thinks a mean and melancholy employment, might be to ſeek for happineſs in heaven itſelf, if ſo unqualified a ſoul could be admitted there. The genuine effect of a nearer or more attentive view of infinite excellency is a deep ſenſe of our own great inferiority to it, and of the great veneration and fear we owe (to ſpeak in a ſcripture phraſe) to this glorious and fearful name, (that is object) *The Lord our God.* And accordingly, when God had ſpoken to *Job* out of the whirlwind, and declared ſomewhat to him of the divine greatneſs, this holy philoſopher much alters his ſtyle, and confeſſes, that in his former diſcourſes of God, he had *uttered what he underſtood not, things too wonderful for him, which he knew not:* and having thereupon implored inſtruction from God, he declares how fit a nearer knowledge of him is to make a man have low thoughts of *himſelf*; *I have heard of thee,* (ſays he to his Maker) *by the hearing of the ear, but now mine eye ſeeth thee: wherefore* (infers he) *I abhor myſelf, and repent in duſt and aſhes.*

Deut. xxviii. 58.

Job xlii. 3, 4, 5, 6.

I KNOW you may look upon a good part of this excurſion as a digreſſion; but if it be, it will quickly be forgiven, if you will pardon me for it, as eaſily as I can pardon myſelf for finding myſelf in *David*'s caſe, when he ſaid, *my heart was hot within me, while I was muſing the fire burned,* as he ſaid, *then ſpake I with my tongue:* ſo I was content to let my pen run on in ſo pleaſant and noble a theme, and endeavour to excite, at leaſt in myſelf, ſuch a well grounded admiration of God, as may perhaps be a part of my *reaſonable ſervice* to him, or rational worſhip of him. God is pleaſed to declare, *that he that offers* (or, as it is in the original, ſacrifices) *praiſe, glorifies him*; and the ſcripture expreſly ſtiles our devotion *ſacrifices of praiſe.* And we may well ſuppoſe, that if the *calves of our lips,* as our celebrations of God are ſomewhere called, are encouraged by God, thoſe mental offerings, that conſiſt in high and honourable thoughts of him, and in lowly humble ſentiments of ourſelves, in the view of his excellency, will not be leſs acceptable to him; ſuch *reverence and devout fear* (to ſpeak with the inſpired writer to the Hebrews) being indeed a kind of *adoring God in ſpirit and in truth*; and he that is ſo employed, may with contentment compare his condition to that of *Zacharias*, when it was ſaid of him, that *his lot was to burn incenſe,* to offer up to God the nobleſt and pureſt ſort of the legal ſacrifices. But, that I may not too far digreſs, I ſhall only add, that I think myſelf very worthily, as well as delightfully

Pſalm xxxix. 3.

Rom. xii. 2.
Pſal. l. 23.
Heb. xiii. 15.

Heb. xii. 28.

John iv. 23.
Luke i. 9.

lightfully employed, when I am ſeeking after, and bringing together, what helps I can, to greaten, as much as I am able, thoſe ſentiments of wonder and veneration for God, that I am ſure can never be great enough; eſpecially ſince the more we know and adore that infinite excellency and exuberant fountain of goodneſs, the more influence and advantages we derive from it: agreeably to which, God is introduced in the ſcripture, ſaying of one of his adorers, to whom, in the ſame pſalm, many other bleſſings are alſo promiſed, *becauſe he has ſet his love upon me, therefore will I deliver him: I will ſet him on high, becauſe he has known my name.* Pſal. xci. 14, 15, 16.

WE have generally, through incogitancy, or vice, or prejudices, or the majeſty and abſtruſeneſs of the ſubject, ſo great an indiſpoſition to excite and cheriſh in ourſelves an awful veneration for God, and a ſtudious contemplation of his adorable attributes, that it ſeemed no more than needful to employ variety of arguments, drawn from different topicks, to engage our own and other men's minds, and repeated inculcations to preſs them to an exerciſe, which they neither are, nor are willing to be acquainted with. This conſideration will, I hope, be my apology, if, in the preſent tract, I lay hold on ſeveral occaſions, and make uſe of diverſities of diſcourſe, to recommend a duty, that does very much both merit, and need to be not only propoſed but inculcated; and yet I will not any farther lengthen this foregoing excurſion, (as I hope you will think it, rather than a mere digreſſion,) nor any longer forget, that when I begun it, I was diſcourſing of the great caution and profound reſpect with which we ought to ſpeak of God.

37. IT were tedious to inſiſt on all the arguments, that may be brought of the immenſe inferiority of man's intellect to God's; and therefore I ſhall here content myſelf to illuſtrate ſome part of it, by a ſimile borrowed from the ſuperior and inferior luminaries of heaven; human reaſon, in compariſon of the divine intellect, being but like the moon in reference to the ſun. For as the moon, at beſt, is but a ſmall ſtar in compariſon of the ſun, and has but a dim light, and that too but borrowed; and has her wane, as well as her full, and is often ſubject to eclipſes, and always blemiſhed with dark ſpots: ſo the light of human reaſon is but very ſmall and dim, in compariſon of his knowledge, that is truly called in ſcripture the *Fountain*, as the *Father*, of light; and this light itſelf, which ſhines in the human intellect, is derived from the irradiation it receives from God, *in whoſe light* it is, that *we ſee light*. And this, as it is but a communicated light, is ſubject to be increaſed, impaired, and oftentimes to be almoſt totally eclipſed, either by the darkening fumes of luſts or paſſions, or the ſuſpenſion of the provoked donor's beams, and, in its beſt ſtate, is always blemiſhed with imperfections, that make it uncapable of an entire and uniform illumination. Pſalm xxxvi. 9. Jam. i. 17.

UPON theſe and divers other conſiderations I, for my part, think it becomes us men to uſe an awful circumſpection, not only when we make philoſophical inquiries or ſcholaſtic diſputes about God, that is, when we preſume to diſcourſe of him; but when we ſolemnly deſign to praiſe him; for it is one thing to ſay true things of God, and another to ſay things worthy of God. Our ideas of him may be the beſt we are able to frame, and yet may far better expreſs the greatneſs of our veneration for him, than the immenſity of his perfections: and even thoſe notions of them, that may be worthy of the moſt intelligent of men, will fall extremely ſhort of being worthy of the incomprehenſible God. The brighteſt and leaſt unlike idea we can frame of God, is infinitely more inferior in reference to him, than a parhelion is in reference to the ſun: for, though that meteor appear a ſplendid and ſublime thing, and have ſo much reſemblance to the ſun (without whoſe own beams it is not produced) as to be readily perceived to be his image, excluſively to that of any other: yet reſiding in a cloud, whoſe ſtation is near the earth, it is by an immenſe diſtance beneath the ſun, and is no

leſs inferior to him in bigneſs and in ſplendor, as well as in many other attributes. He has, in my opinion, the trueſt veneration for God, not who can ſet forth his excellencies and prerogatives in the moſt high and pompous expreſſions; but he, who willingly has a deep and real ſenſe of the unmeaſurable inferiority of himſelf, and his beſt ideas, to the unbounded and unparalleled perfections of his Maker. And here indignation prompts me to this reflection, that if [ſince] even our hymns and praiſes of God, the ſupreme Being, deſerve our bluſhes, and need his pardon, what confuſion will one day cover the faces of thoſe, that do not only ſpeak ſlightly and careleſly, but oftentimes contemptuouſly, and perhaps drollingly, of that ſupreme and infinitely perfect Being, to whom they owe thoſe very faculties, and that wit, which they ſo ungratefully, as well as impiouſly miſemploy? And indeed, ſuch tranſcendent excellencies, as the divine ones muſt be, might juſtly diſcourage us from offering ſo much as to celebrate them, if infinite goodneſs were not one of them. I ſhall not therefore allow myſelf the preſumption of pretending to make, as it were, a panegyric of God, of whom it is very eaſy to ſpeak too much, though it be not poſſible to ſay enough; contenting myſelf with an humble adoration of perfections, whereof my utmoſt praiſes would rather expreſs my own weakneſs than their excellency; ſince of this ineffable object, the higheſt things, that can be expreſſed in words, muſt therefore fall ſhort, becauſe words cannot expreſs them: which aſſertion, though it be a paradox, yet I think it is not truly an hyperbole; for we are not able to determine and reach, ſo much as in our thoughts, the greateſt of all poſſible numbers; ſince we may conceive, that any one (whatſoever it be) that can be pitched upon or aſſigned, may be doubled, trebled, or multiplied by ſome other number, or may be but the root of a ſquare or cubical number. By which inſtance (that perhaps you have not met with) you may perceive, that any determinate conception, that we can have (for example) of God's immenſity (to ſpecify now no other of his attributes) muſt therefore be ſhort of it, becauſe it is a determined or bounded conception. It is fit therefore, that I ſhould at length put limits to my diſcourſe, ſince none can be put to the extent or perfections of my ſubject.

The CONCLUSION.

THE reſult of what hath been ſaid in the paſt excurſion, will, I hope, amount to a ſufficient juſtification of what hath been ſaid at the beginning of this diſcourſe about *The high veneration our intellects owe to God.* For ſince we may well think in general, that he hath divers attributes and perfections, of which we have no knowledge or ſuſpicion in particular; and ſince of thoſe attributes of his, that are the moſt manifeſt to us, as his power and wiſdom, we have but a very dim and narrow knowledge, and may clearly perceive, that there is in theſe an unbounded extent of perfection, beyond all that we can evidently and diſtinctly diſcern of them; how unfit muſt ſuch imperfect creatures, as we are, be to talk haſtily and confidently of God, as of an object, that our contracted underſtandings graſp, as they are able (or pretend to be ſo) to do other objects! And how deep a ſenſe ought we to have of our ineſtimable inferiority to a Being, in reference to whom, both our ignorance and our knowledge ought to be the parents of devotion! ſince our neceſſary ignorance proceeds from the numerouſneſs and incomprehenſibleneſs of his (many of them undiſcovered) excellencies, and our knowledge qualifies us but to be the more intelligent admirers of his conſpicuous perfections.

IF we duly and impartially conſider theſe and the like things, we may clearly perceive, how great an effect and mark of ignorance, as well as preſumption, it is, for us mortals, to talk of God's nature and the extent of his knowledge, as of things,

that

that we are able to look through, and to meaſure. Whereas we ought, whenever we ſpeak of God and of his attributes, to ſtand in great awe, leſt we be guilty of any miſapprehenſion or miſrepreſentation of him, that we might, by any warineſs and humility of ours, have avoided; and leſt, by an over-weening opinion of ourſelves, we preſume, that we have a perfect, or, at leaſt, a ſufficient knowledge of every thing in God, whereof we have ſome knowledge; ſince this, at the leaſt, conſiſts in ſuch notions, as are rather ſuited to our limited faculties, than any way equal to his boundleſs perfections.

THAT high order of intellectual beings the angels, though their minds be ſo illuminated, and their knowledge ſo extenſive; the angels themſelves, I ſay, are in the ſcripture affirmed to be deſirous to pry into the myſteries of the goſpel: whence we may gueſs, how far they are from penetrating to the bottom of what the ſcripture calls *the depths of God*; and how much farther they are from comprehending the infinite nature of God. And accordingly, when in the (formerly mentioned) majeſtic viſion, that appeared to the prophet *Iſaiah*, they are ſet forth as attendants about the throne of God, they are repreſented *covering their faces with their wings*, as not able to ſupport, or not preſuming to gaze on the dazzling brightneſs of the divine majeſty. And ſhall we, poor ſinful mortals, who are infinitely beneath him, not only by the degeneracy and ſinfulneſs of our lives, but even by the imperfection and inferiority of our nature, preſume to talk forwardly or irreverently of the divine eſſence and perfections, without conſidering the immenſe diſtance betwixt God and us: and how unable, as well as unworthy, we are to penetrate the receſſes of that inſcrutable, as well as adorable nature; and how much better it would become us, when we ſpeak of objects ſo much above us, to imitate the juſt humility of that inſpired poet, that ſaid * *Such knowledge is too wonderful for me; it is high, I cannot attain unto it*; and join in that ſeemingly, and yet but ſeemingly, lofty celebration of God, † *That his glorious name is exalted above all bleſſing and praiſe.*

* Pſalm cxxxvi. 6.
† Neh. ix. 5.

A

FREE INQUIRY

Into the VULGARLY RECEIVED

NOTION of NATURE:

MADE IN

An ESSAY addreſſed to a FRIEND.

Audendum eſt, et veritas inveſtiganda; quam etiamſi non aſſequamur, omnino tamen proprius, quam nunc ſumus, ad eam perveniemus GALENUS.

The PREFACE.

I HAVE often wondered, that, in ſo inquiſitive an age as this, among thoſe many learned men, that have with much freedom, as well as acuteneſs, written of the works of nature, (as they call them) and ſome of them of the principles too, I have not met with any, that has made it his buſineſs to write of nature herſelf. This will perhaps hereafter be thought ſuch an omiſſion, as if, giving an account of the political eſtate of a kingdom, one ſhould treat largely of the civil judges, military officers, and other ſubordinate magiſtrates, and of the particular ranks and orders of inferior ſubjects and plebeians, but ſhould be ſilent of the prerogatives and ways of adminiſtration of the king; or, (to uſe a compariſon more ſuitable to the ſubject) as if one ſhould particularly treat of the barrel, wheels, ſtring, balance, index, and other parts of a watch, without examining the nature of the ſpring, that ſets all theſe a moving. When I ſay this, I do not forget, that the word Nature is every where to be met with in the writings of phyſiologers: but, though they frequently employ the word, they ſeem not to have much conſidered what notion ought to be framed of the thing, which they ſuppoſe and admire, and, upon occaſion, celebrate, but do not call in queſtion or diſcuſs. Weighing therefore with myſelf, of what great moment the framing a right or a wrong idea of nature muſt be, in reference both to the ſpeculative and practical part of phyſiology, I judged it very well worth the while, to make, with philoſophical freedom, a ſerious inquiry into the vulgarly received notion of nature; that, if it appeared well grounded, I might have the rational ſatisfaction of not having acquieſced in it, till after a previous examen; if I ſhould find it confuſed and ambiguous, I might endeavour to remedy that inconvenience, by diſtinguiſhing the acceptions of the word; if I found it dubious as to its truth, I might be ſhy in truſting too much to a diſtruſted principle; and, if I found it erroneous, I might avoid the raiſing ſuperſtructures of my own, or relying on thoſe of others, that muſt owe their ſtability to an unſound and deceitful foundation. And, becauſe many atheiſts aſcribe ſo much to nature, that they think it needleſs to have recourſe to a deity for the giving an account of the phænomena of the univerſe; and, on the other ſide, very many theiſts ſeem to think the commonly received notion of nature little leſs than neceſſary to the proof of the exiſtence and providence of God: I, who differ

from both theſe parties, and yet think every true theiſt, and much more every true Chriſtian, ought to be much concerned for truths, that have ſo powerful an influence on religion, thought myſelf, for it's ſake, obliged to conſider this matter, both with the more attention and with regard to religion.

AND yet being to write this treatiſe as a Phyſiologer, not a Chriſtian, I could not rationally build any poſitive doctrine upon mere revelation, which would have been judged a foreign principle in this inquiry: only, ſince the perſon, I intentionally addreſſed my thoughts to, under the name of *Eleutherius*, was a good Chriſtian, I held it not impertinent, now and then, upon the bye, to intimate ſomething to prevent or remove ſome ſcruples, that I thought he might have on the ſcore (I ſay not of natural theology, for that is almoſt directly pertinent, but) of the Chriſtian faith. But theſe paſſages are very few, and but tranſiently touched upon.

SINCE the reader will be told by and by both that, and why the papers, that make up the following treatiſe, were not written in one continued ſeries of times, but many years were interpoſed between the writing of ſome of them, and that of thoſe, which precede and follow them; I hope it will be thought but a venial fault, if the contexture of the whole diſcourſe do not appear ſo uniform, nor all the connections of its parts ſo apt and cloſe, as, if no papers had been loſt and ſupplied, might reaſonably be looked for.

I EXPECT the novelty of divers of the ſentiments and reaſonings propoſed in the following diſcourſe will be ſurpriſing, and incline many to look upon the author, as a bold man, and much addicted to paradoxes. But having formerly, in a diſtinct eſſay, delivered my thoughts about paradoxes in general, I ſhall not now engage in that ſubject, but confine myſelf to what concerns the enſuing paper. I ſay then, in ſhort, that in an opinion, I look upon its being new or antient, and its being ſingular or commonly received, as things, that are but extrinſical to its being true or falſe: and, as I would never reject a truth, for being generally known or received; ſo will I not conclude an opinion to be a truth, merely becauſe great numbers have thought it to be ſo; nor think an opinion erroneous, becauſe it is not yet known to many, or becauſe it oppoſes a tenet embraced by many. For I am wont to judge of opinions, as of coins: I conſider much leſs in any one, that I am to receive, whoſe inſcription it bears, than what metal it is made of. It is indifferent enough to me, whether it was ſtamped many years or ages ſince, or came but yeſterday from the *Mint*. Nor do I regard through how many, or how few, hands it has paſſed for current, provided I know by the touch-ſtone, or any ſuch trial, purpoſedly made, whether or no it be genuine, and does or does not deſerve to have been current: for, if upon due proof it appears to be good, its having been long and by many received for ſuch, will not tempt me to refuſe it. But if I find it counterfeit, neither the prince's image or inſcription, nor its date (how antient ſoever,) nor the multitude of hands, through which it has paſſed unſuſpected, will engage me to receive it; and one diſfavouring trial, well made, will much more diſcredit it with me, than all thoſe ſpecious things I have named can recommend.

BY this declaration of my ſentiments about paradoxes in general, I hope it will be thought, that the motive I had to queſtion that notion of nature, which I diſſent from, was not, that this notion is vulgarly received. And I have this to ſay, to make it probable, that I was not engaged in this controverſy by any ambition of appearing in print an hereſiarch in philoſophy, by being the author of a ſtrange doctrine, that the following diſcourſe was written about the year 1666. (that is, ſome luſtres ago,) and that not long after the youth, to whom I dictated it, having been inveigled to ſteal away, unknown to me or his parents, into the *Indies*, (whence we never heard

of

of him ſince,) left the looſe ſheets, wherein (and not in a book) my thoughts had been committed to paper, very incoherent, by the omiſſion of divers neceſſary paſſages. Upon which account, and my unwillingneſs to take the pains to ſupply what was wanting, thoſe papers lay by me many years together neglected, and almoſt forgotten; until the curioſity of ſome philoſophical heads, that were pleaſed to think they deſerved another fate, obliged me to tack them together, and make up the gaps, that remained between their parts, by retrieving, as well as after ſo many years my bad memory was able to do, the thoughts I ſometimes had pertinent to thoſe purpoſes. And indeed, when I conſidered of how vaſt importance it is in philoſophy, and the practice of phyſic too, to have a right notion of nature; and how little the authority of the generality of men ought, in ſo nice and intricate a ſubject, to ſway a free and impartial ſpirit; as I at firſt thought myſelf obliged, ſince others had not ſaved me the labour, to make a free inquiry into this noble and difficult ſubject, ſo I was afterwards the more eaſily prevailed with by thoſe, that preſſed the publication of it. With what ſucceſs I have made this attempt, I muſt leave others to judge. But if I be not much flattered, whatever becomes of the main attempt, there will be found ſuggeſted here and there, in the following diſcourſe, ſome reflections and explications, that will at leaſt oblige the zealous aſſertors of the vulgar notion of nature to clear up the doctrine, and ſpeak more diſtinctly and correctly about things, that relate to it, than hitherto has been uſual; and that will be fruit enough to recompenſe the labour, and juſtify the title of a free inquiry: in proſecution of which, ſince I have been obliged to travel in an untrodden way, without a guide, it will be thought, I hope, more pardonable than ſtrange, if, in attempting to diſcover divers general miſtakes, I be not ſo happy as to eſcape falling into ſome particular ones myſelf; and, if among theſe, I have been ſo unhappy, as to make any, that is injurious to religion, as I did not at all intend it, ſo, as ſoon as ever I ſhall diſcover it, I ſhall freely diſown it myſelf, and pray that it may never miſlead others. What my performance has been, I have already acknowledged, that I may be unfit to judge; but, for my intentions, I may make bold to ſay, they were to keep the glory of the divine author of things from being uſurped or intrenched upon by his creatures, and to make his works more throughly and ſolidly underſtood by the philoſophical ſtudiers of them.

I DO not pretend, and I need not, that every one of the arguments I employ in the following tract is cogent, eſpecially if conſidered as ſingle. For demonſtrative arguments would be unſuitable to the very title of my attempt; ſince, if about the received notion of nature, I were furniſhed with unanſwerable reaſons, my diſcourſe ought to be ſtiled, not a free inquiry into the vulgar notion of nature I conſider, but a confutation of it; and a heap of bare probabilities may ſuffice to juſtify a doubt of the truth of an opinion, which they cannot clearly evince to be falſe. And therefore, if any man ſhall think fit to criticize upon the leſs principal or leſs neceſſary parts of this treatiſe, perhaps I ſhall not think myſelf obliged to be concerned at it: and even if the main body of the diſcourſe itſelf ſhall be attacked from the preſs; I, who am neither young nor healthy, nor ever made divinity, philoſophy or phyſic, my profeſſion, am not like to oppoſe him in the ſame way: ſince, as I ought not to wiſh, that any errors of mine (if this eſſay teach any ſuch,) ſhould prevail; ſo, if the things I have delivered be true for the main, I need not deſpair, but that in ſuch a free and inquiſitive age as ours, there will be found generous ſpirits, that will not ſuffer weighty truths to be oppreſſed, though the propoſers of them ſhould, by averſeneſs from contention, or by want of time or health, be themſelves kept from defending them: which I have thought fit to take notice of in this place, that the truth

(if I have been ſo happy, as to have found and taught it,) may not ſuffer by my ſilence; nor any reader ſurmiſe, that if I ſhall leave a book unanſwered, I thereby acknowledge it to be unanſwerable. But this regards only the main ſubſtance of our eſſay, not the order or diſpoſition of the parts; ſince, if any ſhall cenſure that, I ſhall not quarrel with him about it: for indeed, conſidering in how prepoſterous an order the papers I have here tacked together came to hand, and how many things are upon that ſcore unduly placed, I ſhall not only be content, but muſt deſire to have this rhapſody of my own looſe papers looked upon but as an apparatus, or collection of materials, in order to [what I well know this maimed and confuſed eſſay is not] a compleat and regular diſcourſe. Yet, (to conclude,) I thought, that the affording even of a little light, in a ſubject ſo dark and ſo very important, might keep an eſſay from being uſeleſs; and that to fall ſhort of demonſtration would prove a pardonable fault, in a diſcourſe, that pretends not to dogmatize, but only to make an inquiry.

Sept. 29, 1682.

A FREE INQUIRY into the received NOTION of NATURE.

SECT. I.

I KNOW not, whether or no it be a prerogative in the human ſoul, that as it is itſelf a true and poſitive Being, ſo it is apt to conceive all other things, as true and poſitive beings alſo: but, whether or no this propenſity to frame ſuch kind of ideas ſuppoſes an excellency, I fear it occaſions miſtakes, and makes us think and ſpeak, after the manner of true and poſitive beings, of ſuch things, as are but chimerical, and ſome of them negations or privations themſelves; as death, ignorance, blindneſs, and the like.

IT concerns us therefore to ſtand very carefully upon our guard, that we be not inſenſibly miſled by ſuch an innate and unheeded temptation to error, as we bring into the world with us; and conſequently I may be allowed to conſider, whether among other particulars, in which this deluding propenſity of our minds has too great, though unſuſpected, an influence upon us, it may not have impoſed on us, in the notion we are wont to frame concerning nature: for this being the fruitful parent of other notions, as nature herſelf is ſaid to be of the creatures of the univerſe; the notion is ſo general in its applications, and ſo important in its influence, that we had need be jealouſly careful of not over-eaſily admitting a notion, than which there can ſcarce be any, that more deſerves to be warily examined, before it be throughly entertained.

LET me therefore make bold to inquire freely, whether that, of which we affirm, ſuch great things, and to which we aſcribe ſo many feats, be that almoſt divine thing whoſe works, among others, we are; or a notional thing, that in ſome ſenſe is rather to be reckoned among our works, as owing its being to human intellects.

I KNOW moſt men will be foreſtalled with no mean prejudices againſt ſo venturous an attempt; but I will not do *Eleutherius* the injury to meaſure him by the prepoſſeſſed generality of men; yet there are two ſcruples, which I think it not amiſs to take notice of, to clear the way for what ſhall be preſented you in the following diſcourſe.

AND firſt, it may ſeem an ingrateful and unfilial thing to diſpute againſt nature, that is taken by mankind for the common parent of us all. But though it be an undutiful thing, to expreſs a want of reſpect for an acknowledged parent, yet I know not, why it may not be allowable to queſtion one, that a man looks upon but as a pretended one, or at leaſt does upon probable grounds doubt, whether ſhe be ſo or no; and until it appear to me, that ſhe is ſo, I think it my duty to pay my gratitude, not to I know not what, but to that deity, whoſe wiſdom and goodneſs, not only deſigned to make me a man, and enjoy what I am here bleſſed with, but contrived the world ſo that even thoſe creatures of his, who by their inanimate condition are not capable of intending to gratify me, ſhould be as ſerviceable and uſeful to me, as they would be if they could and did deſign the being ſo: and you may be pleaſed to remember, that, as men may now accuſe ſuch an inquirer, as I am, of impiety and ingratitude towards nature; ſo the Perſians, and other worſhippers of the cœleſtial bodies, accuſed ſeveral of the antient philoſophers, and all the primitive Chriſtians, of the like crimes, in reference to the ſun; whoſe exiſtence, and whoſe being a benefactor to mankind was far more unqueſtionable, than that there is ſuch a ſemi-deity, as men call nature: and it can be no great diſparagement to me, to ſuffer on the like account with ſo good company, eſpecially when ſeveral of the conſiderations, that juſtify them, may alſo apologize for me. I might add, that it not being half ſo evident to me that what is called nature is my parent, as that all men are my brothers, by being the off-ſpring
Acts xvii. of God; (for the τοῦ γὰρ γένος ἐσμὲν of *Aratus* is adopted by St. *Paul*) I may juſtly prefer the doing of them a ſervice, by diſabuſing them, to the paying of her a ceremonial reſpect. But ſetting allegories aſide, I have ſometimes ſeriouſly doubted, whether the vulgar notion of nature has not been both injurious to the glory of God, and a great impediment to the ſolid and uſeful diſcovery of his works.

AND firſt, it ſeems to detract from the honour of the great author and governor of the world, that men ſhould aſcribe moſt of the admirable things, that are to be met with in it, not to him but to a certain nature, which themſelves do not well know what to make of. It is true, that many confeſs, that this nature is a thing of his eſtabliſhing, and ſubordinate to him: but, though many confeſs it, when they are aſked, whether they do or no? yet, beſides that many ſeldom or never lifted up their eyes to any higher cauſe, he, that takes notice of their way of aſcribing things to nature, may eaſily diſcern, that, whatever their words ſometimes be, the agency of God is little taken notice of in their thoughts: and however, it does not a little darken the excellency of the divine management of things, that, when a ſtrange thing is to be accounted for, men ſo often have recourſe to nature, and think ſhe muſt extraordinarily interpoſe to bring ſuch things about; whereas it much more tends to the illuſtration of God's wiſdom, to have ſo framed things at firſt, that there can ſeldom or never need any extraordinary interpoſition of his power. And, as it more recommends the ſkill of an engineer to contrive an elaborate engine ſo, as that there ſhould need nothing to reach his ends in it but the contrivance of parts devoid of underſtanding, than if it were neceſſary, that ever and anon a diſcreet ſervant ſhould be employed to concur notably to the operations of this or that part, or to hinder the engine from being out of order; ſo it more ſets off the wiſdom of God in the fabric of the univerſe, that he can make ſo vaſt a machine perform all thoſe many things, which he deſigned it ſhould, by the meer contrivance of brute matter managed by certain laws of local motion and upheld by his ordinary and general concourſe, than if he employed from time to time an intelligent overſeer, ſuch as nature is fancied to be, to regulate, aſſiſt, and controul the motions of the parts: in confirmation of which you may remember, that the later poets juſtly reprehended their predeceſſors

for want of ſkill in laying the plots of their plays, becauſe they often ſuffered things to be reduced to that paſs, that they were fain to bring ſome deity (Θεὸς ἀπὸ μηχανῆς) upon the ſtage, to help them out.

(*Nec deus interſit, niſi dignus vindice nodus,*) &c.

And let me tell you freely, that though I will not ſay, that *Ariſtotle* meant the miſchief his doctrine did, yet I am apt to think, that the grand enemy of God's glory made great uſe of *Ariſtotle*'s authority and errors, to detract from it.

For as *Ariſtotle*, by introducing the opinion of the eternity of the world, (whereof he owns himſelf to have been the firſt broacher) did at leaſt, in almoſt all men's opinion, openly deny God the production of the world; ſo, by aſcribing the admirable works of God to what he calls nature, he tacitly denies him the government of the world: which ſuſpicion if you judge ſevere, I ſhall not, at more leiſure, refuſe to acquaint you, (in a diſtinct paper) why I take divers of *Ariſtotle*'s opinions relating to religion to be more unfriendly, not to ſay pernicious, to it, than thoſe of ſeveral other heathen philoſophers.

And here give me leave to prevent an objection, that ſome may make, as if to deny the received notion of nature, a man muſt alſo deny providence, of which nature is the grand inſtrument. For, in the firſt place, my opinion hinders me not at all from acknowledging God to be the author of the univerſe, and the continual preſerver and upholder of it; which is much more than the peripatetic hypotheſis, which (as we were ſaying) makes the world eternal, will allow its embracers to admit: and thoſe things, which the ſchool-philoſophers aſcribe to the agency of nature interpoſing according to emergencies, I aſcribe to the wiſdom of God in the firſt fabric of the univerſe, which he ſo admirably contrived, that, if he but continue his ordinary and general concourſe, there will be no neceſſity of extraordinary interpoſitions, which may reduce him to ſeem, as it were, to play after-games; all thoſe exigencies, upon whoſe account philoſophers and phyſicians ſeem to have deviſed what they call nature, being foreſeen and provided for in the firſt fabric of the world; ſo that mere matter, ſo ordered, ſhall, in ſuch and ſuch conjunctures of circumſtances, do all, that philoſophers aſcribe on ſuch occaſions to their almoſt omniſcient nature, without any knowledge of what it does, or acting otherwiſe than according to the catholic laws of motion. And methinks the difference betwixt their opinion of God's agency in the world, and that, which I would propoſe, may be ſomewhat adumbrated by ſaying, that they ſeem to imagine the world to be after the nature of a puppet, whoſe contrivance indeed may be very artificial, but yet is ſuch, that almoſt every particular motion the artificer is fain (by drawing ſometimes one wire or ſtring, ſometimes another) to guide and oftentimes over-rule the actions of the engine; whereas, according to us, it is like a rare clock, ſuch as may be that at *Straſburgh*, where all things are ſo ſkilfully contrived, that the engine being once ſet a moving, all things proceed, according to the artificer's firſt deſign, and the motions of the little ſtatues, that at ſuch hours performs theſe or thoſe things, do not require, like thoſe of puppets, the peculiar interpoſing of the artificer, or any intelligent agent employed by him, but perform their functions upon particular occaſions, by virtue of the general and primitive contrivance of the whole engine. The modern *Ariſtotelians* and other philoſophers would not be taxed as injurious to providence, though they now aſcribe to the ordinary courſe of nature thoſe regular motions of the planets, that *Ariſtotle* and moſt of his followers (and among them the Chriſtian ſchoolmen) did formerly aſcribe to the particular guidance of intelligent and immaterial beings, which they aſſigned to be the motives

of the cœleſtial orbs. And when I conſider, how many things, that ſeem anomalies to us, do frequently enough happen in the world, I think it is more conſonant to the reſpect we owe to divine providence, to conceive, that as God is a moſt free, as well as a moſt wiſe agent, and may in many things have ends unknown to us, he very well foreſaw, and thought fit, that ſuch ſeeming anomalies ſhould come to paſs, ſince he made them (as is evident in the eclipſes of the ſun and moon) the genuine conſequences of the order he was pleaſed to ſettle in the world; by whoſe laws the grand agents in the univerſe were impowered and determined to act, according to the reſpective natures he had given them, and the courſe of things was allowed to run on, though that would infer the happening of ſeeming anomalies, and things really repugnant to the good or welfare of divers particular portions of the univerſe: this, I ſay, I think to be a notion more reſpectful to divine providence, than to imagine, as we commonly do, that God has appointed an intelligent and powerful Being, called nature, to be, as his vicegerent, continually watchful for the good of the univerſe in general, and of the particular bodies, that compoſe it; whilſt, in the mean time, this Being appears not to have the ſkill, or the power, to prevent ſuch anomalies, which oftentimes prove deſtructive to multitudes of animals, and other noble creatures, (as in plagues, *&c.*) and ſometimes prejudicial to greater portions of the univerſe, (as in earthquakes of a large ſpread, eclipſes of the luminaries, great and laſting ſpots on the ſun, eruptions of vulcanos, great comets, or new ſtars, that paſs from one region of Heaven to another.) And I am the more tender of admitting ſuch a lieutenant to divine providence, as nature is fancied to be, becauſe I ſhall hereafter give you ſome inſtances, in which it ſeems, that, if there were ſuch a thing, ſhe muſt be ſaid to act too blindly and impotently, to diſcharge well the part ſhe is ſaid to be truſted with.

I SHALL add, that the doctrine I plead for does much better, than its rival, comply with what religion teaches us about the extraordinary and ſupernatural interpoſitions of divine providence. For when it pleaſes God to over-rule, or controul, the eſtabliſhed courſe of things in the world, by his own omnipotent hand, what is thus performed may be much eaſier diſcerned and acknowledged to be miraculous by them, that admit, in the ordinary courſe of corporeal things, nothing but matter and motion, whoſe powers men may well judge of, than by thoſe, who think there is beſides a certain ſemi-deity, which they call nature, whoſe ſkill and power they acknowledge to be exceeding great, and yet have no ſure way of eſtimating, how great they are, and how far they may extend. And give me leave to take notice to you, on this occaſion, that I obſerve the miracles of our Saviour and his Apoſtles, pleaded by Chriſtians on the behalf of their religion, to have been very differingly looked on by Epicurean and other corpuſcularian infidels, and by thoſe other unbelievers, who admit of a ſoul of the world, or ſpirits in the ſtars, or, in a word, think the univerſe to be governed by intellectual beings diſtinct from the ſupreme being we call God: for this latter ſort of infidels have often admitted thoſe matters of fact, which we Chriſtians call miracles, and yet have endeavoured to ſolve them by aſtral operations, and other ways not here to be ſpecified; whereas the Epicurean enemies of Chriſtianity have thought themſelves obliged reſolutely to deny the matters of fact themſelves, as well diſcerning, that the things ſaid to be performed exceeded the mechanical powers of matter and motion, (as they were managed by thoſe, that wrought the miracles,) and conſequently muſt either be denied to have been done, or be confeſſed to have been truly miraculous. But there may hereafter be occaſion, both to improve the things already ſaid, and add others, to ſatisfy theological ſcruples about our hypotheſis.

See the III, the IV, and alſo the laſt Section of this Treatiſe.

I FORMERLY told you, that it was not only to the glory of God, (as that reſults from his wiſdom, power and goodneſs, expreſſed in the world) that I ſuſpected the

notion of nature, that I am examining, to be prejudicial, but alſo to the diſcovery of his works. And you will make no great difficulty to believe me, if you conſider, that, whilſt men allow themſelves ſo general and eaſy a way of rendering accounts of things, that are difficult, as to attribute them to nature, ſhame will not reduce them to a more induſtrious ſcrutiny into the reaſons of things, and curioſity itſelf will move them to it the more faintly: of which we have a clear and eminent example in the aſcenſion of water in pumps, and in other phænomena of that kind, whoſe true phyſical cauſes had never been found out, if the moderns had acquieſced, as their predeceſſors did, in that imaginary one, that the world was governed by a watchful being, called nature, and that ſhe abhors a vacuum, and conſequently is ſtill in a readineſs to do irreſiſtibly whatever is neceſſary to prevent it; nor muſt we expect any great progreſs in the diſcovery of the true cauſes of natural effects, whilſt we are content to ſit down with other, than the particular and immediate ones.

It is not, that I deny, that there are divers things, as the number and ſituation of the ſtars, the ſhapes and ſizes of animals, *&c.* about which even a philoſopher being aſked can ſay little, but that it pleaſed the author of the univerſe to make them ſo; but when we give ſuch general anſwers, we pretend not to give the particular phyſical reaſons of the things propoſed, but do in effect confeſs we do not know them. To this I add, that the veneration, wherewith men are imbued for what they call nature, has been a diſcouraging impediment to the empire of man over the inferior creatures of God: for many have not only looked upon it, as an impoſſible thing to compaſs, but as ſomething of impious to attempt, the removing of thoſe boundaries, which nature ſeems to have put and ſettled among her productions; and whilſt they look upon her as ſuch a venerable thing, ſome make a kind of ſcruple of conſcience to endeavour ſo to emulate any of her works, as to excel them.

I have ſtaid ſo long about removing the firſt of the two ſcruples I formerly propoſed againſt my preſent attempt, that, not to tire your patience, I ſhall in few words diſpatch the ſecond; which is, that I venture to contradict the ſenſe of the generality of mankind: to which I anſwer, that in philoſophical inquiries, it becomes not a naturaliſt to be ſo ſolicitous, what has been, or is believed, as what ought to be ſo; and I have alſo elſewhere, on another occaſion, ſhewed, how little the ſenſe of the generality of men ought to ſway us in ſome queſtions. But that, which I ſhall at preſent more directly reply, is, firſt, that it is no wonder men ſhould be generally prepoſſeſt with ſuch a notion of nature, as I call in queſtion, ſince education (eſpecially in ſchools) has imbued them with it from their infancy, and even in their maturer years they find it taken for granted, and employed not only by the moſt but by the learnedeſt writers, and never hear it called in queſtion by any: and then it exceedingly complies with our innate propenſity to think, that we know more than we do, and to appear to do ſo; for to vouch nature for a cauſe, is an expedient, that can ſcarce be wanting to any man, upon any occaſion, to ſeem to know, what he can indeed render no good reaſon of.

And to this firſt part of my anſwer, I ſhall ſubjoin this ſecond: that the general cuſtom of mankind to talk of a thing as a real and poſitive being, and attribute great matters to it, does but little weigh with me, when I conſider, that, though fortune be not any phyſical thing, but a certain looſe and undetermined notion, which a modern metaphyſician would refer to the claſſis of his non entia; yet not only the Gentiles made it a Goddeſs,

(*Nos te facimus, fortuna, deam, cæloque locamus,*)

which many of them ſeriouſly worſhipped, but eminent writers, in verſe and in proſe, ethnick

ethnick and Chriſtian, antient and modern, and all ſorts of men in their common diſcourſe, do ſeriouſly talk of it, as if it were a kind of Antichriſt, that uſurped a great ſhare in the government of the world, and aſcribe little leſs to it, than they do to nature. And not to ſpeak of what poets, moraliſts and divines tell us of the powers of ignorance and vice, which are but moral defects, let us conſider, what things are not only by theſe men, but by the generality of mankind, ſeriouſly attributed to death, to which ſo great and fatal a dominion is aſſigned; and then if we conſider too, that this death, which is ſaid to do ſo many and ſuch wonderful things, is neither a ſubſtance, nor a poſitive entity, but a meer privation; we ſhall, I truſt, the leſs believe, that the feats aſcribed to nature do infer, that there is really ſuch a phyſical agent, as is ſuppoſed.

AND now having, as I preſume, cleared our inquiry, as far as it is yet neceſſary, [and it will be further done hereafter] from thoſe prejudices, that might make the attempt be cenſured before it be examined, I proceed to the inquiry itſelf; wherein I ſhall endeavour (but with the brevity my want of leiſure exacts) to do theſe ſix things. *Firſt*, to give you a ſhort account of the great ambiguity of the word nature, ariſing from its various acceptions. *Secondly*, to ſhew you, that the definition alſo, that *Ariſtotle* himſelf gives of nature, does not afford a clear or ſatisfactory notion of it. *Thirdly*, to gather from the ſeveral things, that are wont to be affirmed of, or attributed to, nature, the received notion of it, which cannot be well gathered from the name, becauſe of its great ambiguity. *Fourthly*, I will mention ſome of thoſe reaſons, that diſſuade me from admitting this notion of nature. *Fifthly*, I ſhall endeavour to anſwer ſeverally the chief things, upon which men ſeem to have taken up the idea of nature, that I diſallow. And, *Sixthly*, I ſhall propoſe ſome of the chief effata or axioms, that are wont to be made uſe of, concerning nature in general, and ſhall ſhew, how far, and in what ſenſe, I may admit them.

AND here it may be opportune, to prevent both miſtakes and the neceſſity of interrupting the ſeries of our diſcourſe, to ſet down two or three advertiſements.

1. WHEN any where in this tract I ſpeak of the opinion of *Ariſtotle* and the Peripatetics, as I would not be thought to impute to him all the ſentiments of thoſe, that will be thought his followers, ſome of which ſeem to me to have much miſtaken his true meaning ſo (on the other ſide) I did not conceive, that my deſign obliged me to inquire anxiouſly into his true ſentiments, whether about the origin of the univerſe, (as whether or no it were ſelf-exiſtent, as well as eternal) or about leſs important points: ſince, beſides that his expreſſions are oftentimes dark and ambiguous enough, and the things he delivers in ſeveral paſſages do not ſeem always very conſiſtent; it ſufficed for my purpoſe, which was to queſtion vulgar notions, to examine thoſe opinions, that are by the generality of ſcholars taken for the *Ariſtotelian* and Peripatetic doctrines, by which, if he be miſrepreſented, the blame ought to light upon his commentators and followers.

2. THE rational ſoul or mind of man, as it is diſtinct from the ſenſitive ſoul, being an immaterial ſpirit, is a ſubſtance of ſo heteroclite a kind, in reference to things ſo vaſtly differing from it, as mere bodies are, that ſince I could neither, without injuring it, treat of it promiſcuouſly with the corporeal works of God, nor ſpeak worthily of it, without frequently interrupting and diſordering my diſcourſe by exceptions, that would either make it appear intricate, or would be very troubleſome to you or any other, that you may think fit to make my reader; I thought I might, for others eaſe and my own, be allowed to ſet aſide the conſiderations of it in the preſent treatiſe; and the rather, becauſe all other parts of the univerſe being, according to the

the received opinion, the works of nature, we ſhall not want in them ſubjects more than ſufficiently numerous, whereon to make our examen; though I ſhall here conſider the world but as the great ſyſtem of things corporeal, as it once really was towards the cloſe of the fixth day of the creation, when God had finiſhed all his material works, but had not yet created man.

SECT. II.

I. A CONSIDERING perſon may well be tempted to ſuſpect, that men have generally had but imperfect and confuſed notions concerning nature; if he but obſerves, that they apply that name to ſeveral things, and thoſe to ſuch, as have ſome of them very little dependance on, or connexion with, ſuch others. And I remember, that in *Ariſtotle*'sMetaphyſicks, I met with a whole chapter expreſly written to enumerate the various acceptions of the Greek word, φύσις, commonly rendered nature; of which, if I miſtake not, he there reckons up ſix. In *Engliſh* alſo we have not fewer, but rather more numerous ſignifications of that term: for ſometimes we uſe the word nature for that author of nature, whom the ſchoolmen harſhly enough call *natura naturans*; as when it is ſaid, that nature hath made man partly corporeal, and partly immaterial. Sometimes we mean by the nature of a thing, the eſſence, or that, which the ſchoolmen ſcruple not to call the quiddity of a thing, namely, the attribute or attributes, on whoſe ſcore it is, what it is, whether the thing be corporeal or not; as, when we attempt to define the nature of an angle, or of a triangle, or of a fluid body, as ſuch. Sometimes we confound that, which a man has by nature, with what accrues to him by birth; as, when we ſay, that ſuch a man is noble by nature, or ſuch a child naturally forward, or ſickly, or frightful. Sometimes we take nature for an internal principle of motion; as, when we ſay, that a ſtone let fall in the air is by nature carried towards the centre of the earth; and, on the contrary, that fire or flame does naturally move upwards towards heaven.

SOMETIMES we underſtand by nature the eſtabliſhed courſe of things; as, when we ſay, that nature makes the night ſucceed the day; nature hath made reſpiration neceſſary to the life of men.

SOMETIMES we take nature for an aggregate of powers belonging to a body, eſpecially a living one; as, when phyſicians ſay, that nature is ſtrong, or weak, or ſpent; or that in ſuch or ſuch diſeaſes, nature left to herſelf will do the cure. Sometimes we take nature for the univerſe, or ſyſtem of the corporeal works of God; as, when it is ſaid of a phenix, or a chimera, that there is no ſuch thing in nature, (*i. e.*) in the world. And ſometimes too, and that moſt commonly, we would expreſs by the word nature a ſemi-deity, or other ſtrange kind of being, ſuch as this diſcourſe examines the notion of, And beſides theſe more abſolute acceptions, if I may ſo call them, of the word nature, it has divers others, (more relative,) as nature is wont to be ſet in oppoſition or contradiſtinction to other things; as when we ſay of a ſtone, when it falls downwards, that it does it by a natural motion; but that if it be thrown upwards, its motion that way is violent. So chymiſts diſtinguiſh vitriol into natural, and factitious, or made by art, (*i. e.*) by the intervention of human power or ſkill: ſo it is ſaid, that water, kept ſuſpended in a ſucking pump is not in its natural place, as that is, which is ſtagnant in the well. We ſay alſo, that wicked men are ſtill in a ſtate of nature, but the regenerate in a ſtate of grace: that cures, wrought by medicines, are natural operations; but the miraculous ones, wrought by Chriſt and his apoſtles, were ſupernatural. Nor are theſe the only forms of ſpeech, that a more diligent collector, than I think it neceſſary I ſhould here be, might inſtance in,

to

to manifeſt the ambiguity of the word nature, by the many and various things it is applied to ſignify, though ſome of thoſe already mentioned ſhould be judged too near to be co-incident. Among *Latin* writers I found the acceptions of the word nature to be ſo many, that I remember one author reckons up no leſs than fourteen or fifteen. From all which it is not difficult to gather, how eaſy it is for the generality of men, without excepting thoſe, that write of natural things, to impoſe upon others and themſelves, in the uſe of a word ſo apt to be miſemployed.

ON this occaſion I can ſcarce forbear to tell you, that I have often looked upon it as an unhappy thing, and prejudicial both to philoſophy and phyſick, that the word nature hath been ſo frequently, and yet ſo unſkilfully employed, both in books and in diſcourſe, by all ſorts of men, learned and illiterate. For the very great ambiguity of this term, and the promiſcuous uſe men are wont to make of it, without ſufficiently attending to its different ſignifications, makes many of the expreſſions, wherein they employ it, (and think they do it well and truly) to be either not intelligible, or not proper, or not true: which obſervation, though it be not heeded, may, with the help of a little attention, be eaſily verified; eſpecially becauſe the term nature is ſo often uſed, that you ſhall ſcarce meet with any man, who, if he have occaſion to diſcourſe any thing long of either natural or medicinal ſubjects, would not find himſelf at a great loſs, if he were prohibited the uſe of the word nature, and of thoſe phraſes, whereof it makes the principal part. And I confeſs I could heartily wiſh, that philoſophers, and other learned men (whom the reſt in time would follow) would by common (though perhaps tacit) conſent, introduce ſome more ſignificant, and leſs ambiguous terms and expreſſions in the room of the too licentiouſly abuſed word nature, and the forms of ſpeech, that depend on it; or would, at leaſt, decline the uſe of it, as much as conveniently they can; and where they think they muſt employ it, would add a word or two, to declare in what clear and determinate ſenſe they uſe it. For without ſomewhat of this kind be done, men will very hardly avoid being led into divers miſtakes, both of things, and of one another; and ſuch wranglings about words and names will be (if not continually multiplied) ſtill kept on foot, as are wont to be managed with much heat, though little uſe, and no neceſſity.

AND here I muſt take leave to complain, in my own excuſe, of the ſcarce ſuperable difficulty of the taſk, that the deſign of a free inquiry puts me upon. For it is far more difficult, than any one, that hath not tried, (and I do not know that any man hath,) would imagine, to diſcourſe long of the corporeal works of God, and eſpecially of the operations and phænomena, that are attributed to nature, and yet decline making oftentimes uſe of that term, or forms of ſpeech, whereof it is a main part, without much more frequent, and perhaps tedious, circumlocutions, than I am willing to trouble you with. And therefore I hope you will eaſily excuſe me, if, partly to ſhun theſe, and to avoid uſing often the ſame words too near one another, and partly out of unwillingneſs to employ vulgar terms likely to occaſion or countenance vulgar errors; I have ſeveral times been fain to uſe paraphraſes, or other expreſſions, leſs ſhort than thoſe commonly received; and ſometimes for one or other of theſe reaſons or out of inadvertence, miſſed of avoiding the terms uſed by thoſe, that admit and applaud the vulgar notion of nature; whom, I muſt here advertiſe you, that partly becauſe they do ſo, and partly for brevity's ſake, I ſhall hereafter many times call naturiſts: which appellation I rather chuſe than that of naturaliſts, becauſe many, even of the learned among them, as logicians, orators, lawyers, arithmeticians, *&c.* are not phyſiologers.

BUT if on this occaſion you ſhould be very urgent to know, what courſe I would think expedient, if I were to propoſe any, for the avoiding the inconvenient uſe of ſo ambiguous

ambiguous a word, as nature; I ſhould firſt put you in mind, that having but very lately declared, that I thought it very difficult, in phyſiological diſcourſes eſpecially, to decline the frequent uſe of that term, you are not to expect from me the ſatisfaction you may deſire in an anſwer; and then I would add, that yet my unwillingneſs to be altogether ſilent, when you require me to ſay ſomewhat, makes me content to try, whether the miſchief complained of may not be in ſome meaſure either obviated or leſſened, by looking back upon the (eight) various ſignifications, that were not long ſince delivered of the word nature, and by endeavouring to expreſs them in other terms, or forms of ſpeech.

1. INSTEAD then of the word nature, taken in the firſt ſenſe, [for *natura naturans*,] we may make uſe of the term it is put to ſignify, namely, God; wholly diſcarding an expreſſion, which, beſides that it is harſh and needleſs, and in uſe only among the ſchoolmen, ſeems not to me very ſuitable to the profound reverence we owe the divine majeſty; ſince it ſeems to make the creator differ too little by far from a created (not to ſay an imaginary) Being.

2. INSTEAD of nature in the ſecond ſenſe, [for, *That, on whoſe account a thing is what it is, and is ſo called*,] we may employ the word eſſence, which is of great affinity to it, if not of an adequate import: and ſometimes alſo we may make uſe of the word quiddity, which, though a ſomewhat barbarous term, is yet frequently employed, and well enough underſtood, in the ſchools; and, which is more conſiderable, is very comprehenſive, and yet free enough from ambiguity.

3. WHAT is meant by the word nature taken in the third ſenſe of it, [for *what belongs to a living creature at its nativity, or accrues to it by its birth*,] may be expreſſed ſometimes by ſaying, that a man or other animal is born ſo; and ſometimes by ſaying, that a thing has been generated ſuch; and ſometimes alſo, that it is thus or thus qualified by its original temperament and conſtitution.

4. INSTEAD of the word nature taken in the fourth acception [for, an *internal principle of local motion*] we may ſay ſometimes, that this or that body moves as it were, or elſe that it ſeems to move, ſpontaneouſly (or of its own accord) upwards, downwards, *&c.* or, that is put into this or that motion, or determined to this or that action by the concourſe of ſuch or ſuch (proper) cauſes.

5. FOR nature in the fifth ſignification, (for, the *eſtabliſhed courſe of things corporeal*] it is eaſy to ſubſtitute what it denotes, *the eſtabliſhed order*, or *the ſettled courſe of things*.

6. INSTEAD of nature in the ſixth ſenſe of the word [for, *an aggregate of the powers belonging to a body, eſpecially a living one*] we may employ the conſtitution, temperament, or the mechaniſm, or the complex of the eſſential properties or qualities; and ſometimes the condition, the ſtructure, or the texture of that body: and if we ſpeak of the greater portions of the world, we may make uſe of one or other of theſe terms, *Fabric of the world, ſyſtem of the univerſe, coſmical mechaniſm*, or the like.

7. WHERE men are wont to employ the word nature in the ſeventh ſenſe [for the *univerſe*, or the *ſyſtem of the corporeal works of God*] it is eaſy, and as ſhort, to make uſe of the word world or univerſe, and inſtead of the phænomena of nature, to ſubſtitute the phænomena of the univerſe, or of the world.

8. AND, as for the word nature taken in the eighth and laſt of the fore-mentioned acceptions [for, either (as ſome Pagans ſtiled her) a goddeſs, or a kind of ſemi-deity] the beſt way is not to employ it in that ſenſe at all, or at leaſt as ſeldom as may be; and that for divers reaſons, which may in due place be met with in ſeveral parts of this eſſay.

BUT though the foregoing diverſity of terms and phraſes may be much increaſed, yet I confeſs it makes but a part of the remedy I propoſe againſt the future miſchiefs of the confuſed acception of the word nature, and the phraſes grounded on it. For beſides the ſynonymous words, and more literal interpretations lately propoſed, a dexterous writer may oftentimes be able to give ſuch a form (or, as the modern *Frenchmen* ſpeak, ſuch a tour) to his many-ways variable expreſſions, as to avoid the neceſſity of making uſe of the word nature; or ſometimes ſo much as of thoſe ſhorter terms, that have been lately ſubſtituted in its place. And to all this I muſt add, that though one or two of the eight fore-mentioned terms or phraſes, as quiddity and coſmical mechaniſm, be barbarous or ungenteel, and ſome other expreſſions be leſs ſhort than the word nature; yet it is more the intereſt of philoſophy to tolerate a harſh term, that has been long received in the ſchools in a determinate ſenſe, and bear with ſome paraphraſtical expreſſions, than not to avoid an ambiguity, that is liable to ſuch great inconveniencies, as have been lately, or may be hereafter, repreſented.

THERE are, I know, ſome learned men, who, (perhaps being ſtartled to find nature uſually ſpoken of ſo much like a kind of goddeſs,) will have the nature of every thing to be only the law, that it receives from the creator, and according to which it acts on all occaſions. And this opinion ſeems much of kin to, if not the ſame with that of the famous *Helmont*, who, juſtly rejecting the *Ariſtotelian* tenet of the contrariety or hoſtility of the elements, will have every body, without any ſuch reſpect, to act that, which it is commanded to act. And indeed this opinion about nature, though neither clear nor comprehenſive enough, ſeems capable of a fair conſtruction. And there is oftentimes ſome reſemblance between the orderly and regular motions of inanimate bodies, and the actions of agents, that, in what they do, act conformably to laws. And even I ſometimes ſcruple not to ſpeak of the laws of motion and reſt, that God has eſtabliſhed among other things corporeal, and now and then, (for brevity's ſake, or out of cuſtom) to call them, as men are wont to do, the laws of nature; having in due place declared, in what ſenſe I underſtand and employ theſe expreſſions.

BUT to ſpeak ſtrictly, (as becomes philoſophers, in ſo weighty a matter) to ſay, that the nature of this or that body is but *the law of God preſcribed to it*, is but an improper and figurative expreſſion: for, beſides that this gives us but a very defective idea of nature, ſince it omits the general fabric of the world, and the contrivances of particular bodies, which yet are as well neceſſary, as local motion itſelf, to the production of particular effects and phænomena; beſides this, I ſay, and other imperfections of this notion of nature, that I ſhall not here inſiſt on, I muſt freely obſerve, that, to ſpeak properly, a law being but a *notional rule of acting according to the declared will of a ſuperior*, it is plain, that nothing but an intellectual Being can be properly capable of receiving and acting by a law. For if it does not underſtand, it cannot know what the will of the legiſlator is; nor can it have any intention to accompliſh it, nor can it act with regard to it, or know when it does, in acting, either conform to it or deviate from it: and it is intelligible to me, that God ſhould at the beginning impreſs determinate motions upon the parts of matter, and guide them, as he thought requiſite, for the primordial conſtitution of things; and that ever ſince he ſhould, by his ordinary and general concourſe, maintain thoſe powers, which he gave the parts of matter, to tranſmit their motion thus and thus to one another. But I cannot conceive, how a body devoid of underſtanding and ſenſe, truly ſo called, can moderate and determinate its own motions, eſpecially ſo, as to make them conformable to laws, that it has no knowledge or apprehenſion of; and that inanimate bodies,

how

how ſtrictly ſoever called natural, do properly act by laws, cannot be evinced by their ſometimes acting regularly, and, as men think, in order to determinate ends: ſince in artificial things we ſee many motions very orderly performed, and with a manifeſt tendency to particular and pre-deſigned ends; as in a watch, the motions of the ſpring, wheels, and other parts, are ſo contemperated and regulated, that the hand upon the dial moves with a great uniformity, and ſeems to moderate its motion ſo, as not to arrive at the points, that denote the time of the day, either in a minute ſooner, or a minute later, than it ſhould do, to declare the hour. And when a man ſhoots an arrow at a mark, ſo as to hit it, though the arrow moves towards the mark, as it would if it could and did deſign to ſtrike it, yet none will ſay, that this arrow moves by a law, but by an external, though well directed, impulſe.

SECT. III.

II. BUT poſſibly the definition of a philoſopher may exempt us from the perplexities, to which the ambiguous expreſſions of common writers expoſe us. I therefore thought fit to conſider, with a ſomewhat more than ordinary attention, the famous definition of nature, that is left us by *Ariſtotle*, which I ſhall recite rather in *Latin* than in *Engliſh*, not only becauſe it is very familiarly known among ſcholars in that language, but becauſe there is ſomewhat in it, that I confeſs ſeems difficult to me to be without circumlocution rendered intelligibly in *Engliſh*: *Natura* (ſays he) *eſt principium & cauſa motus & quietis ejus, in quo ineſt, primo per ſe, & non ſecundum accidens.* 2 Phyſ. c. 1. l. 3. But though when I conſidered, that according to *Ariſtotle*, the whole world is but a ſyſtem of the works of nature, I thought it might well be expected, that the definition of a thing, the moſt important in natural philoſophy, ſhould be clearly and accurately delivered; yet to me this celebrated definition ſeemed ſo dark, that I cannot brag of any aſſiſtance I received from it towards the framing of a clear and ſatisfactory notion of nature. For I dare not hope, that what, as to me, is not itſelf intelligible, ſhould make me underſtand what is to be declared or explicated by it. And when I conſulted ſome of *Ariſtotle*'s interpreters upon the ſenſe of this definition, I found the more conſiderate of them ſo puzzled with it, that their diſcourſes of it ſeemed to tend rather to free the maker of it from tautology and ſelf-contradiction, than to manifeſt, that the definition itſelf is good and inſtructive, and ſuch as affords a fair account of the thing defined. And indeed, though the immoderate veneration they cheriſh for their maſter engages them to make the beſt they can of the definition given to him, even when they cannot juſtify it without ſtrained interpretations, yet what every one ſeems to defend in groſs, almoſt every one of them cenſures in parcels; this man attacking one part of the definition, and that man another, with objections ſo weighty, (not to call ſome of them unanſwerable) that if I had no other arguments to urge againſt it, I might borrow enough from the commentators on it to juſtify my diſlike of it.

HOWEVER, we may hereafter have occaſion to conſider ſome of the main parts of this definition, and in the mean while it may ſuffice, that we obſerve, that ſeveral things are commonly received, as belonging to the idea or notion of nature, that are not manifeſtly, or not at all, comprehended in this *Ariſtotelian* definition, which doth not declare, whether the principle or cauſe (which expreſſion already makes the ſenſe doubtful) here mentioned is a ſubſtance, or an accident; and if a ſubſtance, whether corporeal or immaterial: nor is it clearly contained in this definition, that nature does all things moſt wiſely, and ſtill acts by the moſt compendious ways without ever miſſing of her end; and that ſhe watches againſt a vacuum for the welfare of the uni-

verſe; to omit divers other things, that you will find aſcribed to her in the following ſection, to which I now proceed.

THAT the great ſhortneſs of this third ſection may not make it too diſproportinate in length to the others this tract conſiſts of, I ſhall in this place, though I doubt it be not the moſt proper, that could be choſen, endeavour to remove betimes the prejudice, that ſome divines and other pious men may perhaps entertain, upon the account, as they think, of religion, againſt the care I take, to decline the frequent uſe of that word nature, in the vulgar notion of it; reſerving to another and fitter place ſome other things, that may relate to the theological ſcruples, if any occur to me, that our free inquiry may occaſion.

THE philoſophical reaſon, that inclines me to forbear, as much as conveniently I can, the frequent uſe of the word nature, and the forms of ſpeech, that are derived from it is, that it is a term of great ambiguity: on which ſcore I have obſerved, that being frequently and unwarily employed, it has occaſioned much darkneſs and confuſion in many men's writings and diſcourſes. And I little doubt, but that others would make the like obſervations, if early prejudices and univerſal cuſtom did not keep them from taking notice of it.

NOR do I think myſelf obliged, by the juſt veneration I owe and pay religion, to make uſe of a term ſo inconvenient to philoſophy. For I do not find, that for many ages the *Iſraelites*, that then were the only people and church of God, made uſe of the word nature in the vulgar notion of it. *Moſes* in the whole hiſtory of the creation, where it had been ſo proper to bring in this firſt of ſecond cauſes, has not a word of nature: and whereas philoſophers preſume, that ſhe, by her plaſtic power and ſkill, forms plants and animals out of the univerſal matter, the divine hiſtorian aſcribes the formation of them to God's immediate *fiat*, *Gen.* i. 11. *And God ſaid, let the earth bring forth graſs, and the herb yielding ſeed, and the fruit tree yielding fruit after his kind*, &c. And again, *ver.* 24. *God ſaid, let the earth bring forth the living creature after its kind*, &c. *ver.* 25. *And God* (without any mention of nature) *made the beaſt of the earth after his kind.* And I do not remember, that in the *Old Teſtament*, I have met with any one Hebrew word, that properly ſignifies nature, in the ſenſe we take it in. And it ſeems, that our Engliſh tranſlators of the Bible were not more fortunate in that, than I; for having purpoſely conſulted a late concordance, I found not that word nature in any text of the *Old Teſtament*. So likewiſe, though *Job*, *David*, and *Solomon*, and other *Iſraelitiſh* writers, do, on divers occaſions, many times mention the corporeal works of God, yet they do not take notice of nature, which our philoſophers would have his great vicegerent in what relates to them. To which perhaps it may not be impertinent to add, that though the late famous *Rabbi Menaſſeh Ben Iſrael* has purpoſely written a book of numerous problems touching the creation; yet I do not remember, that he employs the word nature, in the received notion of it, to give an account of God's mundane creatures. And when St. *Paul* himſelf, who was no ſtranger to the Heathen learning, writing to the *Corinthians*, who were *Greeks*, ſpeaks of the production of corn out of ſeed ſown, he does not attribute the produced body to nature; but when he had ſpoken of a *grain of wheat, or ſome other ſeed* put into the ground; he adds, that *God gives it ſuch a body as he pleaſeth, and to every ſeed its own body*, i. e. And a greater than St. *Paul*, ſpeaking of the gaudineſs of the lilies, (or as ſome will have it, tulips,) uſes this expreſſion, *If God ſo clothe the graſs of the field*, &c. *Matt.* vi. 28, 20, 30. The celebrations, that *David*, *Job*, and other holy *Hebrews*, mentioned in the *Old Teſtament*, make on occaſion of the admirable works they contemplated in the univerſe, are addreſſed directly to God himſelf,

1 Cor. xv. 37, 38.

without taking notice of nature. Of this I could multiply inſtances, but ſhall here, for brevity's ſake, be contented to name a few, taken from the book of *Pſalms* alone. In the hundredth of thoſe hymns, the penman of it makes this, *That God has made us*, the ground of an exhortation, *To enter into his gates with thankſgiving, and into his courts with praiſe*, Pſal. lxxix. 34. And in another, *Let the heaven and earth praiſe God*, [that is, give men ground and occaſion to praiſe Him] congruouſly to what *David* elſewhere ſays to the great creator of the univerſe, *All thy works ſhall praiſe thee, O Lord, and thy ſaints ſhall bleſs thee*, Pſal. cxlv. 10. And in another of the ſacred hymns, the ſame royal poet ſays to his maker, *Thou haſt covered me in my mother's womb. I will praiſe thee, for I am fearfully and wonderfully made; marvellous are thy works, and that my ſoul knoweth right well*, Pſal. cxxxix. 13, 14.

I HAVE ſometimes doubted, whether one may not on this occaſion add, that if men will needs take in a Being ſubordinate to God, for the management of the world; it ſeems more conſonant to the holy ſcripture, to depute angels to that charge, than nature. For I conſider, that, as to the cœleſtial part of the univerſe, in compariſon of which the ſublunary is not perhaps the ten thouſandth part, both the heathen *Ariſtotelians*, and the ſchool philoſophers among the Chriſtians, teach the cœleſtial orbs to be moved or guided by intelligences, or angels. And as to the lower or ſublunary world, beſides that the holy writings teach us, that angels have been often employed by God for the government of kingdoms, (as is evident out of the book of *Daniel*) and the welfare and puniſhment of particular perſons; one of thoſe glorious ſpirits is in the apocalypſe, expreſly ſtyled *the angel of the waters*: which title divers learned interpreters think to be given him, becauſe of his charge or office to overſee and preſerve the waters. And I remember, that in the ſame book there is mention made of an angel, that had *power*, *authority*, or *juriſdiction*, (ἐξουσία) *over the fire*. And though the excellent *Grotius* gives another conjecture of the title given the *angel of the waters*; yet in his notes upon the next verſe ſave one, he teaches, that there was an angel appointed to preſerve the ſouls, that were kept under the altar there mentioned. And if we take the *angel of the waters* to be the guardian or conſerver of them, perhaps as the *Romans* (in whoſe empire St. *John* wrote) had ſpecial officers to look to their aqueducts and other waters; it may not be amiſs to obſerve upon the by, that he is introduced praiſing his and his fellow-ſpirits great creator: which is an act of religion, that, for aught I know, none of the naturiſts, whether Pagan or even Chriſtians, ever mentioned their nature to have performed.

Rev. xvi. 5.

Rev. xiv. 18.

Verſe 7.

I KNOW it may on this occaſion be alledged, that *ſubordinata non pugnant*, and nature being God's vicegerent, her works are indeed his. But that he has ſuch a vicegerent, it is one of the main buſineſſes of this diſcourſe to call in queſtion; and till the affirmative be ſolidly proved, (nay, and though it were ſo) I hope I ſhall be excuſed, if with *Moſes*, *Job*, and *David*, I call the creatures I admire in the viſible world, the works of God, (not of nature) and praiſe rather him than her, for the wiſdom and goodneſs diſplayed in them; ſince among the *Iſraelites*, till they were overrun and corrupted by idolatrous nations, there was for many ages a deep ſilence of ſuch a being, as we now call nature. And I think it much more ſafe and fit, to ſpeak as did thoſe, who for ſo long a time were the peculiar people of God, than with the heathen poets and philoſophers, who were very prone to aſcribe divinity to his creatures, and ſometimes even to their own.

I MENTION theſe things, not with deſign to engage in the controverſy, about the authority or uſe of the ſcripture in phyſical ſpeculations, but to obviate or remove a prejudice, that (as I formerly intimated) I fear may be taken up, upon the account of theology or religion, againſt my ſtudiouſly unfrequent employing the word nature in

in the vulgar ſenſe of it; by ſhewing, that, whether or no the ſcriptures be not deſigned to teach us higher and more neceſſary truths than thoſe, that concern bodies, and are diſcoverable by the meer light of reaſon, both its expreſſions and its ſilence give more countenance to our hypotheſis, than to that of the naturiſts.

SECT. IV.

III. HAVING ſhewn, that the definition given of nature by *Ariſtotle* himſelf, as great a logician as he was, has not been able to ſatisfy ſo much as his interpreters and diſciples, what his own idea of nature was, it would be to little purpoſe to trouble you and myſelf with inquiring into the definitions and diſputes of other Peripatetics, about ſo obſcure and perplexed a ſubject; eſpecially ſince it is not my buſineſs in this tract ſolicitouſly to examine, what *Ariſtotle* thought nature to be, but what is to be thought of the vulgarly received notion of nature: and though of this the ſchools have been the chief propagators, for which reaſon it was fit to take notice of their maſter *Ariſtotle*'s definition; yet the beſt way, I know, to inveſtigate the commonly received opinion of nature, is, to conſider, what effata or axioms do paſs for current about her; and what titles and epithets are unanimouſly given her, both by philoſophers and other writers, and by the generality of men, that have occaſion to diſcourſe of her and her actings.

OF theſe axioms and epithets, the principal ſeem to be theſe, that follow.

Natura eſt ſapientiſſima, adeoque opus naturæ eſt opus intelligentiæ.
* *Natura nihil facit fruſtra.*
Natura fine ſuo nunquam excidit.
† *Natura ſemper facit quod optimum eſt.*
Natura ſemper agit per vias breviſſimas.
Natura neque redundat in ſuperfluis, neque deficit in neceſſariis.
Omnis natura eſt conſervatrix ſui.
Natura eſt morborum medicatrix.
Natura ſemper invigilat conſervationi univerſi.
Natura vacuum horret.

* *Ariſt.* de Cœlo, *l.* II. c. 11.
† *Ariſt.* de Cœlo, *l.* II. c. 5. it. de Gen. *l.* II. *c.* 10. § 22.

FROM all theſe particulars put together, it may appear, that the vulgar notion of nature may be conveniently enough expreſſed by ſome ſuch deſcription as this:

NATURE is a moſt wiſe being, that does nothing in vain; does not miſs of her ends; does always that, which (of the things ſhe can do) is beſt to be done; and this ſhe does by the moſt direct or compendious ways, neither employing any things ſuperfluous, nor being wanting in things neceſſary; ſhe teaches and inclines every one of her works to preſerve itſelf: and, as in the microcoſm, (man) it is ſhe, that is the curer of diſeaſes; ſo in the macrocoſm (the world) for the conſervation of the univerſe, ſhe abhors a vacuum, making particular bodies act contrary to their own inclinations and intereſts, to prevent it, for the public good.

WHAT I think of the particulars, that make up this panegyrical deſcription of nature, will (God permitting) be told you in due place; my preſent work being only to make you the cleareſt repreſentation I can, of what men generally (if they underſtand themſelves) do, or, with congruity to the axioms they admit and uſe, ought to conceive nature to be.

IT is not unlike, that you may expect or wiſh, that on this occaſion, I ſhould propoſe ſome definition or deſcription of nature, as my own. But declining (at leaſt at preſent) to ſay any thing dogmatically about this matter, I know not, whether I may not,

not, on this occaſion, confeſs to you, that I have ſometimes been ſo paradoxical, or (if you pleaſe) ſo extravagant, as to entertain, as a ſerious doubt, what I formerly intimated, *viz.* whether nature be a thing, or a name? I mean, whether it be a real exiſtent being, or a notional entity, ſomewhat of kin to thoſe fictitious terms, that men have deviſed, that they might compendiouſly expreſs ſeveral things together by one name? As when, for inſtance, we ſpeak of the concocting faculty aſcribed to animals, thoſe, that conſider, and are careful to underſtand what they ſay, do not mean, I know not what entity, that is diſtinct from the human body, as it is an engine curiouſly contrived, and made up of ſtable and fluid parts; but obſerving an actuating power and fitneſs in the teeth, tongue, ſpittle, fibres and membranes of the gullet and ſtomach, together with the natural heat, the ferment, or elſe the menſtruum, and ſome other agents, by their co-operation, to cook or dreſs the aliments, and change them into chyle; obſerving theſe things, I ſay, they thought it convenient, for brevity's ſake, to expreſs the complex of thoſe cauſes, and the train of their actions, by the ſummary appellation of concocting faculty.

WHILST I was indulging myſelf in this kind of ravings, it came into my mind, that the naturiſts might demand of me, how, without admitting their notion, I could give any tolerable account of thoſe moſt uſeful forms of ſpeech, which men employ, when they ſay, that nature does this or that; or, that ſuch a thing is done by nature, or according to nature, or elſe happens againſt nature? And this queſtion I thought the more worth anſwering, becauſe theſe phraſes are ſo frequently uſed by men of all ſorts, as well learned as illiterate, that this cuſtom hath made them be thought not only very convenient, but neceſſary; inſomuch that I look upon it as none of the leaſt things, that has procured ſo general a reception to the vulgar notion of nature, that theſe ready and commodious forms of ſpeech ſuppoſe the truth of it.

IT may, therefore, in this place, be pertinent to add, that ſuch phraſes, as, that nature, or faculty, or ſuction, doth this or that, are not the only ones wherein I obſerve, that men aſcribe to a notional thing that, which, indeed, is performed by real agents; as, when we ſay, that the law puniſhes murder with death, that it protects the innocent, releaſes a debtor out of priſon, when he has ſatisfied his creditors (and the miniſters of juſtice), on which, or the like occaſions, we may juſtly ſay, that it is plain, that the law, which, being in itſelf a dead letter, is but a notional rule, cannot, in a phyſical ſenſe, be ſaid to perform theſe things; but they are really performed by judges, officers, executioners, and other men, acting according to that rule. Thus when we ſay, that cuſtom does this or that, we ought to mean only, that ſuch things are done by proper agents, acting with conformity to what is uſual, (or cuſtomary) on ſuch occaſions. And, to give you a yet more appoſite inſtance, do but conſider, how many events are wont to be aſcribed to fortune or chance; and yet fortune is, in reality, no phyſical cauſe of any thing, (for which reaſon probably it is, that ancienter naturaliſts than *Ariſtotle*, as himſelf intimates, take no notice of it, when they treat of natural cauſes) and only denotes, that thoſe effects that are aſcribed to it, were produced by their true and proper agents, without intending to produce them; as, when a man ſhoots at a deer, and the arrow lightly glancing upon the beaſt wounds ſome man, that lay beyond him, unſeen by the archer; it is plain, that the arrow is a phyſical agent, that acts by virtue of its fabric and motion, in both theſe effects; and yet men will ſay, that the ſlight hurt it gave the deer, was brought to paſs according to the courſe of nature, becauſe the archer deſigned to ſhoot the beaſt; but the mortal wound it gave the man happened by chance, becauſe the archer intended not to ſhoot him, or any man elſe. And whereas divers of the old atomical philoſophers,

loſophers, pretending (without good reaſon, as well as againſt piety) to give an account of the origin of things, without recourſe to a Deity, did ſometimes affirm the world to have been made by nature, and ſometimes by fortune, promiſcuouſly employing thoſe terms; they did it, (if I gueſs aright) becauſe they thought neither of them to denote any true and proper phyſical cauſe, but rather certain conceptions, that we men have of the manner of acting of true and proper agents. And therefore, when the Epicureans thought the world to have been made by chance, it is probable, that they did not look upon chance as a true and architectonic cauſe of the ſyſtem of the world, but believed all things to have been made by the atoms, conſidered as their conventions and concretions into the ſun, ſtars, earth, and other bodies, were made without any deſign of conſtituting thoſe bodies.

WHILST this vein of framing paradoxes yet continued, I ventured to proceed ſo far, as to queſtion, whether one may not infer, from what has been ſaid, that the chief advantage a philoſopher receives from what men call nature, be not, that it affords them, on divers occaſions, a compendious way of expreſſing themſelves? ſince (thought I) to conſider things otherwiſe than in a popular way, when a man tells me, that nature does ſuch a thing, he does not really help me to underſtand, or to explicate, how it is done; for it ſeems manifeſt enough, that whatever is done in the world, at leaſt wherein the rational ſoul intervenes not, is really effected by corporeal cauſes and agents, acting in a world ſo framed as ours is, according to the laws of motion ſettled by the omniſcient Author of things.

WHEN a man knows the contrivance of a watch or clock, by viewing the ſeveral pieces of it, and ſeeing how, when they are duly put together, the ſpring or weight ſets one of the wheels a working, and by that another, till by a fit conſecution of the motions of theſe and other parts, at length the index comes to point at the right hour of the day; the man, if he be wiſe, will be well enough ſatisfied with this knowledge of the cauſe of the propoſed effect, without troubling himſelf to examine, whether a notional philoſopher will call the time-meaſuring inſtrument an *ens per ſe*, or an *ens per accidens?* and whether it performs its operations by virtue of an internal principle, ſuch as the ſpring of it ought to be? or of an external one, ſuch as one may think the appended weight? And, as he that cannot, by the mechanical affections of the parts of the univerſal matter, explicate a phænomenon, will not be much helped to underſtand, how the effect is produced, by being told, that nature did it: ſo, if he can explain it mechanically, he has no more need to think, or (unleſs for brevity's ſake) to ſay, that nature brought it to paſs, than he, that obſerves the motions of a clock, has to ſay, that it is not the engine, but it is art, that ſhews the hour; whereas, without conſidering that general and uninſtructive name, he ſufficiently underſtands, how the parts, that make up the engine, are determined by their conſtruction, and the ſeries of their motions, to produce the effect that is brought to paſs.

WHEN the lower end of a reed, being dipped, for inſtance, in milk or water, he that holds it, does cover the upper end with his lips, and fetches his breath, and hereupon the liquor flows into his mouth; we are told, that nature raiſeth it to prevent a vacuum, and this way of raiſing it, is called ſuction: but, when this is ſaid, the word nature does but furniſh us with a ſhort term, to expreſs a concourſe of ſeveral cauſes, and ſo does in other caſes, but what the word ſuction does in this; for neither the one, nor the other, helps us to conceive, how this ſeemingly ſpontaneous aſcenſion of a heavy liquor is effected; which they that know, that the outward air is a heavy fluid, and gravitates, or preſſes more upon the other parts of the liquor, than the air contained in the reed (which is rarefied by the dilatation of the ſucker's

ſucker's thorax) does upon the included part of the ſurface, will readily apprehend, that the ſmaller preſſure will be ſurmounted by the greater, and conſequently yield to the aſcenſion of the liquor, which is, by the prevalent external preſſure, impelled up into the pipe, and ſo into the mouth, (as I, among others, have elſewhere made out.) So that, according to this doctrine, without recurring to nature's care, to prevent a vacuum, one, that had never heard of the Peripatetic notions of nature, or of ſuction, might very well underſtand the mentioned phænomenon. And, if afterwards he ſhould be made acquainted with the received opinions, and forms of ſpeech, uſed on this occaſion, he would think, that ſo to aſcribe the effect to nature is needleſs, if not alſo erroneous; and that the common theory of ſuction can afford him nothing, but a compendious term, to expreſs, at once, the concourſe of the agents, that make the water aſcend.

How far I think theſe extravagant reaſonings may be admitted, you may be enabled to diſcern, by what you will hereafter meet with, relating to the ſame ſubjects, in the ſeventh ſection of this diſcourſe. And therefore, returning now to the riſe of this digreſſion, namely, that it is not unlike you may expect, I ſhould, after the vulgar notion of nature, that I lately mentioned, without acquieſcing in it, ſubſtitute ſome definition or deſcription of nature, as mine; I hope you will be pleaſed to remember, that the deſign of this paper was, to examine the vulgar notion of nature, not propoſe a new one of my own. And indeed the ambiguity of the word is ſo great, and it is, even by learned men, uſually employed to ſignify ſuch different things, that, without enumerating and diſtinguiſhing its various acceptions, it were very unſafe to give a definition of it, if not impoſſible to deliver one, that would not be liable to cenſure. I ſhall not therefore preſume to define a thing, of which there is yet no ſettled and ſtated notion agreed on among men: and yet, that I may, as far as I dare, comply with your curioſity, I ſhall tell you, that if I were to propoſe a notion, as leſs unfit, than any I have met with, to paſs for the principal notion of nature, with regard to which many axioms and expreſſions, relating to that word, may be not inconveniently underſtood, I ſhould diſtinguiſh between the univerſal, and the particular nature of things. And, of univerſal nature, the notion I would offer ſhould be ſome ſuch as this; that nature is the aggregate of the bodies, that make up the world, framed as it is, conſidered as a principle, by virtue whereof they act and ſuffer, according to the laws of motion preſcribed by the Author of things. Which deſcription may be thus paraphraſed; that nature, in general, is the reſult of the univerſal matter, or corporeal ſubſtance of the univerſe, conſidered as it is contrived in the preſent ſtructure and conſtitution of the world, whereby all the bodies, that compoſe it, are enabled to act upon, and fitted to ſuffer from one another, according to the ſettled laws of motion. I expect, that this deſcription will appear prolix, and require to be heedfully peruſed; but the intricateneſs and importance of the ſubject hindered me from making it ſhorter, and made me chuſe rather to preſume upon your attention, than not endeavour to expreſs myſelf intelligibly and warily about a ſubject of ſuch moment. And this will make way for the other (ſubordinate) notion, that is to attend the former deſcription: ſince the particular nature of an individual body conſiſts in the general nature, applied to a diſtinct portion of the univerſe; or rather ſuppoſing it to be placed, as it is, in a world, framed by God, like ours, it conſiſts in a convention of the mechanical affections (ſuch as bigneſs, figure, order, ſituation, contexture, and local motion) of its parts, (whether ſenſible or inſenſible) convenient and ſufficient to conſtitute in, or to intitle to, its particular ſpecies or denominations, the particular body they make up, as the concourſe of all theſe is conſidered as the principle of motion, reſt, and changes in that body.

IF you will have me give to theſe two notions more compendious expreſſions, now that, by what hath been ſaid, I preſume you apprehend my meaning; I ſhall expreſs, what I called general nature, by coſmical mechaniſm, that is, a compriſal of all the mechanical affections (figure, ſize, motion, *&c.*) that belong to the matter of the great ſyſtem of the univerſe. And, to denote the nature of this or that particular body, I ſhall ſtyle it, the private, the particular, or (if you pleaſe) the individual mechaniſm of that body; or, for brevity's ſake, barely the mechaniſm of it, that is, the eſſential modification, if I may ſo ſpeak, by which I mean, the compriſal of all its mechanical affections convened in the particular body, conſidered, as it is determinately placed, in a world ſo conſtituted as ours is.

IT is like you will think it ſtrange, that in this deſcription I ſhould make the preſent fabrick of the univerſe, a part, as it were, of the notion I frame of nature, though the generality of philoſophers, as well as other men, ſpeak of her as a plaſtic principle of all the mundane bodies, as if they were her effects; and therefore they uſually call them the works of nature; and the changes, that are obſerved in them, the phænomena of nature: but, for my part, I confeſs, I ſee no need to acknowledge any architectonic being, beſides God, antecedent to the firſt formation of the world.

THE Peripatetics, whoſe ſchool either deviſed, or mainly propagated the received notion of nature, conceiving (not only matter, but) the world to be eternal, might look upon it, as the province, but could not, as the work of nature, which, in their hypotheſis, is its guardian, without having been its architect.

THE Epicureans themſelves, that would refer all things, that are done in the world, to nature, cannot, according to their principles, make what they now call nature, to have been antecedent to the firſt formation of our preſent world: for, according to their hypotheſis, whilſt their numberleſs atoms wildly roved in their infinite vacuity, they had nothing belonging to them but bigneſs, figure and motion; and it was by the coalition or convention of theſe atoms, that the world had its beginning: ſo that, according to them, it was not nature, but chance, that framed the world; though afterwards, this original fabrick of things does, by virtue of its ſtructure, and the innate and unloſeable motive power of atoms, continue things in the ſame ſtate for the main; and this courſe, though caſually fallen into it, and continued without deſign, is that, which, according to their hypotheſis, ought to paſs for nature.

AND, as meer reaſon doth not oblige me to acknowledge ſuch a nature, as we call in queſtion, antecedent to the origin of the world; ſo neither do I find, that any revelation contained in the holy ſcriptures, clearly teaches, that there was ſuch a being. For, in the hiſtory of the creation, it is expreſly ſaid, that *in the beginning God made the heavens and the earth*; and, in the whole account, that *Moſes* gives of the progreſs of it, there is not a word of the agency of nature; and, at the latter end, when God is introduced, as making a review of all the parts of the univerſe,
Gen. i. 31. it is ſaid, that *God ſaw every thing that he had made*; and it is ſoon after added, that
Gen. ii. 3. *he bleſſed and ſanctified the ſeventh day, becauſe, in it,* (or rather, *juſt before it*, as I find the *Hebrew* particle elſewhere uſed) *he had reſted from all his works, which God*
Job xxxvii. 4, 6, 7. *created and made.* And though there be a paſſage in the book of *Job*, that, probably enough, argues the angels (there called the ſons of God) to have exiſted, either at the beginning of the firſt day's work, or ſome time before it; yet it is not there ſo much as intimated, that they were co-operators with their Maker, in the framing of the world, of which they are repreſented as ſpectators and applauders, but not ſo much as inſtruments. But ſince revelation, as much as I always reve-

rence it, is, I confeſs, a foreign principle in this philoſophical inquiry, I ſhall wave it here, and tell you, that, when I conſult only the light of reaſon, I am inclined to apprehend the firſt formation of the world, after ſome ſuch manner as this:

I THINK it probable, (for I would not dogmatize on ſo weighty, and ſo difficult a ſubject) that the great and wiſe Author of things did, when he firſt formed the univerſal and undiſtinguiſhed matter into the world, put its parts into various motions, whereby they were neceſſarily divided into numberleſs portions of differing bulks, figures, and ſituations, in reſpect of each other; and that, by his infinite wiſdom and power, he did ſo guide and over-rule the motions of theſe parts, at the beginning of things, as that (whether in a ſhorter or a longer time, reaſon cannot well determine) they were finally diſpoſed into that beautiful and orderly frame, we call the world; among whoſe parts ſome were ſo curiouſly contrived, as to be fit to become the ſeeds, or ſeminal principles of plants and animals. And I further conceive, that he ſettled ſuch laws or rules of local motion, among the parts of the univerſal matter, that, by his ordinary and preſerving concourſe, the ſeveral parts of the univerſe, thus once completed, ſhould be able to maintain the great conſtruction, or ſyſtem and œconomy of the mundane bodies, and propagate the ſpecies of living creatures. So that, according to this hypotheſis, I ſuppoſe no other efficient of the univerſe, but God himſelf, whoſe almighty power, ſtill accompanied with his infinite wiſdom, did at firſt frame the corporeal world, according to the divine ideas, which he had, as well moſt freely, as moſt wiſely determined to conform them to: for, I think, it is a miſtake to imagine, (as we are wont to do) that what is called the nature of this or that body, is wholly compriſed in its own matter, and its (I ſay not ſubſtantial, but) eſſential form; as if from that, or theſe only, all its operations muſt flow. For an individual body being but a part of the world, and encompaſſed with other parts of the ſame great automaton, needs the aſſiſtance or concourſe of other bodies, (which are external agents) to perform divers of its operations, and exhibit ſeveral phænomena that belong to it. This would quickly and manifeſtly appear, if, for inſtance, an animal or an herb could be removed into thoſe imaginary ſpaces the ſchoolmen tell us of, beyond the world; or into ſuch a ſpace, as the Epicureans fancy their *intermundia*, or empty intervals, between thoſe numerous worlds, their maſter dreamed of: for, whatever the ſtructures of theſe living engines be, they would as little, without the co-operations of external agents, ſuch as the ſun, æther, air, *&c.* be able to exerciſe their functions, as the great mills commonly uſed with us, would be to grind corn, without the aſſiſtance of wind or running water. Which may be thought the more credible, if it be conſidered, that by the mere excluſion of the air, (though not of light, or the earth's magnetical effluvia, *&c.*) procured by the air-pump, bodies placed in an extraordinary large glaſs, will preſently come into ſo differing a ſtate, that warm animals cannot live in it; nor flame (though of pure ſpirit of wine) burn; nor ſyringes draw up water, nor bees, or ſuch winged inſects fly; nor caterpillars crawl; nay, nor fire run along a train of dried gun-powder: all which I ſpeak upon my own experience. According to the foregoing hypotheſis, I conſider the frame of the world already made, as a great, and, if I may ſo ſpeak, pregnant automaton, that, like a woman with twins in her womb, or a ſhip furniſhed with pumps, ordnance, *&c.* is ſuch an engine, as compriſes or conſiſts of ſeveral leſſer engines; and this compounded machine, in conjunction with the laws of motion, freely eſtabliſhed and ſtill maintained by God, among its parts, I look upon as a complex principle, whence reſults the ſettled order or courſe of things corporeal. And that which happens, according to this courſe, may, generally ſpeaking, be ſaid to come to paſs according to nature, or to be done

by nature; and that, which thwarts this order, may be ſaid to be preternatural, or contrary to nature. And indeed, though men talk of nature as they pleaſe, yet whatever is done among things inanimate, which make incomparably the greateſt part of the univerſe, is really done but by particular bodies, acting on one another by local motion, modified by the other mechanical affections of the agent, of the patient, and of thoſe other bodies, that neceſſarily concur to the effect, or the phænomenon produced.

[*N. B.*] THOSE, that do not reliſh the knowledge of the opinions and rites of the ancient *Jews* and *Heathens*, may paſs on to the next or fifth ſection, and ſkip the whole following excurſion, compriſed between double paratheſes, which, though neither impertinent nor uſeleſs to the ſcope of this treatiſe, is not abſolutely neceſſary to it.

[IN the foregoing (third) ſection of this treatiſe, I hope I have given a ſufficient reaſon of my backwardneſs to make frequent uſe of the word nature; and now, in this (fourth) ſection, having laid down ſuch a deſcription of nature, as ſhews that her votaries repreſent her as a goddeſs, or at leaſt a ſemi-deity; it will not be improper, in this place, to declare ſome of the reaſons of my diſſatisfaction with the notion or thing itſelf, as well as with the uſe of the name; and to ſhew, why I am not willing to comply with thoſe many, that would impoſe it upon us as very friendly to religion.

AND theſe reaſons I ſhall the rather propoſe, becauſe not only the generality of other learned men, (as I juſt now intimated) but that of divines themſelves, for want of information, or for ſome other cauſe, ſeem not to have well conſidered ſo weighty a matter.

To manifeſt therefore the malevolent aſpect, that the vulgar notion of nature has had, and therefore poſſibly may have, on religion; I think fit, in a general way to premiſe, what things they are, which ſeem to me to have been the fundamental errors, that miſled the Heathen world, as well philoſophers as others: for, if I miſtake not, the looking upon meerly corporeal, and oftentimes inanimate things, as if they were endowed with life, ſenſe, and underſtanding; and the aſcribing to nature, and ſome other beings, (whether real or imaginary) things, that belong but to God, have been ſome, (if not the chief) of the grand cauſes of the polytheiſm and idolatry of the gentiles.

The moſt ancient idolatry, (taking the word in its laxer ſenſe) or at leaſt one of the earlieſt, ſeems to have been the worſhip of the cœleſtial lights, eſpecially the ſun and moon; that kind of *Aboda zara*, עבודה זרה (as the Jewiſh writers call ſtrange or falſe worſhips) being the moſt natural, as having for its objects, glorious bodies, immortal, always regularly moved, and very beneficial to men. There is recorded, in the holy ſcripture, a paſſage of *Job*, who is probably reputed to be, at leaſt, as antient as *Moſes*, which ſeems to argue, that this worſhip, of the two great luminaries, was practiſed in his time, and looked upon as criminal by religious men; and, as our Engliſh verſion renders the Hebrew words, puniſhable by the civil magiſtrate.

Job xxxi. 26, 27. If, ſays *Job*, *I beheld the ſun, when it ſhined, or the moon walking in brightneſs: and my heart hath been ſecretly inticed, or my mouth hath kiſſed my hand, &c.* And that this idolatry was practiſed in *Moſes*'s time, may be gathered from that paſſage in Deuteronomy. *And leſt thou lift up thine eyes unto heaven, and when thou ſeeſt the ſun, and the moon, and the ſtars, even all the hoſt of heaven, ſhouldſt be driven to worſhip them, and ſerve them, &c.* The Sabeans, or, as many critics call them, the Zabians, are, by ſome very learned men, thought to have been the earlieſt idolaters: and the ableſt of the Jewiſh Rabbies, *Maimonides*, makes them to be ſo antient, that *Abraham* was

Deut. iv. 19.

More Nevoch. lib. 3. *c.* 30.

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put to diſpute againſt them. And their ſuperſtition had ſo overſpread the Eaſt, in *Moſes*'s time, that the ſame *Maimonides* judiciouſly obſerves, that divers of the ceremonial laws, given to the *Jews*, were inſtituted in oppoſition to the idolatrous opinions, magical rites, and other ſuperſtitions of the Zabians. Of this he (ſeconded therein by our famous *Selden*) gives ſeveral inſtances; to which, ſome are added by the learned *Hottinger*. But this only upon the by; my purpoſe in mentioning theſe Zabians, being to obſerve to you, that they looked upon the planets, and eſpecially the ſun and moon, as gods, and worſhipped them accordingly, taking them for intelligent beings, that had a great intereſt in the government of the world. *Hiſt. Orientalis lib.* 1. *cap.* 8.

THIS may be proved out of ſome Eaſtern writers, eſpecially *Maimonides*, who, in one place, aſſerts the Zabians to have adored the ſun and moon, and the *hoſt of heaven*, (as the ſcripture ſtyles the cœleſtial lights) as true gods: and this we ſhall the leſs wonder at, if we conſult another place of the ſame learned author, wherein he informs the readers, that theſe idolaters (the Zabians or Chaldeans) made ſtatues of ſilver and gold, thoſe for the ſun, and theſe for the moon; which, being conſecrated by certain rites and ceremonies, did invite, and, as it were, attract the ſpirits of theſe ſtars into thoſe ſhrines; whence they would ſpeak to their worſhippers, acquaint them with things profitable, and even predict to them things to come. And of ſome ſuch ſort of ſpeaking images, ſome learned criticks ſuppoſe the *Teraphim* (as the original text calls them) to have been, that *Laban* ſo prized, as to call them his gods: which it is gueſſed *Rachel* ſtole from her father, leſt, by conſulting them, he might learn what way her huſband and his company had taken in their flight. And the ſame great Rabbi having informed his readers, that he ſaw ſeveral books of the Zabian ſuperſtition, ſomewhere mentions one or two that treated of ſpeaking-images. And it was perhaps from theſe Zabians, or their diſciples, that *Zeno*, the founder of the Stoical ſect, taught, as *Stobæus* informs us, that the ſun, moon, and the reſt of the ſtars were endowed with underſtanding and prudence. And *Seneca*, an eminent champion of that rigid ſect*, reprehends *Epicurus* and *Anaxagoras*, (whoſe diſciple he was, in that opinion) that they held the ſun to be a burning ſtone, or an aggregate of caſual fires, and any thing, rather than a god. *Lib.* 3. *cap.* 36. 2 Kings xvii. 16. 2 Chron. xxxiii. 3. *Mor. Nevoch. lib.* 3. *cap.* 25. Gen. xxxi. 19. 30. * *Sen. de Benef. lib.* 7. *c.* 21.

I AM ſorry I could not avoid thinking the great *Hippocrates* to have been involved in the great error we are ſpeaking of, when in his book *De principiis aut carnibus*, near the beginning, I met with this paſſage; *Videtur ſane mihi id, quod* (Θερμὸν) *calidum vocamus, immortale eſſe, et cuncta intelligere et videre, et audire et ſcire omnia, tum præſentia tum futura.* According to which ſuppoſition, he preſently attempts to give ſome ſuch account of the origin of the world's frame, as he could in a very few lines; and then ſpends the reſt of the book in giving particular accounts, how the parts of the human body come to be framed; wherein, though I commend the attempt in general, becauſe, without acquieſcing in I know not what faculties, he endeavours to give an intelligible and particular account, how things come to be performed and produced; yet I cannot but look on this book, as a remarkable inſtance of this truth, that, without having recourſe to the true God, a ſatisfactory account cannot be given of the original or primitive production of the greater and leſſer world, ſince ſo great a naturaliſt as *Hippocrates*, by the help of his idolized Θερμὸν, was unable to perform this taſk, with any ſatisfaction to an attentive and intelligent inquirer. And *Galen* himſelf, who was not unacquainted with *Moſes*'s writings, and lived when Chriſtianity was propagated through a great part of the world; *Galen*, I ſay, even in that admirable treatiſe, *De uſu Partium*, where he ſo excellently declares and celebrates the moſt wiſe author of things, was ſo far tranſported with the error, which infected ſo many other heathen philoſophers, that he fancied the earth itſelf, though he

he ſpeaks contemptibly of it, had a certain ſoul or mind, imparted to it by the ſuperior bodies, which, he ſaith, is ſo conſpicuous, firſt in the ſun, then in the moon, and afterwards in the other ſtars; that by their beauty the contemplator will be induced to think it reaſonable, that the more pure their corporeal ſubſtance is, it is inhabited by a mind, ſo much the better and more perfect than that of theſe terreſtrial bodies. And having ſpoken of the reaſoning nature, that ſhined in *Plato*, *Ariſtotle*, *Hipparchus*, *Archimedes*, &c. he thus infers; *Si igitur in tanta colluvie (quo enim alio nomine quis appellet id, quod ex carne, ſanguine, pituita, ac bile utraque eſt conflatum) mens gignatur, adeo eximia & excellens; quantam ejuſdem putandum eſt eſſe excellentiam in Sole, Luna, aliiſque etiam Sideribus?* (to which he ſubjoins) *Mihi quidem, dum hæc mecum voluto, non exigua quædam mens talis, per ipſum etiam nos aerem ambientem, eſſe extenſa videtur. Fieri enim non poteſt, quum lucis ipſius Solis ſit particeps, quin vim etiam ab ipſo aſſumat.*

Galenus de uſu Partium, l. xvii. apud Lacunam in Epitome Oper. Galeni.

BUT this upon the by. Nor did this opinion of the divinity of the cœleſtial bodies die with the *Zabians*, or the *Greek* philoſophers. For I found, by ſome queſtions I propoſed to an inquiſitive perſon, who, having lived many years in *China* and ſeveral of the neighbouring kingdoms, had acquired ſkill enough in the tongues to converſe with the natives; I found, I ſay, that in a ſolemn conference he had with ſome of the more eminent and philoſophical doctors of the *Chineſes* religion, they frankly profeſt, that they believe the heavenly bodies to be truly divine, and to be worſhipped, and that upon this particular ground, that they imparted to men ſuch good things, as light, heat, rain, *&c.* and the productions and conſequences of theſe: and this belief they declared, they thought more rational, than that of the *Europeans*, who worſhip a deity, whoſe neither ſhape, nor colour, nor motion, nor efficacy on ſublunary things, were at all viſible. It agrees very well with the opinion of the antient *Greeks*, who, as *Origen* relates, called the ſun, moon, and the ſtars ἐμφανεῖς Θεὸς καὶ αἰσθητοὺς, *conſpicuous and ſenſible gods.* And we are taught by *Euſebius*, that the antient *Ægyptian* theologizers, whoſe religion was near of kin to that of the *Chaldeans*, if not borrowed of it, looked upon the ſun and moon, whom they worſhipped under the names of *Oſiris* and *Iſis*, not only as the chief gods, but as the makers and governors of much, if not of all, of the reſt of the univerſe.

Origen. cont. *Celſum.* l. v. Præpar. l. iii. c. 4. Damaſcius vita Iſidori apud Photium: Colunt præcœteris. Diis Ægyptii Oſirim & Iſin (*i. e.* Solem & Lunam,) illum omnia condere, & figuris numeriſque materiam adornare arbitrari.

I WILL not here inquire, whether theſe old heathen philoſophers did, beſides the ſtars and other beings, that they adored as gods, believe one only numen or ſupreme deity. But that may ſuffice for my preſent purpoſe, which ſeems manifeſt, *viz*, that they aſcribed to ſenſible beings, attributes peculiar to the true God; that this was occaſioned by their thinking them intelligent and governing; and that theſe inferior beings were, by far, the moſt uſual and familiar objects both of their diſcourſes and their worſhip; and that they did (to uſe the phraſe of the apoſtle of the *Gentiles*) worſhip the *creature beſides*, or *more than*, (for the *Greek* word παρὰ may ſignify either) the *Creator* *, who by *Moſes*, the prophets, and the apoſtles, expreſly declares a diſlike of this worſhip, and even in that more ſpecious and ſeemingly excuſeable kind of it, which was in uſe among the ten tribes that profeſſed, and perhaps believed, their worſhip to be directed to the one ſupreme God, and him the true God of *Iſrael*. But this alſo upon the by.

* Rom. i. 25.

Sed nec illam, quam ejuſdem Numinis (Solis) beneficio adoptus ſum.

THIS belief, that the world, and divers of its principal parts, as the ſun, moon, ſtars, *&c.* were animated and endowed with intelligent minds, was ſo contagious, that not only it helped to ſeduce the emperor *Julian* from Chriſtianity to heatheniſm, (inſomuch that he gives the ſun ſolemn thanks for his advancement to the *Roman* monarchy;) but it infected very learned men among the *Jews* and *Chriſtians*. Of the former, I ſhall need to name but two; the firſt being the famouſeſt and judiciouſeſt

of

of the antienter *Rabbins*, *Maimonides*, in whom, I confeſs, I wondered to find this aſſertion, that the ſun and ſtars were animated beings, endowed with underſtanding and will: and the other being reputed the chief and the moſt learned of the moderns, *Menaſſeh Ben Iſrael*, with whom I have converſed at *Amſterdam*) who in his problems *De Creatione*, hath this notable paſſage.—*Quod de intelligentiis tradunt, id vero mera fabula eſt; nam Cœli, ſecundum Rabbi Moſem, & rei veritatem, habent animas proprias rationali vita præditas, ſicut alibi à me demonſtrabitur.* And a greater man than *Maimonides*, *Origen* himſelf, among the Chriſtians, not only in one place adventures to ſay, *Siquidem etiam Cœleſtes Stellæ Animalia ſunt Rationalia, virtute prædita, illuſtrata Cognitionis Lumine, à Sapientia illa, quæ eſt Splendor æterni Luminis* *; but in another proceeds ſo far, that I found (not without ſurprize) that he ſays, *the Chriſtians ſing hymns to God the Lord of all, and God the word; no otherwiſe than do the ſun, moon, and ſtars, and the whole heavenly hoſt, ſince all theſe, being a heavenly choir, do with juſt men celebrate the ſupreme God, and his only begotten* [*Son.*] † The boldneſs of theſe unjuſtified paradoxes I the leſs wonder at, when I conſider, what has for many ages been taught by the ſchool philoſophers, from *Ariſtotle*; namely, that the cœleſtial ſpheres had their peculiar intelligences, that is, rational, immortal, powerful and active Beings. It is true, that in the *Jews* and *Chriſtians* I have been ſpeaking of, the malignity of the error they embraced was corrected and maſtered by the ſound and orthodox principles they held together with it. But ſtill it is dangerous for thoſe, that would be loyal to him, that ſtiles himſelf a *jealous God* ‡, to adopt premiſes, that have been able to miſlead ſuch great perſons, and from which many famous philoſophers have plauſibly enough drawn conſequences very repugnant to true religion. Nor are Chriſtians themſelves ſo much out of danger of being ſeduced by theſe heatheniſh notions about an intelligent world, but that (not again to mention the apoſtate emperor) even in theſe times there is lately ſprung up a ſect of men, as well profeſſing Chriſtianity, as pretending to philoſophy, who (if I be not miſ-informed of their doctrine) do very much ſymbolize with the antient Heathens, and talk much indeed of God, but mean ſuch a one, as is not really diſtinct from the animated and intelligent univerſe; but is, on that account, very differing from the true God, that we Chriſtians believe and worſhip. And though I find the leaders of this ſect to be looked upon, by ſome more witty than knowing men, as the diſcoverers of unheard of myſteries in phyſics and natural theology; yet their hypotheſis does not at all appear to me to be new, eſpecially when I remember, beſides the paſſages of the antients, cited in this paper, ſome others of the ſame import, ſuch as is particularly that of *Lucan*.

ſortem, conditionemque parvi facio; quod ex eo genere, penes quod Terrarum Dominatus atque Imperium eſt, temporibus noſtris ortum acceperim. Julian. ad Regem Solem.

More Nevochim. l. iii. c. 29. (ni fallor.) Pag. M. 98.

* *Origen.* cont. *Celſum.* l. v.

† *Origen.* cont. *Celſum.* l. viii.

‡ Exod. xx.

> *Eſtque Dei ſedes, niſi Terra, & Pontus, & Aer,*
> *Et Cœlum, & Virtus? Superos quid quærimus ultra?*
> *Jupiter eſt quodcunque vides, quocunque moveris.*

THE great affinity between the *ſoul of the world*, ſo much talked of among the heathen philoſophers, and the thing, that men call nature, makes it fit for me to take notice, in this place, of the influence, which the belief of that imaginary ſoul had upon the *Gentiles*, with reference to religion.

THAT divers of the antient philoſophers held the world to be animated, hath been obſerved by more than one learned man: but that, which makes more for my preſent purpoſe, is, that the ſame old ſages did alſo (at leaſt for the moſt part) believe, that this mundane ſoul was not barely a living, but a moſt intelligent and wiſely active Being. This may be eaſily enough diſcerned by him, that ſhall heedfully peruſe *Diogenes Laertius*'s lives of the philoſophers, and particularly of *Zeno*. But at preſent I ſhall rather make uſe of an author, who, though he be very ſeldom cited for philoſophical

philoſophical hiſtory, ſeems to me to have been very well verſed in it. The writer, I mean, is the acute ſceptic *Sextus Empiricus*, (who is thought to have lived about *Plutarch*'s time, and, by ſome, to have been his nephew;) who recites a long ratiocination of *Xenophon*, which, whether it be ſolid or not, is at leaſt ingenious and plauſible, but too prolix to be tranſcribed in this place, where we may ſuffice to ſay, that he thus concludes: *Eſt ergo Mundus mente præditus & Intelligens, &c.* which aſſertion *Sextus* himſelf thus propoſes for him; *Si non eſſet aliqua Mens in Mundo, neque ulla Mens in te eſſet. Eſt autem in te Mens aliqua; ergo eſt etiam in Mundo. Et Ideo Mundus eſt Mente et Intelligentia præditus.* The ſame ſceptic introduces *Zeno Cittieus* diſcourſing thus: *quod immittit ſemen ejus quod eſt particeps rationis, eſt ipſum quoque rationis particeps. Mundus autem emittit Semen ejus, quod eſt particeps rationis; eſt ergo Mundus rationis particeps.* To which teſtimonies I might add many others out of the ſame author, who, in the ſame diſcourſe, tells us, that the Stoics held the world to be an animal. But the opinion, that the old philoſophers we have been ſpeaking of, held of the world's being endowed with an underſtanding or rational ſoul, will be yet more evident by what I now proceed to alledge, to manifeſt, how this opinion of theirs led them to the worſhip of another, than the true God.

Sextus Empir. adverſus Mathemat. l. viii.

Sextus Empiricus, in the lately cited diſcourſe of *Xenophon*, infers from the world's being an intelligent being, that it is alſo a divine one; for to the lately recited concluſion, *Eſt ergo Mundus mente præditus et intelligens*, he immediately ſubjoins this other, *Et ideo Deus.* And a little after, repeating their diſcourſe, that defended this argumentation of *Xenophon* againſt an objection, he concludes their reaſoning thus; *Ideo Mundus eſt Mente & Intelligentia præditus: Cum ſit autem Mente & Intelligentia præditus, eſt etiam Deus. Quemadmodum* (ſays alſo *Phurnutus* the philoſopher,) *nos anima gubernamur, ſic & Mundus animam habet, quæ vindicet illum ab interitu; & hæc vocatur Jupiter.* To which agrees that in *Cicero*'s Academic Queſtions; *Mundum eſſe ſapientem, & habere mentem, quæ ſeipſam fabricata ſit, & omnia moderatur, regat.* And the reaſoning of the *Stoics* in St. *Auguſtine* is very clear to the ſame purpoſe; * *Dicunt* (ſaith he, ſpeaking of the embracers of that ſect) *omnia Sidera partes Jovis eſſe, & omnia vivere atque rationales animas habere, & ideo ſine controverſia Deos eſſe.* And *Socrates* is introduced by *Ariſtophanes*, as no leſs than invocating the air and the æther together, in theſe words:

F. M. 326.

* Auguſt. de Civit. Dei. l. vii. c. 2.

> *O Rex, O Imperator, Aer vaſte, quæ Terram contines ſuſpenſam,*
> *Nec non ſplendide Æther.*

WHICH brings into my mind that plain confeſſion of the poet *Manilius:*

> *Qua pateat, Mundum divino Numine verti,*
> *Atque ipſum eſſe Deum.*

To all theſe I ſhall add that notable and expreſs paſſage of the elder *Pliny*; † *Mundum, & hoc quod alio nomine Cælum appellare libuit, cujus circumflexu teguntur omnia, Numen eſſe credi par eſt, æternum, immenſum, neque genitum, neque interiturum unquam. Sacer eſt, æternus, immenſus, totus in toto, vero ipſe totum, finitus & infinito ſimilis, extra, intra, cuncta complexus in ſe, idemque Naturæ opus, & rerum ipſa Natura.*

† Natur. Hiſt. l. ii. c. 1.

IF it be objected, that the paſſages I have cited out of heathen philoſophers, concern the ſoul of the world, and not nature; I anſwer, that the affinity of theſe two is ſo great, that divers of the old ſages ſeem to have confounded them, and not to have made account of any other univerſal nature, than the ſoul of the world. And however,

however, the great and pernicious errors they were led into by the belief that the univerſe itſelf, and many of its nobler parts, beſides men, were endowed, not only with life, but underſtanding and providence, may ſuffice to make us Chriſtians very jealous of admitting ſuch a being, as that, which men venerate under the name of nature; ſince they aſcribe to it as many wonderful powers and prerogatives, as the Idolaters did to their adored mundane ſoul. But I ſhall give a further anſwer to the above propoſed objection, if I can ſhew, how ſacrilegiouſly they abuſed the being we are ſpeaking of, as well under the very name of nature, as under that of the ſoul of the world. On this occaſion I remember a paſſage in * *Seneca*, that I did not expect to meet with, where, ſpeaking of ſome ethnic opinions about thunder, *Non Jovem*, (ſays he) *qualem in Capitolio colimus, fulmina mittere, ſed cuſtodem rectoremque Univerſi, animam ac Spiritum Mundani hujus Operis Dominum & Artificem, cui nomen omne convenit:* to which, within a few lines after, he adds, *Vis illam Naturam vocare? Non peccabis, eſt enim, ex quo nata ſunt omnia, cujus Spiritu vivimus. Vis illam vocare Mundum? Non falleris, ipſe enim eſt totum quid, totus ſuis partibus inditus & ſe ſuſtinens vi ſua.* And the ſame author elſewhere, *Nihil* (ſays he) *Natura ſine Deo eſt, nec Deus ſine Natura, ſed idem eſt Uterque.* And in another of the *Roman* ſages we have this paſſage; *Natura eſt igitur, quæ continet Mundum omnem, eumque tuetur, & quidem non ſine ſenſu ac ratione.* And the opinion, not of a private philoſopher, but of the ſect of *Stoicks*, is thus delivered by *Lactantius*: *Iſti uno naturæ nomine res diverſiſſimas comprehenderunt, Deum & Mundum, Artificem & Opus, dicuntque alterum ſine altero nihil poſſe, tanquam Natura ſit Deus Mundo permiſtus. Nam interdum ſic confundunt, ut ſit Deus ipſa mens Mundi, & Mundus ſit Corpus Dei; quaſi vero ſimul eſſe cæperint Mundus & Deus.* And to let you ſee, that in this our free inquiry I do not, without cauſe, here and there ſtyle nature ſometimes a ſemi-deity, and ſometimes a goddeſs, and talk of ſome men's idolizing her; I ſhall here annex part of a hymn of *Orpheus*'s, addreſſed immediately to nature.

* Natur. Quæſt. l. ii. c. 45.

De Benef. l. 4. c. 7.

Lib. vii. Cap. 1.

Ὦ φυσὶ παμμήτειρα Θεὰ, &c.

which his interpreter thus renders into *Latin*;

O Natura omnium Mater Dea, artificioſa admodum Dea,
Suſcitatrix honorabilis, multa creans, Divina Regina,
Omnidomans, indomita gubernatrix, ubique ſplendens.

And after a few lines:

Ætheria, Tereſtris, & Marina Regina, &c.

I know *Ariſtotle*, and his commentators, do not ſo directly idolize nature, as did *Orpheus* (or whoever was the antient author of the hymns, that bear his name); but yet I doubt they paſs further than they can juſtify, when they ſo freely and often aſſert, that *Natura eſt ſapientiſſima*, that *Opus Naturæ eſt opus Intelligentiæ*, that *Natura ſine ſuo nunquam excidit*, that *Natura ſemper quod optimum eſt facit*, (to which may be added other-like axioms;) and when they moſt commonly call the works of God the works of nature, and mention him and her together, not as a creator and a creature, but as two co-ordinate governors, like the two *Roman* conſuls; as when they ſay frequently, and without ſcruple, (what I find to have been firſt by *Ariſtotle* himſelf) that *Deus & Natura nihil faciunt fruſtra*; to which phraſe may agree that expreſſion of *Ovid*, where, ſpeaking of the chaos, whilſt the bodies, that compoſed it, lay ſhuffled together, and were not yet packed, he ſays,

Deus & Natura nihil prorſus *faciunt* fruſtra. Ariſt de Cœlo, lib. ii. cap. 5.

Hanc Deus & melior litem Natura diremit.

To the recital of the irreligious errors of the antient heathens, about the divinity of the world, and ſome of its principal parts, as the ſun, moon, ſtars, æther, &c. I ſhould add a redargution of them, if I thought it neceſſary, in this place, ſolemnly to refute opinions, ſome of which are altogether precarious, and others very improbable. Thoſe Greek and Latin philoſophers, that held the ſun to be a fire, were much at a loſs to find out fuel to maintain the flame. But thoſe *Zabians* and *Chaldeans*, that thought him endowed, not only with a living ſoul, but with underſtanding and will, muſt, if they had duly conſidered things, have been much more puzzled, to find not only food for ſo vaſt a body, (above 160 times bigger than the terraqueous globe) but to find in him the organs neceſſary to the preparations and digeſtion of that food, and to the other functions, that belong to animal nutrition. And if we admit the Carteſian hypotheſis, the way, whereby the ſun, fixed ſtars, and planets, are generated, will ſufficiently manifeſt them to be neither intelligent nor living bodies: and perhaps I could here propoſe a quite other hypotheſis, about the nature of the ſun, and the fuel of its fire, that may be countenanced by ſome phænomena and experiments, without making him other than an igneous, and altogether inanimate body, whoſe flame needs to be repaired by feul furniſhed to it nearer hand, than from the ſea or earth. But I purpoſely omit ſuch objections againſt the opinion I oppoſe, as though drawn from the dictates of ſound philoſophy about the origin of things, may be queſtioned, without being to be cleared in few words. It is alſo without proof, that it is preſumed and aſſerted, that the cœleſtial bodies, newly mentioned, are endowed with underſtanding and prudence, eſpecially ſo, as to be able to know the particular conditions and tranſactions of men, and hear and grant the prayers of their worſhippers. And the moon, which was one of their principal deities, and by them preferred before all the other planets and ſtars, the ſun excepted, is ſo rude and mountainous a body, that it is a wonder, that ſpeculative men, who conſidered, how many, how various, and how noble functions belong to a ſenſitive ſoul, could think a lump or maſs of matter, ſo very remote from being fitly organized, ſhould be animated and governed by a true living and ſenſitive ſoul. I know, that both theſe deifiers of the cœleſtial globes, and alſo the heathen diſciples of *Ariſtotle*, beſides divers of the ſame mind even among the Chriſtians, ſay great and lofty things of the quinteſſential nature of the heavenly bodies, and their conſequent incorruptibility; of the regularity of their motions, and of their divine quality of light, that makes them refulgent: but the perſuaſion they had of this quinteſſential nature of the ſuperior part of the world, was not, if I gueſs aright, grounded upon any ſolid phyſical reaſon, but was entertained by them for its congruity to the opinion they had of the divinity of the cœleſtial bodies; of which *Ariſtotle* himſelf, eſpecially in his books *de Cœlo*, ſpeaks in ſuch a way, as hath not a little contributed, among his followers, to ſuch an exceſſive veneration for thoſe bodies, as is neither agreeable to true philoſophy, nor friendly to true religion. He himſelf takes notice, that the *Pythagoreans* held our earth to be one of the planets, and that it moved about the ſun, which they placed in the middle of the world. And ſince this hypotheſis of the earth's motion was in the laſt age revived by *Copernicus*, not only thoſe great men *Keplerus*, *Galileo*, and *Gaſſendus*, but moſt of the beſt modern aſtronomers, and beſides *des Cartes* and his ſect, many other naturaliſts have embraced this hypotheſis; which, indeed, is far more agreeable to the phænomena, not only than the doctrine of *Ariſtotle*, (who was plainly miſtaken about the order and conſiſtence of the heavens) but than the antient and generally received Ptolomaic ſyſtem. Now, ſuppoſing the terraqueous globe to be a planet, he, that conſiders, that it is but a round maſs of very heterogeneous ſubſtances, (as appears by the differing natures of its great conſtituent parts, land and ſea)

L. xi. c. 3.

Ariſtot. de Cœlo. l. xi. c. 13.

ſea) whoſe ſurface is very rude and uneven, and its body opacous, unleſs as it happens to be enlightened by the ſun, moon, and ſtars, and ſo very inorganical for ſo much as nutrition, that it ſeems wholly unfit to be a living animal: I ſay, he, that conſiders ſuch things, will ſcarce be forward to aſcribe underſtanding and providence, much leſs a divine nature, to the other ſtars; as for inſtance, to the moon, which our beſt teleſcopes manifeſt to be a very craggy and mountainous body, conſiſting of parts of very differing textures, (as appears by her brighter parts and permanent ſpots) and which of herſelf is opacous, having no manifeſt light, but what ſhe borrows from the ſun, and perhaps from the earth,

As for the boaſted immutability of the heavenly bodies, beſides that it may be very probably called in queſtion by the phænomena of ſome (for I do not ſay every one) of the comets, that by their parallax were found to be above the moon, and conſequently in the cœleſtial region of the world: beſides this, I ſay, the incorruptibleneſs and immutability of the heavenly bodies is more than probably diſproveable by the ſudden and irregular generation, changes, and deſtruction, of the ſpots of the ſun; which are ſometimes ſo ſuddenly deſtroyed, that I remember in the year 1660, on the 8th of *May*, having left in the morning a ſpot, whoſe motions we had long obſerved through an excellent teleſcope, with an expectation, that it would laſt many days viſible to us, we were ſurprized to find, that, when we came to obſerve it again in the evening, it was quite diſſipated, though it ſeemed thick; and by comparing it to the ſun, we eſtimated the extent of its ſurface to be equal to that of all *Europe*. As to the conſtancy of the motions of the ſtars; if the earth, which we know to be inanimated, be a planet, it moves as conſtantly and regularly about the ſun, (in that which they call the great orb,) as the other planets do, or as the moon doth about the earth. And I conſider, that though we ſhould ſuppoſe our globe not to be a planet, yet there would manifeſtly be a conſtant motion, and regular enough, of a great part of it; ſince (bating ſome anomalies, that ſhores, winds, and ſome other extrinſic things, occaſion,) there is a regular ebbing and flowing twice a day, and alſo ſpring-tides twice a month, of that vaſt aggregate of waters, the ocean; which perhaps is not inferior in bulk to the whole body of the moon, and whereof alſo vaſt tracts are ſometimes obſerved to ſhine.

And laſtly, whereas a great proof of the divinity of the ſtars is taken from their light; though I grant it to be the nobleſt of ſenſible qualities, yet I cannot think it a good proof of the divine, or very excellent, nature of bodies endowed with it, whether they be cœleſtial or not. For whereas the *Zabians* and *Chaldeans* conſidered and adored the planets, as the chief gods, our teleſcopes diſcover to us, that, except the ſun, (if he be one, rather than a fixed ſtar) they ſhine but by a borrowed light; inſomuch that *Venus*, as vividly luminous as it appears to the naked eye, is ſometimes ſeen (as I have beheld it) horned like the moon in no long time after her change. And at this rate alſo the earth, whether it be a planet or no, is a luminous body, being enlightened by the ſun; and poſſibly, as a body forty times bigger, communicates more light to the moon, than it receives from her, as is probably argued from the light ſeen on the ſurface of the moon in ſome of her eclipſes. And, though in the night, when the darkneſs hath widened the pupils of our eyes, and the moon ſhines with an unrivaled luſtre, ſhe ſeems exceeding bright, yet ſhe may be, for aught I know, more opacous than the ſolid part of the terreſtrial globe: for I remember, that I have more than once heedfully obſerved a ſmall cloud in the weſt, where the moon then was, about ſun ſet; and comparing them together, the little cloud, as opacous and looſe a body as it was, reflected the light as ſtrongly to my eye, as did the moon, that ſeemed perhaps to be not far from it, both of them appearing like little

whitiſh clouds, though afterwards, as the ſun deſcended lower and lower beneath the horizon, the moon grew more and more luminous. And, ſpeaking of light indefinitely, it is ſo far from arguing a divine nature in the bodies, that are endowed with it, whether, as the planets, by participation from an external illuminant, or as the ſun, from an internal principle; that a burned ſtone, witneſs that of Bolonia, will afford, in proportion to its bulk, incomparably more borrowed light, than one of the planets. And a light from its internal conſtitution may be found, not only in ſuch abject creatures as inſects, whether winged, as the cucupias of *Hiſpaniola*, or creeping, as our glow-worms; but alſo in bodies inanimate and corrupted, as in rotten wood, in ſtinking whitings, and divers other putrified fiſhes.

I cannot now ſtay to inquire, how the Zabians, and ſuch idolaters as they, could make out the connexion, ſymmetry, and ſubordination or dependance of the ſeveral parts of the world, compoſed of ſo many different and diſtant beings, endowed not only with animal ſouls, but with their diſtinct and peculiar underſtandings and wills, and many of them alſo with divine nature. Nor ſhall I conſider, how ſtrange a monſter, rather than an animal and a deity, thoſe many heathen philoſophers and their adherents muſt make of the univerſe, who held it to be but one; and yet were of the paradoxical opinion, that (as hath been elſewhere noted) is roundly profeſſed by *Stobæus*, at the very beginning of his phyſical eclogues, Ζεὺς ἔν, *&c. i. e. Jupiter (quidem) totus mundus eſt: animal ex animalibus; numen ex numinibus compoſitum.*

THESE, I ſay, and the like objections againſt the pagan doctrine, I muſt not now inſiſt on, becauſe I perceive, that I have ſlipped into a ſomewhat long digreſſion, (which yet perhaps may not be altogether unſeaſonable or uſeleſs;) which therefore I ſhall here break off, to reſume and conclude the diſcourſe, that this ſection was allotted to, which I might eaſily have enlarged; but I preſume there is enough ſaid in it already, to let you ſee, that it is a dangerous thing to believe other creatures, than angels and men, to be intelligent and rational; eſpecially to aſcribe to any of them an architectonic, provident, and governing power. And though I readily acknowledge, that there is no great danger, that well inſtructed Chriſtians ſhould, like ſome Heathens, worſhip nature as a Goddeſs; yet the things I formerly alledged, to ſhew it unſafe to cheriſh opinions of kin to thoſe, that miſ-led a multitude even of philoſophers, make me fear too many, and not a few of the learned themſelves, may have a veneration for what they call nature; much greater than belongs to a meer creature; if they do not, to uſe a ſcripture expreſſion, *worſhip the creature, above* or *beſides* the *creator*, who, and not the world, nor the ſoul of it, is the true God. And though I ſhould grant, that the received notion of nature doth neither ſubvert, nor much endanger any principle of religion; yet that is not enough for the purpoſe of thoſe naturiſts I reaſon with; ſince they are here ſuppoſed to make it a fault in others, not to aſcribe to the nature they venerate, as much as themſelves do; and they repreſent their own notion of it, not only as innocent, but as very uſeful, if not neceſſary to religion.

Rom. i. 25.

SECT. V.

IV. I COME now, *Eleutherius*, to acquaint you with ſome of the reaſons, that have made me backward to entertain ſuch a notion of nature, as I have hitherto diſcourſed of; and I ſhall at preſent compriſe them under the following five.

I. THE firſt whereof is, that ſuch a nature, as we are ſpeaking of, ſeems to me to be either aſſerted, or aſſumed without ſufficient proof. And this ſingle reaſon, if it be well made out, may, I think, ſuffice for my turn. For, in matters of philoſophy, where

where we ought not to take up any thing upon truſt, or believe it without proof, it is enough to keep us from believing a thing, that we have no poſitive argument to induce us to aſſent to it, though we have no particular arguments againſt it. And if this rule be to take place in leſſer caſes, ſure it ought to hold in this, where we are to entertain the belief of ſo catholick an agent, that all the others are looked upon but as its inſtruments, that act in ſubordination to it; and which, being ſaid to have an immediate agency in many of the phænomena of the world, cannot but be ſuppoſed to be demonſtrable by divers of them. I have yet met with no phyſical arguments, either demonſtrative, or ſo much as conſiderably probable, to evince the exiſtence of the nature we examine. And, though I ſhould admit the uſe, that ſome divines contend for, of the holy ſcriptures in philoſophical controverſies; yet I ſhould not be perſuaded of the exiſtence of the nature, we diſpute of: for I do not remember, that the ſcripture any where declares to us, that there is ſuch a thing, (in the ſenſe by me queſtioned) though (as I formerly noted more fully in the IV. ſection,) in *Geneſis* and ſome other places, where the corporeal works of God are expreſly treated of, (though in order to ſpiritual ends) one might probably enough expect to find ſome mention of God's grand vicegerent in the univerſe of bodies, if he had eſtabliſhed any ſuch. But whatever be the true cauſe of the ſcripture's ſilence about this matter, the ſilence itſelf is ſufficient to juſtify me for examining freely by reaſon a thing, that is not impoſed on my belief by revelation. And as for the phyſical arguments, that may be brought in favour of the queſtioned notion of nature, I ſhall, ere long, examine the principal of them, and ſhew that they are not convincing. To theſe things may be added, as to the proof drawn from the general opinion about nature, that being a popular, not a phyſical argument, it may indeed paſs for current with the vulgar, but ought not to do ſo with philoſophers.

II. The ſecond reaſon is taken from the unneceſſarineſs of ſuch a nature, as is pretended: for, ſince a great part of the work of true philoſophers has been, to reduce the true principles of things to the ſmalleſt number they can, without making them inſufficient; I ſee not, why we ſhould take in a principle, of which we have no need. For ſuppoſing the common matter of all bodies to have been at firſt divided into innumerable minute parts, by the wiſe author of nature, and theſe parts to have been ſo diſpoſed of, as to form the world, conſtituted as it now is; and eſpecially, ſuppoſing that the univerſal laws of motion, among the parts of the matter, have been eſtabliſhed, and ſeveral conventions of particles contrived into the ſeminal principles of various things; all which may be effected by the mere local motion of matter, (not left to itſelf, but ſkilfully guided at the beginning of the world) if (I ſay) we ſuppoſe theſe things, together with God's ordinary and general concourſe, which we very reaſonably may; I ſee not, why the ſame phænomena, that we now obſerve in the world, ſhould not be produced, without taking in any ſuch powerful and intelligent being, diſtinct from God, as nature is repreſented to be. And, till I ſee ſome inſtance produced to the contrary, I am like to continue of this mind, and to think, that the phænomena, we obſerve, will genuinely follow from the mere fabrick and conſtitution of the world: as, ſuppoſing the ſun and moon to have been put, at firſt, into ſuch motions about the earth, as experience ſhews they have, the determinate celerity of theſe motions, and the lines, wherein they are performed, will make it neceſſary, that the moon ſhould be ſometimes full, ſometimes ſcarce illuminated at all to us-ward, ſometimes horned, and, in a word, ſhould exhibit ſuch ſeveral phaſes, as every month ſhe doth, and that, at ſometimes, ſhe and the ſun ſhould have a trine, or a quadrate aſpect, *&c.* and that now one, and now the other of them, ſhould, at ſet times, ſuffer an eclipſe; though theſe eclipſes were, by the Romans, and others of old,

and are by many unlearned nations at this day, looked upon as ſupernatural beings; and though alſo *Ariſtotle*, and a multitude of his followers, fancied, that ſuch regular motions could not be maintained without an aſſiſtant intelligence, which he and they therefore aſſigned to each of the heavenly orbs. And indeed the difficulty we find to conceive, how ſo great a fabric, as the world, can be preſerved in order, and kept from running again to a chaos, ſeems to ariſe from hence; that men do not ſufficiently conſider the unſearchable wiſdom of the divine architect, or Δημιουργὸς (as the ſcripture ſtyles him) of the world, whoſe piercing eyes were able to look, at once, quite through the univerſe, and take into his proſpect both the beginning and end of time: ſo that perfectly fore-knowing, what would be the conſequences of all the poſſible conjunctures of circumſtances, into which matter, divided and moved according to ſuch laws, could, in an automaton ſo conſtituted as the preſent world is, happen to be put; there can nothing fall out, unleſs when a miracle is wrought, that ſhall be able to alter the courſe of things, or prejudice the conſtitution of them, any further, than he did from the beginning foreſeee, and think fit to allow.

Heb. xi. 10.

NOR am I ſure, that the received notion of nature, though it be not neceſſary, is at leaſt very uſeful, to explicate phyſical phænomena: for beſides that I ſhall ſhew ere long, that ſeveral explications, where recourſe to it is preſumed to be the moſt advantageous, are not to be allowed; to give the nature of a thing for the cauſe of this or that particular quality, or operation of it, is to leave men as ignorant as they were before; or, at leaſt, is to acknowledge, that a philoſopher can, in ſuch caſes, aſſign no better particular and immediate cauſes of things, than a ſhepherd or a tradeſman, that never learned natural philoſophy, can aſſign of the ſame things, and of a thouſand others. And though it be true, (as I formerly alſo intimated) that, in many caſes, philoſophers themſelves can anſwer no otherwiſe to ſuch queſtions, as may be propoſed to them, than by having recourſe to the nature of the thing; yet ſuch anſwerers do not declare the proper cauſe of a dark phænomenon, but only that he, who employs them, does not yet know it: and ſo this indefinite notion of nature, which is equally applicable to the reſolving of all difficulties, is not uſeful to diſcloſe the thing, but to delude the maker of the queſtion, or hide the ignorance of the anſwerer.

III. MY third argument is, that the nature, I queſtion, is ſo dark and odd a thing, that it is hard to know what to make of it, it being ſcarce, if at all, intelligibly propoſed by them, that lay moſt weight upon it. For it appears not clearly, whether they will have it to be a corporeal ſubſtance, or an immaterial one, or ſome ſuch thing, as may ſeem to be betwixt both; ſuch as many Peripatetics do repreſent ſubſtantial forms, and what they call real qualities, which divers ſchool-men hold to be (at leaſt by miracle) ſeparable from all matter whatſoever. If it be merely corporeal, I confeſs I underſtand not, how it can be ſo wiſe, and almoſt omniſcient an agent, as they would have it paſs for: beſides, that if it be a body, I would gladly know, what kind of body it is; and how, ſince, among bodies, there can be no penetration of dimenſions, this body can ſo intimately pervade, as they pretend nature does all the other bodies of the world? And to this I would add divers other queſtions that would not be eaſily anſwered: (but I ſhall reſume this third argument in another place.) If it be ſaid, that nature is a ſemi-ſubſtantia, as ſome of the moderneſt ſchool-men are pleaſed to call ſubſtantial forms and real qualities; I roundly anſwer, that I acknowledge no ſuch chimerical and unintelligible beings, and ſhall only deſire you to apply to them a good part of the diſcourſe, made in certain papers, occaſioned by a chymico-phyſical eſſay about ſalt-petre, againſt the pretended origin, and inexplicable nature of the imaginary ſubſtantial forms of the Peripatetics.

ripatetics. It remains therefore, that this nature, we ſpeak of, if it be any thing poſitive, ſhould be an immaterial ſubſtance: but to have recourſe to ſuch an one, as a phyſical agent, and not only a determiner, but the grand author of the motion of bodies, and that, eſpecially, in ſuch familiar phænomena, as the aſcenſion of water in pumps, the ſuſpenſion of it in water-pots for gardens, the running of it through ſiphons, and I know not how many others, and to explain its caſuality, as they ſpeak, will I think, prove a work exceeding difficult: though I ſhall not here ſpend time to ſhew the farther inconveniences of ſuch a ſuppoſition, being to do that hereafter; and, in the mean-while, contenting myſelf to obſerve, as to many of the naturiſts, that though their doctrine may favour it, they ſeem rather content to talk darkly, and uncertainly, of what they call nature, than by clearly defining it, expoſe it to objections not eaſy to be anſwered, and who foreſee the advantage, that the unſettledneſs of the notion gives them, to pretend knowledge, or diſguiſe ignorance.

IV. SINCE many of the moſt learned amongſt the naturiſts are Chriſtians; and not few of them divines too, it may not be improper (which elſe I ſhould, perhaps, think it would be) to add, in this place, that the next thing, for which I diſlike the vulgar notion (or idea) of nature, is, that I think it dangerous to religion in general, and conſequently to the Chriſtian.

FOR this erroneous conceit defrauds the true God of divers acts of veneration and gratitude, that are due to him from men, upon the account of the viſible world, and diverts them to that imaginary being they call nature, which has no title to them; for whilſt nature is ſuppoſed to be an intelligent thing, that wiſely and benignly adminiſters all, that is done among bodies, it is no wonder that the generality of philoſophers, and, after their example, of other men, ſhould admire and praiſe her, for the wonderful, and for the uſeful things, that they obſerve in the world. And, in effect, though nature, in that ſenſe of the word I am ſpeaking of, be never (that I remember) to be found in the ſacred writings; yet nothing is to be more frequently met with (and that adorned with titles and encomiums) in the books of philoſophers, than nature and her effects. And, if we conſider, that whatever has been ſaid by ſome, in excuſe of *Ariſtotle* himſelf, yet the generality of the Peripatetics, from whom the vulgar notion of nature is chiefly received, made the world to be eternal, and referred all the tranſactions among the bodies it contains, to what they called nature. Whence it will not be difficult to perceive, that, if they do not quite exclude God, yet, as they leave him no intereſt in the firſt formation of the univerſe, ſo they leave him but very little in the adminiſtration of the parts it conſiſts of, eſpecially the ſublunary ones: ſo that, inſtead of the true God, they have ſubſtituted for us a kind of a goddeſs, with the title of nature; which as they look upon as the immediate agent and director, in all excellent productions, ſo they aſcribe to her the praiſe and glory of them.

WHETHER this great error, in a point of ſuch importance, may not undermine the foundation of religion, I think it may not irrationally be ſuſpected: for, ſince the moſt general and efficacious argument, that has perſuaded philoſophers, and other men, that there is a God and a conſideration of the providence, is afforded by the viſible world, wherein ſo many operations and other things are obſerved, that are managed (or performed) with ſuch conduct and benignity, as cannot juſtly be aſcribed but to the wiſdom and goodneſs of a Deity; they, that aſcribe theſe things to mere nature, do much weaken the force of that argument, if they do not quite take away the neceſſity of acknowledging a Deity, by ſhewing, that without any need of having recourſe to him, of the adminiſtration of the world, and of what is performed.

performed among things corporeal, an account may be given. Though when men are put upon conſidering the matter, and preſſed to declare themſelves more clearly, they are aſhamed to affirm, that God and nature are the ſame thing, and will confeſs, that ſhe is but his vicegerent; yet, in practice, their admiration and their praiſes are frequently given to nature, not to God: in like manner, as, though the ſun be the fountain of light, and the moon derives all hers from the ſun; yet the ſea, in its grand motions of ebbing and flowing, appears to reſpect the moon, and not the ſun: for thus the generality of men, though they will acknowledge, that nature is inferior and ſubordinate to God, do yet appear to regard her more than him.

To be ſhort, nature uſes to be ſo frequently recurred to, and is ſo magnified in the writings of phyſiologers, that the exceſſive veneration men have for nature, as it has made ſome philoſophers (as the Epicureans) deny God, ſo it is to be feared, that it makes many forget him: and, perhaps, a ſuſpicious perſon would venture to add, that, if other principles hindered not (as, I know, that in many, and, I think, that in moſt of the Chriſtian naturiſts they do) the erroneous idea of nature would, too often, be found to have a ſtrong tendency to ſhake, if not to ſubvert, the very foundations of all religion; miſleading thoſe, that are inclined to be its enemies, from over-looking the neceſſity of a God, to the queſtioning, if not to the denial of his exiſtence.

V. My fifth and laſt argument is taken from hence; that I obſerve divers phænomena, which do not agree with the notion or repreſentation of nature, that I queſtion: for if indeed there were ſuch an intelligent, powerful, and vigilant being, as philoſophers are wont to deſcribe nature to be, divers things would not be done, which experience aſſures us are done.

And here I ſhall, once for all, give an advertiſement, which I deſire may be called to mind, whenever there ſhall be occaſion, in the following part of this tract, which is this: that becauſe inanimate bodies are uſually more ſimple, or leſs compounded, and of a ſlighter and leſs complicated or curious contrivance, than animals or plants, I thought fit to chuſe moſt of the inſtances I employ, rather among lifeleſs bodies, whoſe ſtructure and qualities are more eaſy to be intelligibly and with brevity diſcourſed of, than among living creatures, whoſe textures, being organical, are much more intricate and ſubtile. And this courſe I did not ſcruple to take, becauſe the celebrators of nature give her a province, or rather an empire, as large as the world, and will have her care and juriſdiction reach, as well to inanimate, as to living bodies; and accordingly moſt of the conſpicuous inſtances they alledge of her providence and power, are taken from bodies deſtitute of life; as when they tell us that the aſcenſion of water in ſucking pumps, and the ſuſtentation of it in gardeners watering pots, are cauſed by nature's abhorrence of a vacuum: that heavy bodies (unhindered) fall to the ground in a perpendicular line, becauſe nature directs them the ſhorteſt way to the centre of the earth; and that bubbles riſe through the water, and flames aſcend in the air, becauſe nature directs the bodies to rejoin themſelves to their reſpective elements; to omit other inſtances of this ſort, that there will be occaſion to mention hereafter: till when, theſe may ſuffice to warrant my taking moſt of my inſtances from inanimate bodies; though I ſhall not confine myſelf to theſe, eſpecially when I ſhall come to anſwer objections, that are taken from living creatures.

The foregoing advertiſement will be, I hope, found conducive to clear the way for my fifth argument, lately propoſed, which concludes, that if indeed there were ſuch a being, as nature is uſually repreſented to be, ſeveral things would be otherwiſe adminiſtred in the univerſe, than experience ſhews they are.

To

To enumerate all the particulars, that may be propoſed to make this good, would ſwell this diſcourſe much beyond the bulk, to which my haſte obliges me to confine it. But, to make you amends for the paucity of inſtances, I ſhall now name, by the kind of them; I ſhall propoſe ſuch, as, for the moſt part, are taken from thoſe very things, whence the wiſdom and vigilancy of nature is wont to be confidently argued, which I the rather do, that by ſuch I may make way for, and ſhorten the anſwers I am to give to the arguments ere long to be examined.

FIRST then, whereas the great care and vigilancy of nature, for the common good of the univerſe, is wont to be demonſtrated from the watchful care ſhe takes to prevent or repleniſh a vacuum, which would be very prejudicial to the fabric of the world: I argue the quite contrary from the phænomena, that occur about a vacuum. For whereas it is alledged, that nature, in great pumps, and in the like caſes, lifts up the heavy body of water in ſpite of its tendency towards the centre of the earth, to obviate, or fill up a vacuity; and that out of a gardener's pot, or inverted pipe, ſtopped at one end, neither the water, nor even quickſilver, that is near fourteen times as heavy, will fall down, leaſt it ſhould leave a vacuum behind it; I demand, how it comes to paſs, that, if a glaſs pipe be but a foot longer than 34 or 35 feet, or an inverted tube, filled with quickſilver, be but a finger's breadth longer than 30 inches, the water in the one, and the quickſilver in the other, will ſubſide, though the one will leave but about a foot, and the other but about an inch, of deſerted ſpace, which they call vacuum, at the top of the glaſs? Is it poſſible, that nature, that in pumps is ſaid to raiſe up every day ſo many hundred tun of water, and if you believe the ſchools, would raiſe it to any height, (leſt there ſhould be a vacuum) ſhould not have the diſcretion, or the power, to lift up, or ſuſtain, as much water as would ſerve to fill one foot in a glaſs tube, or as much quickſilver, as an inch of a ſlender pipe will contain, to obviate or repleniſh the vacuum, ſhe is ſaid ſo much to abhor? Sure at this rate, ſhe muſt either have very little power, or very little knowledge of the power ſhe has. So likewiſe, when a glaſs bubble is blown very thin at the flame of a lamp, and hermetically ſealed, whilſt it is very hot; the cauſe, that is rendered, why it is apt to break, when it grows cold, is, that the inward air, which was before rarefied by the heat, coming to be condenſed by the cold, leſt the ſpace deſerted by the air, that thus contracts itſelf, ſhould be left void, nature, with violence, breaks the glaſs in pieces: but, by theſe learned men's favour, if the glaſs be blown but a little ſtronger than ordinary, though at the flame of a lamp, the bubble, as I have often tried, will continue unbroken, in ſpite of nature's pretended abhorrency of a vacuum; which needs not at all to be recurred to in the caſe: for the reaſon, why the thin glaſs broke not when it was hot, and did when it grew cold, is plainly this; that, in the former ſtate, the agitation of the included air, by the heat, did ſo ſtrengthen the ſpring of it, that the glaſs was thereby aſſiſted and enabled to reſiſt the weight of the incumbent air; whereas upon the ceſſation of that heat, the debilitated ſpring of the internal being unable to aſſiſt the glaſs, as formerly, to reſiſt the preſſure of the external air, the glaſs itſelf being too thin, becomes unable to ſupport the weight or preſſure of the incumbent air; the atmoſphærical pillar, that leans upon a bubble of about two inches diameter, amounting to above one hundred pound weight, as may be manifeſtly concluded from a late experiment, that I have tried, and you may meet with in another paper. And the reaſon, why, if the bubble be blown of a due thickneſs, it will continue whole after it is cold, is, that the thickneſs of it, though but faintly aſſiſted by the weakened ſpring of the included air, is ſufficient to ſupport the weight of the incumbent air, though, ſeveral times, I have obſerved the preſſure of the atmoſphere, and the reſiſtance of the bubble, to have been, by accident, ſo near the equipollent, that

a much leſs outward force than one would imagine, applied to the glaſs, as, perhaps, a pound, or a leſs weight, gently laid on it, would enable the outward air to break it, with noiſe, into a multitude of pieces. And, now give me leave to conſider, how ill this experiment, and the above mentioned phænomena, that happen in glaſs pipes, wherein water and quickſilver ſubſide, agree with the vulgar apprehenſion men have of nature: for, if in caſe ſhe did not hinder the falling down of the water, or the quickſilver, there would be no ſuch vacuum produced, as ſhe is ſaid to abhor; why does ſhe ſeem ſo ſolicitous to hinder it? And why does ſhe keep three or four and thirty feet of water in perpendicular height, contrary to the nature of all heavy bodies, ſuſpended in the tube? And why does ſhe furiouſly break in pieces a thin ſealed bubble, ſuch as I come from ſpeaking of, to hinder a vacuum? If, in caſe ſhe did not break it, no vacuum could enſue? And, on the other ſide, if we admit her endeavours, to hinder a vacuum, not to have been ſuperfluous, and conſequently fooliſh, we muſt confeſs, that, where theſe endeavours ſucceed not, there is really produced ſuch a vacuum, as ſhe is ſaid to abhor: ſo that, as I was ſaying, either ſhe muſt be very indiſcreet to trouble herſelf, and to tranſgreſs her own ordinary laws, to prevent a danger ſhe need not fear; or her ſtrength muſt be very ſmall, that is not able to fill a vacuity, that half a pint of water, or an ounce of quickſilver, may repleniſh; or break a tender glaſs bubble, which, perhaps, a pound weight on it would, with the help of ſo light a body as the incumbent air, cruſh in pieces.

THE other grand inſtance, that is given of the wiſdom of nature, and her watchfulneſs for the good of the whole world, is the appetite ſhe has implanted in all heavy bodies, to deſcend to the centre of the earth, and in all light ones, to aſcend towards heaven; or, as ſome would have it, towards the element of fire, contiguous to the orb of the moon. But for poſitive levity, till I ſee it better proved, than it hath hitherto been, I allow no ſuch thing implanted in ſublunary bodies; the prepollent gravity of ſome ſufficing to give others a comparative or reſpective lightneſs. As a piece of oak, or the like wood, being let go in the air, falls down by its own gravity, or rather by virtue of the efficient of that gravity; but if it be let go under water, it will, though it be never ſo great a log or piece of timber, aſcend, with a conſiderable force, to the top of the water; which, I hope, will not be aſcribed to a poſitive levity, ſince, when it is deſcended in the air, it was by its gravity, that it did ſo. But not to inſiſt on this, nor to take notice, how wiſely nature has implanted in all heavy bodies an appetite to deſcend to the centre of the earth, which being but a point, is not able to contain any one of them; not to urge theſe things, I ſay, I will only invite you to conſider one of the moſt familiar things, that occur among heavy bodies.

FOR if, for example, you let fall a ball upon the ground, it will rebound to a good height, proportionable to that, from whence you let it fall, or, perhaps, will make ſeveral leſſer rebounds, before it come to reſt. If it be now aſked, why the ball, being let out of your hand, does not fall on this or that ſide, or move upwards, but falls directly towards the centre of the earth, by that ſhorteſt line, (which mechanicians call *linea directionis)* which is the diameter of the earth prolonged to the centre of gravity of the ball? It will be readily anſwered, that this proceeds from the ball's gravity, *i. e.* an innate appetite, whereby it tends to the centre of the earth the neareſt way. But then I demand, whence comes this rebound, *i. e.* this motion upwards? for it is plain, it is the genuine conſequence of the motion downwards, and therefore is increaſed according as that motion in the ball was increaſed by falling from a greater height: ſo that it ſeems, that nature does, in ſuch caſes, play a very odd game, ſince ſhe forces a ball, againſt the laws of heavy bodies, to aſcend divers times upwards,

upon the account of that very gravity, whoſe office it is to carry it downwards the directeſt way; and, at leaſt, ſhe ſeems, in ſpite of the wiſdom aſcribed to her, to take her meaſures very ill, in making the ball move downwards with ſo much violence, as makes it divers times fly back from the place ſhe intended it ſhould go to; as if a ball, which a child can play with, and direct as he pleaſes, were ſo unweildy a thing, that nature cannot manage it, without letting it be hurried on with far greater violence, than her deſign requires.

THE reflection I have been making on a ball may (*mutatis mutandis*, as they ſpeak) be applied to a pendulum. For, ſince it is unanimouſly affirmed by all, that have written of it, that it falls to the perpendicular, upon the account of its gravity; it muſt not be denied, that it is from a motion proceeding from the ſame gravity, that the ſwinging weight paſſes beyond the perpendicular, and conſequently aſcends, and oftentimes makes a multitude of diadroms, or vibrations; and conſequently does very frequently aſcend, before it comes to reſt in the perpendicular; which is the poſition, wherein its gravity is beſt complied with, and which therefore it had been beſt ſettled in at firſt.

I SHALL not here mention thoſe grand anomalies, or exorbitances, even in the vaſter bodies of the univerſe; ſuch as earthquakes, that reach ſome hundreds of leagues, deluges, deſtructive eruptions of fire, famines of a large ſpread, raging peſtilencies, cœleſtial comets, ſpots in the ſun, that are recorded to have obſcured it for many months; the ſudden appearing, the diſappearing, and the re-appearing of ſtars, that have been judged to be as high as the region of the fixed ones: I will not, I ſay, inquire, how far theſe anomalies agree to the character wont to be given of nature's watchfulneſs and vigilancy; becauſe probably I may have hereafter a fit opportunity to do it, and muſt now proceed to the remaining inſtances I promiſed you, which are taken from what happens to animals, as ſoon as I ſhall have diſpatched ſome conſiderations and advertiſements, that ſeem neceſſary to be premiſed to what I have to offer about that difficult ſubject.

IF the paſt diſcourſe give riſe to a queſtion, *Whether the world, and the creatures, that compoſe it, are as perfect as they could be made?* The queſtion ſeems to me, becauſe of the ambiguity of the terms, too intricate to be reſolved by a ſingle anſwer: but yet, becauſe the problem is not wont to be diſcuſſed, and is, in my opinion, of moment, in reference to natural theology; I ſhall venture briefly to intimate ſome of the thoughts, that occurred to me about it; having firſt declared, that I am, with reaſon, very backward to be poſitive in a matter of this nature, the extent of the divine power and wiſdom being ſuch, that its bounds, in caſe it have any, are not known to me.

THIS premiſed, I conſider, that the ſenſe of the queſtion may be, whether God could make the material world, and the corporeal creatures it conſiſts of, better and more perfect than they are? Speaking in a general way and abſolute ſenſe: or elſe, whether the particular kinds or orders of the creatures, in the world, could any of them be made more perfect or better, than they have been made?

TO anſwer the queſtion in the firſt named ſenſe of it, I think it very unſafe to deny, that God, who is almighty and omniſcient, and an owner of perfections, which, for aught we know, are participable in more different manners and degrees, than we can comprehend, could not diſplay, if it be not fitter to ſay adumbrate them, by creating a work more excellent than this work: and his immenſe power and unexhauſted wiſdom conſidered, it will not follow, either that becauſe this world of ours is an admirable piece of workmanſhip, the divine architect could not have bettered it; or,

becauſe God himſelf is able to make a greater maſter-piece, this exquiſitely contrived ſyſtem is not admirably excellent.

BUT the propoſed queſtion, in the other ſenſe of it, will require ſome more words to reſolve it. For if we look upon the ſeveral ſpecies of viſible creatures under a more abſolute conſideration, without reſpect to the great ſyſtem of the univerſe, of which they are parts, or to the more particular deſigns of the creator; it ſeems manifeſt, that many ſorts of creatures might have been more perfect than they are, ſince they want many completing things, that others are endowed with: as an oyſter, that can neither hear, nor ſee, nor walk, nor ſwim, nor fly, *&c.* is not ſo perfect a creature, as an eagle, or an elephant, that have both thoſe ſenſes, that the oyſter wants, and a far more active faculty of changing places; and of this inequality of perfection in creatures of differing kinds, the examples are too obvious to need to be enumerated. But if the queſtion be better propoſed, and it be inquired, not whether God could have made more perfect creatures, than many of thoſe he has made, for that it is plain he could do ſo, becauſe he has done it; but whether the creatures were not ſo curiouſly and ſkilfully made, that it was ſcarce poſſible they could have been better made, with due regard to all the wiſe ends he may be ſuppoſed to have had in making them, it will be hard to prove a negative anſwer.

THIS I ſhall endeavour to illuſtrate by a ſuppoſition. If one ſhould come into the well-furniſhed ſhop of an excellent watch-maker, and ſhould there ſee a plain watch, deſigned barely to ſhew the hour of the day; another that ſtrikes the hours; a third that is alſo furniſhed with an alarum; a fourth, that, beſides theſe, ſhews the month current, and the day of it; and laſtly, a fifth, that over and above all theſe, ſhews the motions of the ſun, moon, and planets, the tides, and other things, which may be ſeen in ſome curious watches: in this caſe, I ſay, the ſpectator, ſuppoſing him judicious, would indeed think one of theſe watches far more excellent and compleat than another; but yet he would conclude each of them to be perfect in its own kind, and the plain watch to anſwer the artificer's idea and deſign in making it, as well as the more compounded and elaborate one did. The ſame thing may, in ſome circumſtances, be further illuſtrated, by conſidering the copy of ſome excellent writing-maſter, for though there we may find ſome leaves written in an Italian hand, others in a ſecretary, and, in others, hands of other denominations; though one of theſe patterns may be much fairer, and more curious than another, if they be compared together; yet, if we conſider their equal conformity to the reſpective ideas of the author, and the ſuitableneſs to the deſign he had of making each copy, not as curious, ſightly and flouriſhing as he could, but as conformable to the true idea of the ſort of hand he meant to exhibit, and the deſign he had to ſhew the variety, number and juſtneſs of his ſkill, by that of the patterns he made compleat in the reſpective kinds; we ſhall not think, that any of them could have been bettered by him: and if he ſhould have made a text-hand as fair as a Roman hand, by giving it more beauty and ornament, he would not have made it better in its kind, but ſpoiled it, and, by a flouriſh of his ſkill, might have given a proof of his want of judgment.

BUT to return thither, whence I began to make this excurſion, perhaps, *Eleutherius*, you will object againſt the examples I have produced before it, that the exceptions I have taken at ſome of the proceedings of nature, may be as well urged againſt providence, and exclude the one as well as the other from the government of the world.

BUT to this I anſwer, that this objection is foreign to the queſtion, which is about men's notion of nature, not God's providence; which, if it were here my taſk to aſſert, I ſhould eſtabliſh it upon its proper and ſolid grounds; ſuch as the infinite per-

fections of the divine nature, which both engage and enable him to adminiſter his dominion over all things; his being the author and ſupporter of the world; the exquiſite contrivance of the bodies of animals, which could not proceed but from a ſtupendous wiſdom; the ſupernatural revelations and diſcoveries he has made of himſelf, and of his particular care of his creatures, by prophecies, apparitions, true miracles, and other ways, that tranſcend the power, or at leaſt over-rule the phyſical laws of motion in matter: by theſe, I ſay, and the like proper means, I would evince divine providence. But being not now obliged to make an attempt, which deſerves to be made very ſolemnly, and not in ſuch haſte, as I now write in; I ſhall at preſent only obſerve to you, that the caſe is very differing between providence and nature, and therefore there is no neceſſity, that the objections I have made againſt the latter, ſhould hold againſt the former. As, (to give you a few inſtances of the diſparity) in the firſt place, it appears not, nor is it likely, that it is the deſign of providence to hinder thoſe anomalies and defects, I have been mentioning; whereas it is ſaid, to be the duty and deſign of nature, and her only taſk, to keep the univerſe in order, and procure, in all the bodies, that compoſe it, that things be carried on in the beſt and moſt regular way, that may be, for their advantage. Secondly, nature is confeſſed to be a thing inferior to God, and ſo but a ſubordinate agent, and therefore cannot, without diſparagement to her power, or wiſdom, or vigilancy, ſuffer divers things to be done, which may, without degradation to God, be permitted by him, who is not only a ſelf-exiſtent and independent Being, but the ſupreme and abſolute Lord, and, if I may ſo ſpeak, the proprietor of the whole creation; whence both *Melchizidec* and *Abram* ſtile him, (*Gen.* xiv. 19, 23.) not only the moſt high God, but קנה *koneh*, poſſeſſing (or, as our verſion has it, poſſeſſor of) heaven and earth; and who, when he made the world, and eſtabliſhed the laws of motion, gave them to matter, not to himſelf: and ſo being obliged to none, either as his ſuperior or benefactor, he was not bound to make, or adminiſter, corporeal things after the beſt manner, that he could, for the good of the things themſelves; among which, thoſe, that are capable of gratitude, aught to praiſe and thank him for having vouchſafed them ſo much as they have, and have no right to except againſt his having granted them no more. And, as being thus obliged to none of his works, he has a ſovereign right to diſpoſe of them; ſo he has other attributes, which he may juſtly exerciſe, and both intend and expect to be glorified for, beſides his goodneſs to inferior creatures: and his wiſdom may be better ſet off to men, and perhaps to angels or intelligencies, by the great variety of his contrivancies in his works, than by making them all of the excellenteſt kind; as ſhadows in pictures, and diſcords in muſic, ſkilfully placed and ordered, do much recommend the painter and the muſician. Perhaps it may be added, that the permitting the courſe of things to be ſomewhat violated ſhews, by the miſchief ſuch exorbitances do, how good God has been in ſettling and preſerving the orderly courſe of things. Thirdly, as God is a moſt abſolute and free. ſo he is an omniſcient Being; and as, by his ſupreme dominion over the works of his hands, he has a right to diſpoſe of them, as he thinks beſt for his own glory; ſo upon the ſcore of his unfathomable wiſdom, he may have deſigns, and, if I may ſo ſpeak, reaches in the anomalies, that happen in the world, which we men are too ſhort ſighted to diſcern; and may exerciſe as much wiſdom, nay, and as much providence (in reference to men, the nobleſt viſible object of his providence) in ſometimes (as in divine miracles) receding from what men call the laws of nature, as he did at firſt in eſtabliſhing them: whereas the office of nature being but to preſerve the univerſe in general, and particular bodies in it, after the beſt manner, that their reſpective conditions will permit; we know, what it is ſhe aims at, and conſequently can better diſcern,

cern, when ſhe miſſes of her aims, by not well acting what is preſumed to be her part. Fourthly, we muſt conſider, that, as God is an independent, free and wiſe, ſo he is alſo a juſt agent; and therefore may very well be ſuppoſed to cauſe many irregularities and exorbitances in the world, to puniſh thoſe, that men have been guilty of. And whereas nature is but a nurſing mother to the creatures, and looks even upon wicked men, not in their moral but in their philoſophical capacities, God expreſly declares, in the ſacred ſcriptures, that, upon *Adam*'s fall, he *curſed the ground*, or *earth*, *for man*'s *ſake*, Gen. iii. 17, 18. and that there is no penal evil in the city, that is not derived from him, *Amos* iii. 6. He is not over-ruled, as men are fain to ſay of erring nature, by the head-ſtrong motions of the matter, but ſometimes purpoſely over-rules the regular ones, to execute his juſtice; and therefore plagues, earthquakes, inundations, and the like deſtructive calamities, though they are ſometimes irregularities in nature, yet for that very reaſon they are deſigned by providence, which intends, by them, to deprive wicked men of that life, or of thoſe bleſſings of life, whereof their ſins have rendered them unworthy. But, whilſt I mention deſigns, I muſt not forget, that mine was only to give you a taſte of the conſiderations, by which one may ſhew, that ſuch things, as manifeſt nature to act unſuitably to the repreſentation, that is made of her, may yet, when attributed to divine providence, be made out to have nothing inconſiſtent with it.

AND yet, ſomewhat further to clear this weighty matter, and particularly ſome things but briefly hinted in what I have been lately diſcourſing, I think it fit, before I deſcend to the particulars, that I am apt to employ againſt the vulgar notion of nature, to premiſe ſomewhat by way of caution, that I may do ſome right (though I can never do enough,) to divine providence; and take care betimes, that no uſe, injurious to it, may be made of any thing, that my argument hath obliged me, or will oblige me, to ſay about that imaginary thing, vulgarly called nature, either in this or the ſixth ſection, or any other part of our preſent inquiry.

I CONCEIVE then, that the divine author of things, in making the world, and the particular creatures, that compoſe it, had reſpect to ſeveral ends; ſome of them knowable by us men, and others hid in the abyſs of the divine wiſdom and counſels; and that of thoſe ends, which are either manifeſt to us, or at leaſt diſcoverable by human ſagacity and induſtry, ſome of the principles are, the manifeſtation of the glory of God, the utility of man, and the maintenance of the ſyſtem of the world, under which is comprized, the conſervation of particular creatures, and alſo the propagation of ſome kinds of them.

BUT this general deſign of God, for the welfare of man and other creatures, is not (as I conceive) to be underſtood, but with a twofold limitation.

FOR firſt, though men, and other animals, be furniſhed with faculties or powers, and other requiſites, to enable them to preſerve themſelves, and procure what is neceſſary for their own welfare; yet this proviſion, that God has been pleaſed to make for them, is made with reference to what regularly, or what moſt uſually, happens to beings of that ſpecies or ſort, that they belong to, but not with regard to ſuch things as may happen to them irregularly, contingently, and (in compariſon of the others,) unfrequently. Thus it is, in general, far better for mankind, that women, when they are brought to bed, ſhould have their breaſts filled with milk, to give ſuck to the new born babe, than that they ſhould not; though ſometimes, as if the child die in the delivery, or preſently after, and in ſome other caſes alſo, the plentiful recourſe of milk to the mother's breaſts proves troubleſome and inconvenient, and ſometimes alſo dangerous to her. Thus a head of hair is, for the moſt part, uſeful to the perſon, whether man or woman, that nature has furniſhed with it; though in ſome

caſes

caſes (as of conſumptions, and in a few other circumſtances) it happens to be prejudical to the wearer; and therefore phyſicians do often, with good ſucceſs, preſcribe, that it be ſhaven off. Thus the inſtinct, that hens have to hatch their eggs and take care of their young, is, in general, very uſeful, if not neceſſary, for the conſervation of that ſpecies of birds; and yet it ſometimes miſguides and deludes them, when it makes them take a great deal of pains to brood upon thoſe duck-eggs, that houſewives, (having taken away the bird's own eggs) lay in her neſt, which makes her very ſolicitous to hatch and take care of ducklings, inſtead of chickens. Thus it is an inſtitution, that ordinarily is profitable for man, that his ſtomach ſhould nauſeate or reject things, that have a loathſome taſte or ſmell, becauſe the generality of thoſe things, that are provided for his nouriſhment, are well, or, at leaſt, not ill taſted; and yet, on ſome occaſions of ſickneſs, that diſpoſition of the ſtomach to refuſe, or vomit up, nauſeous purges, and other diſtaſteful medicines, (as ſuch remedies are uſually loathſome enough) proves very prejudical, by being a great impediment to the recovery of health. And thus (to be ſhort) the paſſions of the mind, ſuch as fear, joy and grief, are given to man, for his good, and, when rightly uſed, are very advantageous, if not abſolutely neceſſary, to him; though, when they grow unruly, or are ill-managed, as it but too often happens, they frequently prove the cauſes of diſeaſes, and of great miſchief, as well to the paſſionate man himſelf, as to others.

The ſecond limitation (which has a natural connexion with the former,) is this; that the omniſcient author of things, who, in his vaſt and boundleſs underſtanding, comprehended at once the whole ſyſtem of his works, and every part of it, did not mainly intend the welfare of ſuch or ſuch particular creatures, but ſubordinated his care of their preſervation and welfare to his care of maintaining the univerſal ſyſtem and primitive ſcheme or contrivance of his works, and eſpecially thoſe Catholic rules of motion, and other grand laws, which he at firſt eſtabliſhed among the portions of the mundane matter. So that, when there happens ſuch a concourſe of circumſtances, that particular bodies, fewer or more, muſt ſuffer, or elſe the ſettled frame, or the uſual courſe of things, muſt be altered, or ſome general law of motion muſt be hindered from taking place; in ſuch caſes, I ſay, the welfare and intereſt of man himſelf (as an animal) and much more that of inferior animals, and of other particular creatures, muſt give way to the care, that providence takes of things of a more general and important nature or condition.

Thus (as I formerly noted) God eſtabliſhed the lines of motion, which the ſun and the moon obſerve, though he foreſaw, that from thence there would neceſſarily, from time to time, enſue eclipſes of thoſe luminaries; which he choſe rather to permit, than to alter that courſe, which, on ſeveral accounts, was the moſt convenient. Thus a blown bladder, or a foot ball, falling from a conſiderable height upon the ground, rebounds upwards, and ſo, contrary to the nature of heavy bodies, moves from the centre of the earth, leſt the Catholic laws of motion, whereby the ſpringineſs and reflection of bodies, in ſuch circumſtances, are eſtabliſhed, ſhould be violated or intrenched upon.

Thus, he thought not fit to furniſh ſheep with paws or tuſks, or ſwiftneſs, or animoſity, or craft, to defend or preſerve themſelves from wolves, and foxes, and other beaſts of prey. And tame and fearful birds, ſuch as hens, are ſo ill provided for defence, that they ſeem deſigned to be the food of hawks, kites, and other rapacious ones. Thus oyſters, having neither eyes nor ears, are not near ſo well provided for, as the generality of beaſts and birds, and even moſt other fiſhes. And thus ſilk-worms (to name no other caterpillars,) uſually (at leaſt in theſe countries,) live not much

much above half a year, being leſs furniſhed with the requiſites of longevity, than the generality of birds, and beaſts, and fiſhes.

I HAVE thought fit to lay down the two foregoing limitations, partly becauſe they will be of uſe to me hereafter, and partly becauſe they contain ſomething, that may be added to what hath been lately repreſented on behalf of the divine providence (as it falls under the naturiſt's conſideration.) For by theſe limitations we may perceive, that it is not juſt preſently to deny, or cenſure the providence of God, whenever we ſee ſome creatures leſs compleatly furniſhed to maintain themſelves; or ſome caſes leſs provided for, than we think they might be; or ſeeming anomalies permitted, which we look upon as miſchievous irregularities: for the welfare of men, or of this or that other particular ſort of creatures, being not the only, nor, in likelihood, the principal end of God, in making the world; it is neither to be admired nor reprehended, that he has not provided for the ſafety and conveniency of particular beings any further, than well conſiſts with the welfare of beings of a more conſiderable order, and alſo will comport with his higher ends, and with the maintenance of the more general laws and cuſtoms, ſettled by him among things corporeal. So that divers ſeeming anomalies and incongruities, whence ſome take occaſion to queſtion the adminiſtration of things, and to deny the agency of providence, do not only comport with it, but ſerve to accompliſh the deſign of it.

I HAVE the more expreſly declared my mind on this occaſion, becauſe, indeed, of the two main reaſons, which put me upon ſo difficult a work, as I foreſaw this treatiſe would be, as one was the love I bear to truth and philoſophical freedom; ſo the other was a juſt concern for religion. For thinking it very probable, that in ſo inquiſitive an age as this, ſome obſervations, like mine, about nature itſelf, might come into the minds of perſons ill affected to divine providence, who would be glad and forward to wreſt them, and make a perverſe uſe of them; I thought it better, that ſuch notions ſhould be candidly propoſed by one, that would take care to accompany them with thoſe cautions, that may keep them from being injurious to religion.

HAVING premiſed the two foregoing advertiſements to obviate miſconſtructions, I hope I may now ſafely proceed to particulars; whereof, for brevity's ſake, I ſhall here mention but a few, leaving you to add to them thoſe others, that occur in other parts of this treatiſe.

IN the firſt place then, I ſhall take notice, that there are ſeveral inſtances of perſons, that have been choaked with a hair, which they were unable, either to cough up, or ſwallow down. The reaſon of this fatal accident is probably ſaid to be the irritation, that is made by the ſtay of ſo unuſual a thing, as a hair, in the throat; which irritation occaſions very violent and diſorderly, or convulſive motions to expel it, in the organs of reſpiration, by which means the continual circulation of the blood, neceſſary to the life of man, is hindered, the conſequence whereof is ſpeedy death. But this agrees very ill with the vulgar ſuppoſition of ſuch a kind and provident being, as they repreſent nature, which is always at hand to preſerve the life of animals, and ſuccour them in their (phyſical) dangers and diſtreſſes, as occaſion requires: for ſince a hair is ſo ſlender a body, that it cannot ſtop the throat ſo, as to hinder either the free paſſage of meat and drink into the ſtomach, or that of the air to or from the lungs, (as may be argued from divers no-way mortal excreſcences and ulcers in the throat;) were it not a great deal better for nature to let the hair alone, and ſtay until the juices of the body have reſolved or conſumed it, or ſome favourable accident have removed it, than, like a paſſionate and tranſported thing, oppoſe it like a fury with ſuch blind violence, as, inſtead of ejecting the hair, expels the life of him, that was troubled with it?

How

How the care and wiſdom of nature will be reconciled to ſo improper and diſorderly a proceeding, I leave her admirers to conſider. But it will appear very reconcileable to providence, if we reflect back upon the lately given advertiſement: for, in regard of the uſe and neceſſity of deglutition, and in many caſes of coughing and vomiting, it was, in the general, moſt convenient, that the parts, that miniſter to theſe motions, ſhould be irritated by the ſudden ſenſe of things, that are unuſual, though perhaps they would not be otherwiſe dangerous or offenſive; becauſe (as we formerly noted,) it was fit, that the providence of God ſhould, in making proviſion for the welfare of animals, have more regard to that, which uſually and regularly befals them, than to extraordinary caſes or unfrequent accidents.

THOUGH moſt women are offended with the ſtink of the ſmoaking wick of a candle, which is no more than men alſo are; yet it has been frequently obſerved, that big-bellied women have been made to miſcarry by the ſmell of an extinguiſhed candle, which would before have indeed diſpleaſed, but not endangered, the ſame perſons: ſo that it ſeems nature is, in theſe caſes, very far from being ſo prudent and careful, as men are wont to fancy her; ſince by an odour, (which, if calmly received, would have done no harm to the teeming woman,) ſhe is put into ſuch unruly tranſports; and inſtead of watching for the welfare of the teeming woman, whoſe condition needed a more than ordinary meaſure of her care and tenderneſs, ſhe violently precipitates her poor charge into a danger, that oftentimes proves fatal, not only to the mother, but the child alſo.

THE improper, and oftentimes hurtful, courſes, that nature takes in perſons, that are ſick, ſome of one diſeaſe, ſome of another, will be hereafter taken notice of in opportune places; and therefore, for the preſent, I ſhall only obſerve, that nature ſeems to do her work very weakly, or bunglingly, in the production of monſters, whoſe variety and numerouſneſs is almoſt as great, as their deformity, or their irregularity; inſomuch that ſeveral volumes have been written, and many more might have been, to give the deſcription of them. How theſe groſs aberrations will agree with that great uniformity, and exquiſite ſkill, that is aſcribed to nature in her ſeminal productions, I leave the naturiſts to make out. I know, that ſome of them lay the fault upon the ſtubborneſs of the matter, that would not be obſequious to the plaſtic power of nature; but I can hardly admit of this account from men of ſuch principles, as they are, that give it: for it is ſtrange to me, they ſhould pretend, that nature, which they make a kind of ſemi-deity, ſhould not be able to mould and faſhion ſo ſmall, and ſoft, and tractable, a portion of matter, as that, wherein the firſt model and efformation of the embryo is made; when, at the ſame time, they tell us, that it is able, in ſucking pumps, to raiſe, and, if need be, ſuſtain whole tons of water, to prevent a vacuum; and can, in mines, toſs up into the air houſes, walls, and caſtles, and perhaps the rocks they are built on, to give the kindled gunpowder the expanſion, that its new ſtate requires.

OTHER arguments, that, by a light change and eaſy application, may be made uſe of and added to theſe, againſt the vulgar notion of nature, may be met with in divers parts of this treatiſe, and eſpecially in the VIIth ſection; for which reaſon (among others) I decline lengthening this part of my diſcourſe, with the mention of them.

I FORESEE it may be ſaid, that unleſs we admit ſuch a being, as nature, to contrive and manage things corporeal, and in a regular and methodical way direct them to their reſpective ends, there will appear no viſible footſteps or proof of a divine wiſdom in the corporeal world: and this argument, I confeſs, is ſo ſpecious, that it was one of the things, that made me the longeſt heſitate, what I ſhould think of the received notion

of nature. But having further conſidered the matter, I ſaw it might be anſwered, that the curious contrivance of the univerſe and many of its parts, and the orderly courſe of things corporeal, with a manifeſt tendency to determinate ends, are matters of fact, and do not depend upon the ſuppoſition of ſuch a being, as they call nature; but ſetting aſide this or that hypotheſis, may be known by inſpection, if thoſe, that make the inſpection, be attentive and impartial: as when a man ſees a human body ſkilfully diſſected by a dexterous anatomiſt, he cannot, if he be intelligent and unprejudiced, but acknowledge, that there is a moſt curious and exquiſite contrivance in that incomparable engine, and in the various parts of it, that are admirably fitted for diſtinct and determinate functions or uſes. So that I do not at all, nor indeed can, ſuppreſs the manifeſt tokens of wiſdom and deſign, that are to be obſerved in the wonderful conſtruction and orderly operations of the world and its parts; but I endeavour to refer theſe indications of wiſdom to the true and proper cauſe. And whereas, in the hypotheſis of the objectors, there may be three cauſes aſſigned of theſe ſpecimens or footſteps of wiſdom; namely, God, nature, and chance; if, according to the doctrine by me propoſed, nature be laid aſide, the competition will remain only between God and chance; and ſure he muſt be very dull, or very ſtrongly prejudiced, that ſhall think it reaſonable to attribute ſuch admirable contrivances and ſuch regular conducts, as are obſervable in the corporeal world, rather to chance, (which is a blind and ſenſeleſs cauſe, or indeed no proper cauſe at all, but a kind of *ens rationis)* than to a moſt intelligent being, from which the curiouſeſt productions may with congruity be expected: whereas, if ſuch a celebrated thing, as nature is commonly thought, be admitted, it will not be near ſo eaſy to prove the wiſdom (and conſequently the exiſtence) of God by his works, ſince they may have another cauſe, namely, that moſt watchful and provident being, which men call nature. And this will be eſpecially difficult in the Peripatetic hypotheſis of the eternity (not of matter only, for in that the atomiſt and others agreed with them, but) of the world: for, according to this account of the univerſe, there appears no neceſſity, that God ſhould have any thing to do with it, ſince he did not make this automaton, but it was always ſelf-exiſtent, not only as to matter, but to form too; and as for the government or adminiſtration of the bodies it conſiſts of, that is the proper buſineſs of nature. And if it be objected, that this being is by its aſſertors acknowledged to be ſubordinate to God; I ſhall anſwer, that as, upon the reaſons and authorities I elſewhere delivered, it may juſtly be queſtioned, whether many philoſophers, and perhaps ſome ſects of them, who are adorers of nature, confeſſed her to be but the ſubſtitute of a ſuperior being? So this diſtinction and ſubordination is not ſo eaſy to be proved againſt thoſe, that ſide with thoſe other antient philoſophers, who either acknowledged no ſuch thing, or expreſly denied it: beſides that this objection ſuppoſes the exiſtence and ſuperiority of a Deity, which therefore needs to be proved by other ways; whereas in the hypotheſis I propoſe, the ſame phænomena, that diſcover admirable wiſdom and manifeſt deſigns in the corporeal world, do themſelves afford a ſolid argument, both of the exiſtence and of ſome of the grand attributes of God, with which the reſt, that properly belong to him, have a neceſſary connexion.

SECT. VI.

V. HAVING, in the foregoing ſection, propoſed ſome of the conſiderations, that have diſſatisfied me with the received notion of nature, it may now be juſtly expected, that I ſhould alſo conſider, what I foreſee will be alledged in its behalf, by the more intelligent of its favourers: and I ſhall not deny the objections I am going to

to name to be conſiderable, eſpecially for this reaſon, that I am very unwilling to ſeem to put ſuch an affront upon the generality as well of learned men as of others, as to maintain, that they have built a notion of ſo great weight and importance upon ſlight and inconſiderable grounds.

THE reaſons, that I conceive may have induced philoſophers to take up, and rely on, the received notion of nature, are ſuch as theſe, that follow:

AND the firſt argument, as one of the moſt obvious, may be taken from the general belief, or, as men ſuppoſe, obſervation, that divers bodies, as particularly earth, water, and other elements, have each of them its natural place aſſigned it in the univerſe; from which place, if any portion of the element, or any mixt body, wherein that element predominates, happens to be removed, it has a ſtrong inceſſant appetite to return to it; becauſe, when it is there, it ceaſes either to gravitate, or (as ſome ſchoolmen ſpeak) to levitate, and is now in a place, which nature has qualified to preſerve it, according to the axiom, that *locus conſervat locatum.*

To this argument I anſwer, that I readily grant, that there being ſuch a quantity of very bulky bodies in the world, it was neceſſary they ſhould have places adequate to their bigneſs; and it was thought fit by the wiſe architect of the univerſe, that they ſhould not be all blended together, but that a great portion of each of them ſhould, at the beginning of things, be diſpoſed of and lodged in a diſtinct and convenient place. But when I have granted this, I ſee not any neceſſity of granting likewiſe, what is aſſerted in the argument above propoſed: for inanimate bodies having no ſenſe or perception, (which is the prerogative of animadverſive beings) it muſt be all one to them in what place they are, becauſe they cannot be concerned to be in one place rather than in another, ſince ſuch a preference would require a knowledge, that inanimate things are deſtitute of; and, for the ſame reaſon, a portion of an element, removed by fotce or chance, from what they call its proper place, can have no real appetite to return thither: for, who tells it, it is in an undue place, and that it may better its condition by removing into another? And who informs it, whether that place lies on this hand of it, or that hand of it, or above it, or beneath it? Some philoſophers indeed have been ſomewhat aware of the weakneſs of the argument drawn from the vulgarly propoſed inſtance (which yet is the beſt that is wont to be employed) of earthy bodies, which being let fall from the top of a houſe, or thrown into the air, do of themſelves fall in a direct line towards the centre of the earth; and therefore they have ſtrengthened this argument, as far as might be, by pretending, that theſe bodies have not indeed, as former philoſophers were wont to think, an appetite to deſcend to the centre of the earth, but to the great maſs of their connatural bodies. I will not therefore accuſe theſe philoſophers of the inconſiderate opinion of their predeceſſors, who would have nature make all heavy things affect to lodge themſelves in the centre of the earth, which (as was formerly noted) being but a point, cannot contain any one of them, (how little ſoever it be;) but yet the hypotheſis of theſe moderns is liable, though not to that, yet to other weighty objections.

FOR the firſt argument I lately employed will hold good againſt theſe philoſophers too, it not being conceivable, how an inanimate body ſhould have an appetite to rejoin homogeneous bodies, neither whoſe ſituation, nor whoſe diſtance from it, it does at all know.

SECONDLY, It does not appear, that all bodies have ſuch an appetite, as is preſumed, of joining themſelves to greater maſſes of connatural bodies; as if you file the end of an ingot or bar of ſilver or of gold, the filings will not ſtick to their own maſs, though it be approached never ſo near, or made to touch them; and much leſs will they leap to it, when it is at a diſtance from them. The like may be ſaid almoſt

of all conſiſtent bodies we are acquainted with, except the loadſtone and iron, and bodies, that participate of one of thoſe two.

THIRDLY, It is obvious to them, that will obſerve, that that, which makes lumps of earth, or terreſtrial matter, fall through the air to the earth, is ſome general agent, whatever that be, which, according to the wiſe diſpoſition of the author of the univerſe, determines the motion of thoſe bedies we call heavy, by the ſhorteſt ways, that are permitted them, towards the central part of the terraqueous globe; whether the body, put into motion downwards be of the ſame, or a like, or a quite differing nature, from the greater maſs of matter, to which when it is aggregated, it reſts there. If, from the ſide of a ſhip you let fall a chip of wood out of your hand, when your arm is ſo ſtretched out, that the perpendieular, or ſhorteſt line, between that and the water, lies never ſo little without the ſhip, that chip will fall into the ſea, which is a fluid body, and quite of another nature than itſelf, rather than ſwerve in the leaſt from the line of direction, as mechanicians call it, to rejoin itſelf to the great bulk of wood, whereof the ſhip, though never ſo big, conſiſts. And, on the other ſide, if a man, ſtanding upon the ſhore juſt by the ſea, ſhall pour out a glaſs of water, holding the glaſs juſt over his feet, that water will fall into the ſand, where it will be immediately ſoaked up and diſperſed, rather than deviate a little, to join itſelf to ſo great a maſs of connatural body, as the ocean is.

AND as to what is generally believed, and made part of the argument, that I am anſwering, that water does not weigh in water, becauſe it is in its own natural place, and *elementa in proprio loco non gravitant*; I deny the matter of fact, and have convinced divers curious perſons by experiment, * that water does gravitate in water, as well as out of it, though indeed it does not prægravitate, becauſe it is counter-ballanced by an equal weight of collateral water, which keeps it from deſcending.

* See the Appendix to the *Hydroſtat. Paradoxes.*

AND laſtly, for the maxim, that *locus conſervat locatum*, beſides that it has been prooflefly aſſerted, and therefore, unleſs it be cautiouſly explained, I do not think myſelf bound to admit it; beſides this, I ſay, I think, that either the proper place of a body cannot be inferred, as my adverſaries would have it, from the natural tendency of a body to it; or elſe it will not hold true in general, that *locus conſervat locatum*: as when, for inſtance, a poor unlucky ſeaman falls from the main-yard of a ſhip into the water, does the ſea, to which he makes ſuch haſte, preſerve him or deſtroy him? And when, in a foul chimney, a lump of ſoot falls into the hearth, and preſently burns up there; can we think, that the wiſdom of nature gave the ſoot an appetite to haſten to the fire, as a greater bulk of its connatural body, or a place provided by nature for its conſervation?

AND now I ſpeak of ſuch an innate appetite of conjunction between bodies, I remember, what I lately forgot to mention in a fitter place; that bubbles themſelves may overthrow the argument I was anſwering. For if a bubble happens to ariſe from the bottom of a veſſel to the upper part of it, we are told, that the haſte, wherewith the air moves thorough water, proceeds from the appetite it has to quit that preternatural place, and rejoin the element, or great maſs of air, detained at the very ſurface of the water by a very thin ſkin of that liquor, together with which it conſtitutes a bubble. Now I demand, how it comes to paſs, that this appetite of the air, which when it was at the bottom of the water, and alſo in its paſſage upwards, is ſuppoſed to have enabled it to aſcend with ſo much eagerneſs and force, as to make its way thorough all the incumbent water, (which poſſibly was very deep,) ſhould not be able, when the air is arrived at the very top of the water, to break through ſo thin a membrane of water, as uſually ſerves to make a bubble, and which ſuffices to keep it from the beloved conjunction with the great maſs of the external air? Eſpecially ſince they

they tell us, that natural motion grows more quick, the nearer it comes to the end or place of reſt; the appetites of bodies encreaſing with their approaches to the good they aſpire to; upon which account, falling bodies, as ſtones, *&c.* are ſaid (though falſely) to encreaſe their ſwiftneſs, the nearer they come to the earth. But if, ſetting aſide the imaginary appetite of the air, we attribute the aſcenſion of bubbles to the gravity and preſſure upwards of the water, it is eaſy hydroſtatically to explicate, why bubbles often move ſlower, when they come near the ſurface of the water, and why they are detained there; which laſt phænomenon proceeds from this, that the preſſure of the water being there inconſiderable, it is not able to make the air quite ſurmount the reſiſtance made by the tenacity of the ſuperficial part of the water; and therefore in good ſpirit of wine, whoſe tenacity and glutinouſneſs is far leſs than that of water, bubbles rarely continue upon the ſurface of the liquor, but are preſently broken and vaniſh.

And to make this preſumed appetite of the ſmaller portions of the air to unite with the great maſs of it, appear the leſs probable; I ſhall add, that I have often obſerved, that water, in that ſtate, which is uſually called its natural ſtate, is wont to have ſtore of ærial particles mingled with it, notwithſtanding the neighbourhood of the external air, that is incumbent on the water; as may appear by putting a glaſs full of water into the receiver of the new pneumatical engine: for the preſſure of the external air being by the pump taken off, there will, from time to time, diſcloſe themſelves in the water a multitude of bubbles, made by the ærial particles, that lay concealed in that liquor.

And I have further tried, as I doubt not but ſome others alſo have done, that by exactly incloſing in a conveniently ſhaped glaſs ſome water, thus freed from the air, and leaving a little air at the top of the veſſel, which was afterwards ſet by in a quiet place; the corpuſcles of that incumbent air did, one after another, inſinuate themſelves into the water, and remained lodged in it; ſo little appetite has air, in general, to flie all aſſociation with water, and make its eſcape out of that liquor; though, when ſenſible portions of it happen to be under water, the great inequality in gravity between thoſe two fluids makes the water preſs up the air. But though it were eaſy to give a mechanical account of the phænomena of mingled air and water; yet, becauſe it cannot be done in few words, I ſhall not here undertake it, the phænomena themſelves being ſufficient to render the ſuppoſition of my adverſaries improbable.

Another argument, in favour of the received opinion of nature, may be drawn from the ſtrong appetite, that bodies have to recover their natural ſtate, when by any means they are put out of it, and thereby forced into a ſtate, that is called preternatural; as we ſee, that air being violently compreſſed in a blown bladder, as ſoon as the force is removed, will return to its firſt dimenſions; and the blade of a ſword being bent, by being thruſt againſt the floor, as ſoon as the force ceaſes, reſtores itſelf, by its innate power, to its former ſtraightneſs; and water, being made hot by the fire, when it is removed thence, haſtens to recover its former coldneſs.

But though I take this argument to have much more weight in it, than the foregoing, becauſe it ſeems to be grounded upon ſuch real phænomena of nature, as thoſe newly recited, yet I do not look upon it as cogent.

In anſwer to it therefore, I ſhall repreſent, that it appears by the inſtances lately mentioned, that the propoſers of the argument ground it on the affections of inanimate bodies. Now, an inanimate portion of matter being confeſſedly devoid of knowledge and ſenſe, I ſee no reaſon, why we ſhould not think it uncapable of being concerned to be in one ſtate or conſtitution, rather than another; ſince it has no

knowledge

knowledge of that, which it is in at preſent, nor remembrance of that, from which it was forced; and conſequently no appetite to forſake the former, that it may return to the latter: but every inanimate body, (to ſay nothing now of plants and brute animals, becauſe I want time to launch into an ample diſcourſe) being of itſelf indifferent to all places and ſtates, continues in that place or ſtate, to which the action and reſiſtance of other bodies, and eſpecially contiguous ones, effectually determine it.

As to the inſtance afforded by water, I conſider, that before it be aſſerted, that water, being heated, returns of itſelf to its natural coldneſs, it were fit, that the aſſertors ſhould determine, what degree or meaſure of coldneſs is natural to that liquor, and this, if I miſtake not, will be no eaſy taſk. It is true indeed, that, in reference to us men, water is uſually cold, becauſe its minute parts are not ſo briſkly agitated, as thoſe of the blood and juices, that are to be found in our hands, or other organs of feeling; but that water is actually cold in reference to frogs, and thoſe fiſhes, that live in it, whoſe blood is cold as to our ſenſe, has not, that I know of, been proved, nor is eaſy to be ſo. And I think it yet more difficult to determine, what degree of coldneſs is natural to water, ſince this liquor perpetually varies its temperature, as to cold and heat, according to the temper of the contiguous or the neighbouring bodies, eſpecially the ambient air. And therefore the water of an unſhaded pond, for inſtance, though it reſts in its proper and natural place, as they ſpeak, yet in autumn, if the weather be fair, the temperature of it will much vary in the compaſs of the ſame day, and the liquor will be much hotter at noon, than early in the morning, or at midnight; though this great diverſity be the effect only of a natural agent, the ſun, acting according to its regular courſe. And, in the depth of winter, it is generally confeſſed, that water is much colder, than in the heat of ſummer; which ſeems to be the reaſon of what is obſerved by watermen, as a wonderful thing, namely, that, in rivers, boats equally laden will not ſink ſo deep in winter, as in ſummer, the cold condenſing the water, and conſequently making it heavier in ſpecie, than it is in ſummer, when the heat of the ambient air makes it more thin. In divers parts of *Africk*, that temperature is thought natural to the water, becauſe it is that, which it uſually has, which is far hotter than that, which is thought natural to the ſame liquor in the frigid zone. And, I remember, on this occaſion, what perhaps I have elſewhere mentioned upon another, that the Ruſſian Czar's chief phyſician informed me, that in ſome parts of *Siberia*, (one of the more northern provinces of that monarch's empire, water is ſo much more cold, not only than in the torrid zone, but than in *England*, that two or three foot beneath the ſurface of the ground, all the year long (even in ſummer itſelf,) it continues concreted in the form of ice; ſo intenſe is the degree of cold, that there ſeems natural to it. This odd phænomenon much confirms, what I lately intimated of the power of contiguous bodies, and eſpecially of the air, to vary the degree of the coldneſs of water. I particularly mention the air, becauſe, as far as I have tried, it has more power to bring water to its own temperature, than is commonly ſuppoſed: for though, if in ſummer-time, a man puts his hand into water, that has lain expoſed to the ſun, he will uſually feel it cold, and ſo conclude it much colder, than the ambient air; yet that may often happen upon another account, namely, that the water being many hundred times a more denſe fluid than the air, and conſiſting of particles more apt to inſinuate themſelves into the pores of the ſkin, a greater part of the agitation of the blood and ſpirits contained in the hand is communicated to the water, and thereby loſt by the fluids, that part with it: and the minute particles of the water, which are, perhaps, more ſupple and flexible, inſinuating themſelves into the pores of the ſkin, which the ærial particles, by reaſon of their ſtiffneſs,

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and perhaps length, cannot do; they come to affect the ſomewhat more internal parts of the hand, which, being much hotter, than the cuticula or ſcarf-ſkin, makes us feel them very cold; as, when a ſweating hand is plunged into luke-warm water, the liquor will be judged cold by him, who, if his other hand be very cold, will with it feel the ſame water hot. To confirm which conjecture I ſhall add, that having ſometimes purpoſely taken a ſealed weather-glaſs, whoſe included liquor was brought to the temperature of the ambient air, and thruſt the ball of it under water kept in the ſame air, there would be diſcovered no ſuch coldneſs in the water as one would have expected; the former reaſon of the ſenſible cold the hand feels, when thruſt into that liquor, having here no place. To which I ſhall add, that having, for trial's ſake, made water very cold, by diſſolving ſal-armoniac in it, in ſummer-time, it would, after a while, return to its uſual degree of warmth; and having made the ſame experiment in winter, it would return to ſuch a coldneſs as belonged to it in that ſeaſon: ſo that it did not return to any determinate degree of coldneſs, as natural to it; but to that, greater or leſſer, that had been accidentally given to it by the ambient air, before the ſal-ammoniac had refrigerated it.

As to the motion of reſtitution, obſerved upon the removal or ceaſing of the force in air violently compreſſed, and in the blade of a ſword forcibly bent, I confeſs it ſeems to me a very difficult thing to aſſign the true mechanical cauſe of it, but yet I think it far more likely, that the cauſe ſhould be mechanical, than that the effect proceeds from ſuch a watchfulneſs of nature as is pretended. For, firſt, I queſtion whether we have any air here below, that is in other than a preternatural or violent ſtate; the lower parts of our atmoſpherical air being conſtantly compreſſed by the weight of the upper parts of the ſame air, that lean upon them.

As for the reſtitution of the bent blade of a ſword, and ſuch like ſpringy bodies, when the force that bent them is removed; my thoughts about the theory of ſpringineſs belong to another paper. And therefore, I ſhall here only, by way of argument *ad hominem*, conſider, in anſwer to the objection, that if, for example, you take a ſomewhat long and narrow plate of ſilver, that has not been hammered or compreſſed, or, which is ſurer, has been made red-hot in the fire, and ſuffered to cool leiſurely, you may bend it which way you will, and it will conſtantly retain the laſt curved figure that you gave it: but if, having again ſtraightned this plate, you give it ſome ſmart ſtrokes of a hammer, it will, by that merely mechanical change, become a ſpringy body; ſo that, if with your hand you force it a little from its rectitude, as ſoon as you remove your hand it will endeavour to regain its former ſtraightneſs. The like may be obſerved in copper, but nothing near ſo much, or ſcarce at all, in lead. Now, upon theſe phænomena, I demand, why, if nature be ſo careful to reſtore bodies to their former ſtate, ſhe does not reſtore the ſilver blade or plate to its rectitude, when it is bent this way or that way, before it is hammered? And why a few ſtrokes of a hammer (which, acting violently, ſeems likely to have put the metal into a preternatural ſtate) ſhould entitle the blade to nature's peculiar care, and make her ſolicitous to reſtore it to its rectitude, when it is forced from it? And why, if the ſpringy plate be again ignited and refrigerated of itſelf, nature abandons her former care of it, and ſuffers it quietly to continue in what crooked poſture one pleaſes to put it into? Not, now, to demand a reaſon of nature's greater partiality to ſilver, and copper and iron, than to lead and gold itſelf, in reference to the motion of reſtitution; I ſhall add to what I was juſt now ſaying, that even in ſword-blades it has been often obſerved, that though, if ſoon after they are bent, the force, that bent them, be withdrawn, they will nimbly return to their former ſtraightneſs; yet, if they (which are not the only ſpringy bodies of which this has been obſerved) be kept too

long

long bent, they will loſe the power of recovering their former ſtraightneſs, and continue in that crooked poſture, though the force, that put them into it, ceaſe to act: ſo that, it ſeems, nature eaſily forgets the care ſhe was preſumed to take of it at firſt.

THERE is an axiom, that paſſes for current among learned men, *viz. nullum violentum durabile*, that ſeems much to favour the opinion of the naturiſts, ſince it is grounded upon a ſuppoſition, that what is violent is, as ſuch, contrary to nature, and, for that reaſon, cannot laſt long. And this trite ſentence is, by the ſchools and even ſome modern philoſophers, ſo particularly applied to local motion, that ſome of them have, not improbably, made it the characteriſtic token, whereby to diſtinguiſh natural motions from thoſe that are not ſo; that the former are perpetual, or at leaſt very durable; whereas the latter, being continually checked more and more by the renitency of nature, do continually decay, and within no long time are ſuppreſſed or extinguiſhed: but, on this occaſion, I muſt crave leave to make the following reflections:

1. IT may be juſtly queſtioned, upon grounds laid down in another part of this eſſay, whether there be any motion among inanimate bodies that deſerves to be called violent, in contradiſtinction to natural; ſince, among ſuch, all motions, where no intelligent ſpirit intervenes, are made according to catholic, and almoſt, if not more than almoſt, mechanical laws.

2. METHINKS the Peripatetics, who are wont to be the moſt forward to employ this axiom, ſhould find but little reaſon to do ſo, if they conſider how unſuitable it is to their doctrine, that the vaſt body of the firmament and all the planetary orbs are, by the *primum mobile*, with a ſtupendous ſwiftneſs whirled about from Eaſt to Weſt in four and twenty hours, contrary to their natural tendency; and that this violent and rapid motion of their incomparably greater part of the univerſe has laſted as long as the world itſelf, that is, according to *Ariſtotle*, for innumerable ages.

3. WE may obſerve here below, that the ebbing and flowing of the ſea, which is generally ſuppoſed to proceed either from the motion of the moon or that of the terreſtrial globe, or ſome other external cauſe, has laſted for ſome thouſands of years, and probably will do ſo as long as the preſent ſyſtem of our vortex ſhall continue. I conſider alſo, that the other great ocean, the atmoſphere, conſiſts of numberleſs myriads of corpuſcles, that are here below continually kept in a violent ſtate; ſince they are elaſtical bodies, whereof the lower are ſtill compreſſed by the weight of the higher. And to make a ſpring of a body, it is requiſite, that it be forcibly bent or ſtretched, and have ſuch a perpetual endeavour to fly open, or to ſhrink in, that it will not fail to do ſo, as ſoon as the external force that hindered it is removed. And as for the ſtate of inanimate bodies, I do not ſee, that their being or not being natural can be, with any certainty, concluded from their being or not being very durable. For, not to mention that leaves, that wither in a few months, and even bloſſoms, that often fade and fall off in a few days, are as well natural bodies as the ſolid and durable trees that bear them; it is obvious, that, whether we make the ſtate of fluidity, or that of congelation, to be that which is natural to water, and the other that which is violent; its change from one of thoſe ſtates into another, and even its return to its former ſtate, is oftentimes, at ſome ſeaſons, and in ſome places, made very ſpeedily, perhaps in an hour or leſs, by cauſes that are acknowledged to be natural. And miſts, hail, whirlwinds, lightning, falling ſtars, to name no more, notwithſtanding their being natural bodies, are far from being laſting, eſpecially in compariſon of glaſs, wherein the ingredients, ſand and fixed ſalt, are brought together by great violence of fire. And the motion, that a thin plate, or ſlender wire, of this glaſs can exerciſe, to reſtore itſelf to its former poſition, when forcibly

forcibly bent, is (in great part) a laſting effect of the ſame violence of the fire: and ſo is the moſt durable perſeverance of the indiſſolubleneſs of the alcaliſate ſalt, that is one of the two ingredients of glaſs, notwithſtanding its being very eaſily diſſoluble in water and other liquors, and not uneaſily even in the moiſt air itſelf.

THERE is a diſtinction of local motion into natural and violent, that is ſo generally received and uſed, both by philoſophers and phyſicians, that I think it deſerves to have ſpecial notice taken of it in this ſection; ſince it implicitly contains an argument for the exiſtence of the thing called nature, by ſuppoſing it ſo manifeſt a thing, as that an important diſtinction may juſtly be grounded on it.

THIS implied objection, I confeſs, is ſomewhat difficult to clear; not for any great force that is contained in it, but becauſe of the ambiguity of the terms wherein the diſtinction is wont to be employed: for moſt men ſpeak of the propoſed diſtinction of motion in ſo obſcure or ſo uncertain a way, that it is not eaſy to know what they mean by either of the members of it. But yet ſome there are who endeavour to ſpeak intelligibly, (and for that are to be commended) and define natural motion to be that, whoſe principle is within the moving body itſelf; and violent motion that, which bodies are put into by an external agent or cauſe. And in regard theſe ſpeak more clearly than the reſt, I ſhall here principally conſider the lately mentioned diſtinction, in the ſenſe they give it. I ſay then, that, even according to this explication, I am not ſatisfied with the diſtinction: for, whereas it is a principle received, and frequently employed by *Ariſtotle* and his followers, *Quicquid movetur ab alio movetur*; it ſeems that, according to this axiom, all motion may be called violent, ſince it proceeds from an external agent; and indeed, according to the ſchool philoſophers, the motion of far the greateſt part of the viſible world, though this motion be moſt regular and laſting, muſt, according to the propoſed diſtinction, be reputed violent; ſince they aſſert, that the immenſe firmament itſelf, and all the planetary orbs, (in compariſon of which vaſt cœleſtial part of the world the ſublunary part is little more than a phyſical point) is perpetually (and againſt its native tendency) hurried about the centre of the world once in twenty-fours, by an external though inviſible agent, which they therefore call the *primum mobile*. And as for the criterion of natural motion, that its principle is within the moving body; it may be ſaid, that all bodies, once in the ſtate of actual motion, whatever cauſe firſt brought them to it, are moved by an internal principle: as, for inſtance, an arrow, that actually flies in the air towards a mark, moves by ſome principle or other reſiding within itſelf; for it does not depend on the bow it was ſhot out of, ſince it would continue though that were broken, or even annihilated; nor does it depend upon the medium, which more reſiſts than aſſiſts its progreſs, as might be eaſily ſhewn, if it were needful; and if we ſhould ſuppoſe the ambient air either to be annihilated, or (which in our caſe would be equivalent) rendered incapable of either furthering or hindering its progreſs, I ſee not why the motion of the arrow muſt neceſſarily ceaſe, ſince in this caſe there remains no medium to be penetrated, and on that account oppoſe its progreſs. When in a watch, that is wound up, the ſpring endeavours to unbend or diſplay itſelf; and when the ſtring of a drawn bow is broken or let go, the ſpring of the former, and the woody part of the latter, does each return to a leſs crooked line: And though theſe motions be occaſioned by the forcible acts of external agents, yet the watch-ſpring, and the bow, have in themſelves (for aught appears to thoſe I reaſon with) an inward principle, by which they are moved, till they have attained their poſition. Some perhaps would add, that a ſquib or a rocket, though an artificial body, ſeems, as well as a falling ſtar, to move from an internal principle: but I ſhall rather obſerve, that, on the other ſide, external agents are requiſite to many motions that are ac-

knowledged to be natural; as, to omit the germination and flouriſhing of divers plants, as onions, leeks, potatoes, *&c.* though hung up in the air, by the heat of the ſun in the ſpring; to paſs by this, I ſay, if in the pneumatical engine or air-pump you place divers inſects, as bees, flies, caterpillars, *&c.* and withdraw the common air from the receiver, they will lie moveleſs, as if they were dead, though it be for ſeveral hours, whilſt they are kept from enjoying the preſence of the air: but when the external air is permitted again to return upon them, they will preſently be revived, (as I have with pleaſure tried) and be brought to move again, according to their reſpective kinds; as if a fly, for inſtance, reſembled a little windmill in this, that, being moveleſs of itſelf, it required the action of the air to put its wings and other parts into motion. But, to inſiſt no farther on theſe arguments *ad hominem*, we may conſider, that, ſince motion does not eſſentially belong to matter, as diviſibility and impenetrableneſs are believed to do, the motions of all bodies, at leaſt at the beginning of things, and the motions of moſt bodies, the cauſes of whoſe motions we can diſcern, were impreſſed on them, either by an external immaterial agent, God, or by other portions of matter (which are alſo extrinſical impellers) acting on them.

Natura eſt Principium quoddam & Cauſa, cur id moveatur & quieſcat, in quo ineſt, &c. Ariſtot. Auſcult. l. II. c. 1.

AND this occaſion invites me to obſerve, that though motion be deſervedly made one of the principal parts of *Ariſtotle*'s definition of nature, yet men are wont to call ſuch motions natural, as are very hard to diſtinguiſh from thoſe they call violent. Thus, when water falls down to the ground, they tell us that this motion is natural to that liquor, as it is a heavy body; but when a man ſpurts up water out of his mouth into the air, they pronounce that motion, becauſe of its tendency upwards, to be contrary to nature. And yet when he draws water into his mouth, by ſucking it through a long pipe held perpendicularly, they will have this motion of the water, though directly upwards, to be not violent, but natural. So when a foot-ball, or blown bladder, being let fall upon a hard floor, rebounds up to a good height, the deſcent and aſcent are both ſaid to be natural motions, though the former tends towards the centre of the earth, and the latter recedes as far as it can do from it. And ſo if from a conſiderable height you let fall a ball of ſome cloſe wood, that yet is not too heavy, as oak or the like, into a deep veſſel of water, it will deſcend a great way in that liquor, by a natural motion; and yet its contrary motion upwards ought not to be eſteemed violent, ſince, according to the ſchools, being lighter in ſpecie than water, it is natural to it to affect its proper place, for which purpoſe it muſt aſcend to the top of the liquor, and lie afloat there; and yet it is from theſe tendencies to oppoſite points (as the zenith and the nadir) that men are wont to judge many motions of bodies to be natural or violent.

AND indeed, ſince it muſt be indifferent to a lifeleſs and inſenſible body to what place it is made to move, all its motions may in ſome reſpect be ſaid to be natural, and in another violent: for as very many bodies of viſible bulk are ſet a moving by external impellents, and on that ſcore their motions may be ſaid to be violent, ſo the generality of impelled bodies do move either upwards, downwards, *&c.* toward any part of the world, in what line or way ſoever they find their motion leaſt reſiſted; which impulſe or tendency being given by virtue of what they call the general laws of nature, the motion may be ſaid to be natural.

I MIGHT here take notice that, according to the Epicurean hypotheſis, it need not at all be admitted, that motion muſt be produced by ſuch a principle as the ſchoolmen's nature: for, according to that great and antient ſect of philoſophers, the atomiſts, every indiviſible corpuſcle has actual motion, or an inceſſant endeavour to change places, eſſentially belonging to it as it is an atom; inſomuch that in no caſe it can be

be deprived of this property or power. And all ſenſible bodies being, according to theſe phyſiologers, but caſual concretions or coalitions of atoms, each of them needs no other principle of motion than that unloſeable endeavour of the atoms that compoſe it, and happen, on the account of circumſtances, to have the tendency of the more numerous, or at leaſt the predominant, corpuſcles determined one way: and to theſe I might add ſome other ſuch reflections. But I ſhall, in this place, ſay no more concerning motion, not only becauſe, even after having conſidered the differing definitions that *Ariſtotle*, *Carteſius*, and ſome other philoſophers, have given of it, I take it to be too difficult a ſubject to be clearly explicated in few words; but becauſe the only occaſion I had to mention it here was to ſhew, that the vulgar diſtinction of it into natural and violent is not ſo clear and well grounded as to oblige us to admit, (what it ſuppoſes) that there is ſuch a being as the naturiſts aſſert.

I COME now to conſider the argument that may be drawn in favour of the received notion of nature, from the critical evacuations which happen at certain times in diſeaſes, and the ſtrange ſhifts that nature ſometimes makes uſe of in them, to free herſelf from the noxious humours that oppreſſed her.

THIS argument I willingly acknowledge to be very conſiderable: for we really ſee, that in continual fevers, eſpecially in hotter climates, there do uſually happen, at certain times of the diſeaſes, notable and critical commotions or conflicts, after which the morbific matter is diſpoſed of and diſcharged by ways ſtrange and ſurpriſing, to the great and ſpeedy relief of the patient, if not to his perfect cure; as may appear by many inſtances to be met with in the obſervations of phyſicians about fevers, pleuriſies, *&c.* Upon this account I take the argument drawn from criſiſes to be much the weightieſt that can be urged for the opinion from which I diſſent; and therefore I ſhall employ the more words in clearing this important difficulty.

IN order to this I deſire it may be kept in mind, that I do not only acknowledge, but teach, that the body of a man is an incomparable engine, which the moſt wiſe Author of things has ſo ſkilfully framed for laſting very many years, that if there were in it an intelligent principle of ſelf-preſervation, (as the naturiſts ſuppoſe there is) things would not, in moſt caſes, be better or otherwiſe managed, for the conſervation of the animal's life, than they generally are. So that the queſtion is not, whether there is a great deal of providence and wiſdom exerciſed in the criſiſes of diſeaſes, but upon what account it is that theſe appoſite things are performed? The univerſal opinion of phyſicians is, that it is that intelligent principle they call nature, which, being ſolicitous for the welfare of the patient, and diſtreſſed by the quantity or hurtfulneſs of the morbific matter, watches her opportunity (eſpecially when it is concocted) to expel it haſtily out of the body, by the moſt ſafe and convenient ways which, in the preſent condition of the patient, can be taken: and I, on the other ſide, attribute criſiſes to the wiſdom and ordinary providence of God, exerting itſelf by the mechaniſm partly of that great machine the world, and partly of that ſmaller engine the human body, as it is conſtituted in the patient's preſent circumſtance; and the reaſons, that hinder me from acquieſcing in the general opinion of phyſicians about criſiſes, are principally theſe:

FIRST, I obſerve, that criſiſes, properly ſo called, do very ſeldom happen in other than fevers, and the like acute diſeaſes, where, according to the common courſe of things, the malady is terminated, in no long time, either by recovery or death, or a change into ſome other diſeaſe: but chronical ſickneſſes, ſuch as coughs, dropſies, gouts, *&c.* unleſs they happen to be accompanied with feveriſh diſtempers, are not wont to have criſiſes; which argues, that nature doth not make critical evacuations upon the account of ſuch care and watchfulneſs as phyſicians aſcribe them to; ſince

ſhe neglects to employ ſo ſalutary an expedient in diſeaſes, that are oftentimes no leſs dangerous and mortal than divers acute diſeaſes, which ſhe attempts to cure by criſiſes.

NEXT I conſider, that critical evacuations may be procured by the bare mechaniſm of the body: for, by virtue of that, it will often happen, that the fibres, or motive organs of the ſtomach, bowels, and other parts, being diſtended or vellicated by the plenty or acrimony of the peccant matter, will, by that irritation, be brought to contract themſelves vigorouſly, and to throw out the matter, that offends the parts, either by the emunctories or common-ſhores of the body, or by whatever paſſages the proſcribed matter can be with more eaſe diſcharged. Thus, when ſome men find their ſtomachs burdened with a clog of meat or drink, they uſe to thruſt their fingers into their throats, and by that mechanical way provoke the ſtomach to diſburden itſelf of its offenſive load, without being beholden to nature's watchfulneſs for a criſis, which probably ſhe would not (at leaſt ſo ſeaſonably) attempt. And thus, whereas it is uſual enough for criſiſes to be made in fevers by large hæmorrhages at the noſe, and ſometimes at other parts, which is aſcribed to nature's watchful ſolicitude for the patient's recovery; I muſt take leave to add, that it hath been divers times obſerved, that even after death large bleedings have ſucceeded at the noſe and other parts of the body; which ſhews, that ſuch excretions may be made by virtue of the ſtructure of it, and the turgeſcence and acrimony of the humours, without any deſign of nature to ſave the life of the patient already dead.

INDEED, if it did appear by experience, that all, or almoſt all, the criſiſes of diſeaſes did either expel the morbific matter, or at leaſt notably relieve the patient, the critical attempts of nature would much favour the opinion men have conceived of her vigilance and conduct: but unwelcome inſtances daily ſhew, that as ſome criſiſes are ſalutary, (as they call them) ſo others prove mortal; and among thoſe, that do not directly or preſently kill the patient, there are divers that leave him in a worſe condition than he was before. And therefore I wonder not, that phyſicians have thought themſelves obliged to lay down ſeveral circumſtances, as neceſſary requiſites of a laudable criſis, if any of which be wanting, it is not thought of the beſt kind; and if the contrary to ſome of them happen, it is to be judged either pernicious, or at leaſt hurtful. For, whereas there are two general ways ſuppoſed to be employed by nature in making criſiſes, the one by expulſion of the peccant matter out of the body, and the other by the ſettling of the matter ſomewhere within it, neither of theſe two ways is conſtantly ſucceſsful.

AND therefore experience hath obliged phyſicians to divide criſiſes, not only into perfect, that fully determine the event of the diſeaſe; and imperfect, that do but alter it for the better or the worſe: but into ſalutary, that quite deliver the patient; and mortal, that deſtroy him. And to a perfect and ſalutary criſis ſome learned men require no leſs than ſix conditions; namely, that it be preceded by ſigns of coction of the peccant matter; that it be made by a manifeſt and ſufficiently copious excretion or tranſlation; that it be made upon a critical day, as the ſeventh, fourteenth, *&c.* that it leave no relicks behind it, that may endanger a relapſe; that it be made ſafely, that is, without dangerous ſymptoms; and laſtly, that it be ſuitable to the nature of the diſeaſe and the patient. By this it may appear, that it is no common thing to meet with a perfect and ſalutary criſis, ſo many laudable conditions muſt concur in it; and indeed nature doth uſually take up with but imperfectly good ones, and it were happy if ſhe made not better, provided ſhe made no worſe. But it is found by ſad experience, that ſhe rouſes herſelf up to make a criſis, not only upon improper, and, as phyſicians call them, intercident days, ſuch as the third, fifth,

fifth, ninth, *&c.* or upon thoſe they call empty or medicinal days, which ſeldom afford any criſis, and much ſeldomer a good one; but alſo when there appear not any ſigns of coction, or at leaſt of due coction, and by theſe unſeaſonable attempts weaken the patient, and increaſe the malady, or perhaps make it ſpeedily mortal. Nor will it juſtify nature, to ſay, with ſome learned phyſicians, that theſe attempts are accidentally brought on by the acrimony or importunity of the morbific matter, by which ſhe is provoked, before the time, to endeavour an expulſion of it: for if nature be indeed ſo prudent and watchful a guardian, as ſhe is thought, ſhe ought not to ſuffer herſelf to be provoked to act prepoſterouſly, and make furious attempts that laviſh to no purpoſe, or worſe than no purpoſe, that little ſtrength the patient hath ſo much need of. And therefore phyſicians do oftentimes very well, when to act agreeably to the dictates of prudence, they forget how much wiſdom they are wont to aſcribe to nature, and employ their beſt ſkill and remedies to ſuppreſs or moderate the inordinate motions, or the improper and profuſe evacuations, that irritated nature raſhly begins to make. And though the criſiſes, that are made by a metaſtaſis of the peccant matter, or by lodging it in ſome particular part of the body, whether external or internal, be oftentimes, when they are not ſalutary, ſomewhat leſs hurtful, than thoſe, that are made by excretion: yet theſe do frequently, though perhaps more ſlowly, prove dangerous enough, producing ſometimes inward impoſthumes, and ſometimes external tumors, in parts, that are either noble by their functions, or by their ſituation, or connexion, or ſympathy with others, that are not to be without hazard or great inconvenience oppreſſed.

I KNOW, that phyſicians make it a great argument of nature's providence and ſkill, that ſhe watches for the concoction of the peccant matter, before ſhe rouſes herſelf up to expell it by a criſis. What is to be meant by this coction of humours (for it ought not to be confounded with the coction of the aliments) they are not wont ſo clearly to declare: but, as I underſtand it, when they ſay, that a portion of peccant matter is brought to coction, they mean, that it has acquired ſuch a diſpoſition, as makes it more fit, than before, to be ſeparated from the ſounder portion of the maſs of blood, or from the conſiſtent parts, to which it perhaps formerly adhered, and to be afterwards expelled out of the body. This may be partly exemplified by what happens in ſome recent colds, where the lungs are affected, in which we ſee, that after a few days the phlegm is made more fluid; and that which is lodged in the lungs, (not ſticking ſo faſt to the inſide of the *aſpera arteria)* is eaſily brought up by coughing, which could not diſlodge it before. And in fevers, that ſeparation in the urine, formerly cloudleſs, that phyſicians look upon as a good ſign of coction, ſeems to be produced by ſome part of the peccant matter, that beginning to be ſeparated from the blood, mingles with the urine, and is not uſually diſtinguiſhed from it, whilſt this liquor is warm; but when it is grown cold, does, on the ſcore of its weight or texture, ſomewhat recede, and appear in a diſtinct form, as of a cloud, a ſediment, *&c.* But whatever they mean by coction, it is plain enough, by what hath been lately noted, that on many occaſions, nature doth not wait for it, but unſeaſonably, and oftentimes dangerouſly, attempts to proſcribe the matter, that offends her, before it be duly prepared for expulſion.

I COME now to that circumſtance of criſiſes, that is thought the moſt wonderful, which is, that nature does oftentimes by very unuſual ways, and at unexpected places, diſcharge the matter, that offends her, and thereby either cures, or notably relieves the patient: and it muſt not be denied, that, in ſome caſes, the critical evacuations have ſomewhat of ſurprizing in them; and I ſhall alſo readily grant, that *N. B.* [Divine providence may expreſly interpoſe, not only in the infliction of diſ-

caſes

eaſes by way of puniſhment, but in the removal of them in the way of mercy.] But ſetting aſide theſe extraordinary caſes, I think it not abſurd to conjecture, that the performances of nature, in common criſiſes, may be probably referred, partly to the particular condition of the matter to be expelled, and partly, (and indeed principally) to ſome peculiar diſpoſition in the primitive fabric of ſome parts of the patient's body, or ſome unuſual change made in the conſtruction of theſe parts by the diſeaſe itſelf, or other accidents; which original or adventitious diſpoſition of the ſick man's body, not being viſible to us, at leaſt while he is alive, we are apt to aſcribe the unexpected accidents of a criſis, if it prove ſalutary, to the wonderful providence of nature; and, if it happen to be other than ſalutary, we are wont to overlook them. To illuſtrate this matter, we may conſider, that plentiful evacuations, procured by medicines, are a kind of artificial criſiſes: we ſee, that ſome bodies are ſo conſtituted, that although the peccant humour, wrought on by the medicine, ought, as the phyſician thinks, to be expelled by ſiege, and indeed is wont to be ſo, in the generality of thoſe, that take that kind of medicine, as, for inſtance, rhubarb or ſenna; yet the peculiar diſpoſition of the patient's ſtomach will make that an emetic, which was intended to be, and regularly ſhould be, a cathartic. Nor does this conſtitution of the ſtomach equally regard all purging medicines; for the ſame ſtomach, that will reject them in form, for inſtance, of a potion, will quietly entertain them, being in the form of pills. And to this let me add, what we obſerve of the operation of mercury; which though, if it be duly prepared, it is uſually given to procure ſalivation eſpecially to ſucculent bodies; yet there are ſome patients, wherein, inſtead of ſalivating, it will violently and dangerouſly work downwards, like a purge, or make ſome other unexpected evacuation. And I have ſeen a patient, who, though young and very fat, could not be brought to ſalivate, neither by the gentler ways, nor by turbith-mineral and other harſher medicines, though adminiſtered by very ſkilful phyſicians and chirurgeons. And this peculiarity may be as well contracted, as native: for ſome perſons, eſpecially after ſurfeits, having been roughly dealt with, or at leaſt tired out with a medicine of this or that kind of form, will afterwards nauſeate and vomit up the like medicine, though in other bodies it be never ſo far from being emetic. We ſee alſo, that ſometimes ſudorific medicines, inſtead of procuring ſweat, prove briſkly diuretic, and ſometimes either purging or vomitive. From all this we may argue, that the qualities of the irritating matter, and much more the particular diſpoſition of the patient's body, may procure evacuations at unexpected places. I remember too, that, among the obſervations I have met with of famous phyſicians, there are inſtances of periodical and critical evacuations, at very inconvenient, as well as unuſual vents; as ſome women are recorded to have had their menſes ſometimes at the eyes, ſometimes at the navel, and ſometimes at the mouth; of which there ſeems no cauſe ſo probable, as ſome peculiar ſtructure, whether native or adventitious, of the internal parts concerned in that diſcharge; and of ſuch unuſual ſtructures anatomiſts muſt have ſeen many, ſince I myſelf have obſerved more than one or two. If theſe uncommon ways of diſpoſing of the morbific matter were always ſalutary to the patient, the argument grounded on them would have more weight: but though moſt men take notice of this ſort of criſiſes but when they are lucky; yet an impartial obſerver ſhall often find, that ill-conditioned and hurtful criſiſes may be made by unuſual and unexpected ways. And, in ſome tranſlations of the morbific matter to diſtant and nobler parts, perhaps it will be as difficult to ſhew, by what channels or known ways the matter paſſed from one to another, as it is to determine

determine, how it was conducted to thoſe parts, at which it was the moſt happily vented.

In the foregoing diſcourſe about criſiſes, there is, I confeſs, much of paradox; and it was unwillingly enough that I made an excurſion, or in-road into a ſubject that has been looked upon as the phyſician's peculiar province. And you may remember, that, not far from the beginning of this little book, I told you that I was willing to decline meddling with other than inanimate bodies; living ones being, as of a leſs ſimple ſort, ſo of a more intricate ſpeculation: which reflection will, I hope, excuſe me to you, if you find, that my propoſed brevity, or the difficulty of the ſubject, has had any great influence on what I write, about health, diſeaſes, and criſiſes. And, as for the ſons of *Æſculapius*, it may be repreſented to them, in my favour, that, beſides that I have treated of ſickneſs and criſiſes, rather as a phyſiologer than a phyſician, I could not leave them unconſidered, without being thought, if not to betray, at leaſt to be wanting to the cauſe I was to plead for.

If it ſhould be diſliked that I make the phænomena of the merely corporeal part of the world, under which I compriſe the bodies of animals, though not the rational ſouls of men, to be too generally referred to laws mechanical; I hope you will remember, for me, ſeveral things diſperſed in this treatiſe, that may, when laid together, afford a ſufficient anſwer to this ſurmiſe; and particularly, that almoſt all the modern philoſophers, and among them divers eminent divines, ſcruple not to forſake the ſpread opinion, that the cœleſtial orbs were moved and guided by intelligences; and to explicate, by phyſical cauſes, the eclipſes of the ſun and moon, the production or apparition and phænomena of comets, and other things, that the Romans, as well as other heathens, both antient and modern, have aſcribed to the immediate agency of divine cauſes. This allows me to obſerve to you, that, ſince theſe modern naturaliſts and divines are wont to explicate the phænomena of the vaſt cœleſtial bodies, by their local motions, and the conſequences of them, they do, as well as I, endeavour to account for what happens in the incomparably greateſt part of the univerſe, by phyſico-mechanical principles and laws. And, even in the terreſtrial part of the world, which we men inhabit, moſt of the moderns, that have freed themſelves from the prejudices of the ſchools, do not ſtick to give ſtatical, hydroſtatical, and other mechanical explications of the aſcenſion of water in pumps, the detention of it in watering-pots, whoſe upper orifices are cloſed, and of other various phænomena, which were formerly unanimouſly aſcribed to nature's wonderful providence, expreſſed in her care to hinder a vacuum.

But perhaps you will think it fitter for me to provide againſt their cenſure, who will diſlike what I have written about criſiſes, not becauſe I have aſcribed too much to merely phyſical cauſes, but (on the contrary) becauſe I do not ſtrictly confine myſelf to them: for I doubt, that if you ſhould ſhew theſe papers to ſome of your friends, that affect to be ſtrict naturaliſts, they will think it ſtrange, that in one of the clauſes in the foregoing diſcourſe about criſiſes (I mean that to which this mark [*N. B.*] is prefixed) I admit, that their events may ſometimes be varied by ſome peculiar interpoſition of God. But yet I own to you, that the clauſe, it is like they would take exceptions at, did not unawares ſlip from my pen; for it is my ſettled opinion, that divine providence is often, at leaſt, converſant in a peculiar manner about the actions of men, and the things that happen to them, or have a neceſſary connexion with the one or the other, or both. And though I think it probable, that, in the conduct of that far greateſt part of the univerſe which is merely corporeal, the wiſe Author of it does ſeldom manifeſtly procure a receſſion from the ſettled courſe of the univerſe, and eſpecially from the moſt catholic laws of motion; yet, where men, who are crea-

tures, that he is pleaſed to endow with free wills, (at leaſt in reference to things not ſpiritual) are nearly and highly concerned; I think he has, not only ſometimes by thoſe ſignal and manifeſt interpoſitions we call miracles, acted by a ſupernatural way, but, as the ſovereign Lord and Governor of the world, doth divers times (and perhaps oftener than mere philoſophers imagine) give, by the intervention of rational minds, as well united, as not united, to human bodies, divers ſuch determinations to the motion of parts in thoſe bodies, and of others which may be affected by them, as by laws merely mechanical thoſe parts of matter would not have had: by which motions, ſo determined, either ſalutary or fatal criſiſes, and many other things conducive to the welfare or detriment of men, are produced.

The fifth commandment, in Exod. xx. Pſalm v. 6. Pſalm lv. 23. 2 Kings i. 16. Iſ. xxxviii. James x. 25. 1 Cor. xi. 30.

THE interpoſitions of divine Providence, in caſes of life and death, might be eaſily ſhewn to Chriſtians out of divers paſſages of ſcripture, which expreſly propoſed long life as a reward to obedient children, and to other righteous perſons among the *Jews*, and threatens *bloody and deceitful men*, that they *ſhall not live out half their days*; and which relates, that a king of *Iſrael* had his diſeaſe made mortal by his impious recourſe to the falſe god of *Eckron*, and that, upon *Hezekiah*'s prayers and tears, God was pleaſed to add fifteen years to his life, and grant a ſpecial benediction to an outward medicine applied to his threatening ſore. To which paſſages divers might be added out of the new teſtament alſo, and eſpecially that of St. *James*, who exhorts the ſick to ſeek for recovery by prayer; and that of St. *Paul*, where, ſpeaking to the *Corinthians* of the unworthy receivers of the euchariſt, he tells them, that *For that cauſe divers were become ſick and weak among them, and many alſo died.* But though the nature of this diſcourſe diſſuades me from employing the authority of ſcripture, yet it allows me to obſerve, (what is conſiderable on this occaſion) that natural theology and right reaſon comport very well with our propoſed doctrine: for, as I lately intimated, and do more fully ſhew, in another paper *, God has left to the will of man the direction of many local motions in the parts of his own body, and thereby of ſome others; though the mechanical laws, on which the ordinary courſe of things mainly depends, do not only regulate the motions of bodies, but the determinations too, and ſince man himſelf is vouchſafed a power to alter, in ſeveral caſes, the uſual courſe of things, it ſhould not ſeem incredible, that the latent interpoſition of men, or perhaps angels, or other cauſes unthought of by us, ſhould ſometimes be employed to the like purpoſes by God, who is not only the all-wiſe Maker, but the abſolute and yet moſt juſt and benign Rector of the univerſe and of men.

* A diſcourſe relating to miracles.

To conclude this excurſion, which I hope will not appear uſeleſs, that has been occaſioned by the diſcourſe of criſiſes, I think it becomes a Chriſtian philoſopher to admit, in general, that God doth ſometimes, in a peculiar though hidden way, interpoſe in the ordinary phænomena and events of criſiſes; but yet that this is done ſo ſeldom, at leaſt in a way that we can certainly diſcern, that we are not haſtily to have recourſe to an extraordinary providence, and much leſs to the ſtrange care and ſkill of that queſtioned being called nature, in this or that particular caſe, though perhaps unexpected, if it may be probably accounted for by mechanical laws, and the ordinary courſe of things.

AND here, though in a place leſs proper than I might have choſen if I had timely remembered, I ſhall, both in reference to the extraordinary accidents that ſometimes happen in criſiſes, and more generally to the ſeemingly irregular phænomena of the univerſe, venture to offer you a notion that perhaps you will not diſlike. I think then, that, when we conſider the world, and the phyſical changes that happen in it, with reference to the Divine Wiſdom and Providence, the arguments for the affirmative ought, in their kind, to have more force than thoſe for the negative. For it ſeems

more allowable to argue a providence, from the exquiſite ſtructure and ſymmetry of the mundane bodies, and the apt ſubordination and train of cauſes, than to infer from ſome phyſical anomalies, that things are not framed and adminiſtered by a wiſe author and rector: for the characters and impreſſions of wiſdom, that are conſpicuous in the curious fabrick and orderly train of things, can, with no probability, be referred to blind chance, but muſt be to a moſt intelligent and deſigning agent. Whereas on the other hand, beſides that the anomalies, we ſpeak of, are incomparably fewer than thoſe things, which are regular, and are produced in an orderly way; beſides this, I ſay, the divine Maker of the univerſe, being a moſt free agent, and having an intellect infinitely ſuperior to ours, may, in the production of ſeemingly irregular phænomena, have ends unknown to us, which even the anomalies may be very fit to compaſs.

THUS, when a man, not verſed in the mathematicks, looks upon a curious geographical globe, though as ſoon as he perceives, that the differing bigneſſes, and particular confines of kingdoms and provinces, and the apt ſituations, true diſtances and bearings of the cities and towns he knows by ſight or fame, be rightly ſet down; he cannot but conclude, from theſe impreſſes of art or ſkill, that this was the work of a deſigning artificer: but though he alſo ſees on the ſame globe ſeveral circles, as the tropicks, the zodiack, the meridians, *&c.* if he be a ſober man, he will not think, that theſe were made by chance only, becauſe he knows not the reaſons or uſes of them, or becauſe ſome of the lines, as thoſe curve lines the ſeamen call rhumbs, are not, like the other, circular, but do oddly, and, with a ſeeming irregularity, interſect them; but will rather think, that the artiſt, that had knowledge enough to repreſent the globe of the earth and waters, in a body not two feet in diameter, had alſo ſkill enough to draw thoſe lines, with ſome deſign worthy of the ſame ſkill, though not obvious to thoſe, that are unacquainted with his art.

I DID not incogitantly ſpeak of irregularities, as if they might ſometimes be but ſeeming ones: for I think it very poſſible, that an artificer of ſo vaſt a comprehenſion, and ſo piercing a ſight, as is the Maker of the world, might, in this great automaton of his, have ſo ordered things, that divers of them may appear to us, and, as it were, break out abruptly and unexpectedly, and at great diſtances of time or place from one another, and on ſuch accounts be thought irregular; which yet really have, both in his pre-ordination, and in the connection of their genuine cauſes, a reference, that would, if we diſcerned it, keep us from imputing it either to chance, or to nature's aberrations. To illuſtrate this a little, let us conſider, that if, when the Jeſuits, that firſt came into *China*, preſented a curious ſtriking watch to the king, he, that looked to it, had wound up the alarum ſo as to ſtrike a little after one; if, I ſay, this had been done, and that theſe Chineſes, that looked upon it as a living creature, or ſome European animal, would think, that when the index, pointing at two of the clock, likewiſe ſtruck the ſame hour, and ſo three, four, and on-ward, they would judge, that theſe noiſes were regularly produced, becauſe they (at equal intervals of time) heard them, and whenſoever the index pointed at an hour, and never but then; but when the alarum came unexpectedly to make a loud, confuſed, and more laſting noiſe, they could ſcarce avoid thinking that the animal was ſick, or exceedingly diſordered: and yet the alarming noiſe, did as properly flow from the ſtructure of the little engine, and was as much deſigned by the manager of it, as thoſe ſounds of the clock, that appeared manifeſtly regular.

SECT. VII.

I PROCEED now to the ſixth and difficulteſt part of my taſk, which is to ſhew, that the moſt general and current effata and axioms concerning nature, that are wont to be employed in the writings of philoſophers, may have a fair account given of, them, agreeably to the doctrine I have hitherto propoſed, though theſe axioms do ſome of them ſuppoſe, and others ſeem ſtrongly to ſupport, the received notion of nature.

To clear the way for the enſuing explications, I muſt deſire you to recall to mind the two cautions I have formerly offered you (in the fifth ſection) wherewith I would have the common doctrine, about the ends or deſigns of nature, to be underſtood or limited; and therefore I ſhall not here repeat, what I there ſaid, but only add in two words, that if thoſe, and ſome few other ſuch things, had been obſerved and duly conſidered, they might perhaps have prevented much of the obſcurity, and ſome of the errors, that relate to the notion of nature.

I HOPE you have not forgot, that the deſign of this paper was to examine the vulgar notion of nature, not to eſtabliſh a new one of my own. And indeed the ambiguity of the word is ſo great, (as hath in the ſecond ſection been made appear) and it is, even by learned men, frequently employed to ſignify ſuch different things; that, without enumerating and diſtinguiſhing its various acceptions, it were very unſafe to venture at giving a definition of it, and perhaps it were very impoſſible to give any, that would not be liable to cenſure. I ſhall not therefore here preſume to define a thing, of which I have not found a ſtated and ſettled notion ſo far agreed on amongſt men, but that I was obliged, out of *Ariſtotle* and others, to compile, in the fourth ſection, a collective repreſentation of the vulgarly received idea, or notion of nature; and afterwards to draw up, as well as I could, inſtead of an accurate definition, tolerable deſcriptions of what, on moſt occaſions, may be intelligibly meant by it. Wherefore, deſiring and preſuming, that you will retain in your mind, and, as occaſion ſhall require, apply, in the following part of this eſſay, the things already delivered in the fourth ſection, I will not trouble you with the repetition of them.

BUT before I deſcend to treat of the particular effata or ſentences, that are received concerning nature's actings, it may not be improper, nor unuſeful, to try, if we can clear the way, by conſidering in what ſenſe nature may, or may not, be ſaid to act at all. For, for aught I can clearly diſcern, whatſoever is performed in the merely material world, is really done by particular bodies, acting according to the laws of motion, reſt, *&c.* that are ſettled and maintained by God among things corporeal; in which hypotheſis nature ſeems rather a notional thing, than a true phyſical, and diſtinct or ſeparate efficient; ſuch as would be, in caſe *Ariſtotle*'s doctrine were true, one of thoſe intelligences that he preſumed to be the movers of the ceeleſtial orbs. But men do oftentimes expreſs themſelves ſo very ambiguouſly or intricately, when they ſay, that nature does this and that, or, that ſhe acts thus and thus, that it is ſcarce (if at all) poſſible to tranſlate their expreſſions into any forms of ſpeech, adequate to the original, and yet intelligible: for which reaſon, though I have in the ſection ſaid ſomething to the ſame purpoſe with what I am now to propoſe, yet the difficulty and weight of the ſubject makes me think it may be expedient, if not neceſſary, in this place ſomewhat more fully to declare what men do, or ſhould mean, when they ſpeak of nature's acting, or of a thing's being naturally

turally done or performed, by giving their words and phraſes ſometimes one interpretation, and ſometimes another.

I. SOMETIMES, when it is ſaid that nature does this or that, it is leſs proper to ſay, that it is done by nature, than that it is done according to nature: ſo that nature is not to be looked on as a diſtinct or ſeparate agent, but as a rule, or rather a ſyſtem of rules, according to which thoſe agents, and the bodies they work on, are, by the great Author of things, determined to act and ſuffer.

THUS, when water is raiſed in a ſucking-pump, it is ſaid that nature makes the water aſcend after the ſucker, to prevent a vacuum; though in reality this aſcenſion is made, not by ſuch a ſeparate agent as nature is fancied to be, but by the preſſure of the atmoſphere acting upon the water, according to ſtatical rules, or the laws or the æquilibrium of liquors, ſettled by God among fluids, whether viſible or pneumatical. So, when the ſtrict Peripatetics tell us, that all the viſible cœleſtial orbs being, by a motion that they call violent, hurried about the earth every four-and-twenty hours, from eaſt to weſt, each of the planetary orbs has a natural motion, that is quite contrary, tending from the weſt to the eaſt; if they will ſpeak congruouſly to their maſter's doctrine, they muſt uſe the term natural in the ſenſe our obſervation gives it; ſince *Ariſtotle* will have the cœleſtial orbs to be moved by external or ſeparate agents, namely, ſpiritual intelligences. Our obſervation may be alſo illuſtrated by other forms of ſpeech that are in uſe; as when it is ſaid, that the law takes care of infants and lunatics, that their indiſcreet actions or omiſſions ſhould not damnify their inheritances; and that the law hangs men for murder, but only burns them in the hand for ſome leſſer faults; of which phraſes the meaning is, that magiſtrates and other miniſters of juſtice, acting according to the law of the land, do the things mentioned. And it tends yet more directly to our purpoſe to take notice, that it is common to aſcribe to art thoſe things that are really performed by artificers, according to the preſcriptions of the art; as when it is ſaid that geometry (as the name imports) meaſures land, aſtrology foretels changes of weather, and other future accidents, architecture makes buildings, and chymiſtry prepares medicines.

II. SOMETIMES, when divers things, ſuch as the growth of trees, the maturation of fruits, *&c.* are ſaid to be performed by the courſe of nature, the meaning ought to be, that ſuch things will be brought to paſs by their proper and immediate cauſes, according to the wonted manner and ſeries or order of their actings. Thus it is ſaid, that by the courſe of nature the ſummer days are longer than thoſe of the winter; that, when the moon is in oppoſition to the ſun, (that is in the full moon) that part of her body, which reſpects the earth, is more enlightened than at the new moon, or at either of the quadratures; and laſtly, that, when ſhe enters more or leſs into the conical ſhadow of the earth, ſhe ſuffers a total or a partial eclipſe: and yet theſe, and other illuſtrious phænomena, may be clearly explicated, without recourſe to any ſuch being as the Ariſtotelians nature, barely by conſidering the ſituations and wonted motions of the ſun or earth, and the moon, with reference to each other, and to the terreſtrial globe.

AND here it may not be amiſs to take notice, that we may ſometimes uſefully diſtinguiſh between the laws of nature, more properly ſo called, and the cuſtom of nature, or, if you pleaſe, between the fundamental and general conſtitutions among bodily things, and the municipal laws (if I may ſo call them) that belong to this or that particular ſort of bodies. As, to reſume and ſomewhat vary our inſtance drawn from water, when this falls to the ground, it may be ſaid to do ſo by virtue of the cuſtom of nature, it being almoſt conſtantly uſual for that liquor to tend downwards, and actually to fall down, if it be not hindered: but when water aſcends by

ſuction in a pump, or other inſtrument, that motion, being contrary to that which is wonted, is made in virtue of a more catholic law of nature, by which it is provided, that a greater preſſure, which in our caſe the water ſuffers from the weight of the incumbent air, ſhould ſurmount a leſſer, ſuch as is here the gravity of the water, that aſcends in the pump or pipe.

THE two foregoing obſervations may be farther illuſtrated, by conſidering in what ſenſe men ſpeak of things which they call preter-natural, or elſe contrary to nature: for divers if not moſt of their expreſſions of this kind argue, that nature is in them taken for the particular and ſubordinate (or as it were the municipal) laws eſtabliſhed among bodies. Thus water, when it is intenſely hot, is ſaid to be in a preter-natural ſtate, becauſe it is in one that is not uſual to it, and, men think, doth not regularly belong to it; though the fire or ſun, that thus agitates it, and puts it into this ſtate, is confeſſed to be a natural agent, and is not thought to act otherwiſe than according to nature. Thus when a ſpring, forcibly bent, is conceived to be in a ſtate contrary to its nature, as is argued from its inceſſant endeavour to remove the compreſſing body; this ſtate, whether preter-natural or contrary to nature, ſhould be thought ſuch but in reference to the ſpringy body: for otherwiſe it is as agreeable to the grand laws, that obtain among things corporeal, that ſuch a ſpring ſhould remain bent by the degree of force that actually keeps it ſo, as that it ſhould diſplay itſelf in ſpight of a leſs or incompetent degree of force. And, to omit the ſix non-natural things ſo much ſpoken of by phyſicians, I muſt here take notice, that though a diſeaſe be generally reckoned as a preter-natural thing, or, as others carry the notion farther, a ſtate contrary to nature; yet that muſt be underſtood only with reference to what cuſtomarily happens to a human body: ſince exceſſively cold winds, and immoderate rains, and ſultry air, and other uſual cauſes of diſeaſes, are as natural agents, and act as agreeably to the catholic laws of the univerſe, when they produce diſeaſes, as when they condenſe the clouds into rain or ſnow, blow ſhips into their harbour, make rivers overflow, ripen corn and fruit, and do ſuch other things, whether they be hurtful or beneficial to men. And, upon a like account, when monſters are ſaid to be preter-natural things, the expreſſion is to be underſtood with regard to that particular ſpecies of bodies from which the monſter does enormouſly deviate, though the cauſes, that produce that deviation, act but according to the general laws whereby things corporeal are guided.

III. I DOUBT whether I ſhould add as a third remark, or as ſomewhat that is referible to one or both of the two foregoing, that ſometimes, when it is ſaid that nature performs this or that thing, we are not to conceive that this thing is an effect really produced by other than by proper phyſical cauſes or agents; but, in ſuch expreſſions, we are rather to look upon nature, either as a relative thing, or as a term employed to denote a notional thing, with reference whereunto phyſical cauſes are conſidered as acting after ſome peculiar manner, whereby we may diſtinguiſh their operations from thoſe that are produced by other agents, or perhaps by the ſame, conſidered as acting in another way. This, I think, may be illuſtrated by ſome other received expreſſions, or forms of ſpeech. As, when many of the antient and ſome of the modern philoſophers have ſaid, that things are brought fatally to paſs; they did not mean, that fate was a diſtinct and ſeparate agent, but only that the phyſical cauſes performed the effect, as in their actings they had a neceſſary dependance upon one another, or an inviolable connexion that linked them together. And, on the other ſide, when men ſay, as they too frequently do, that fortune or chance, ἡ τυχὴ or τὸ αὐτόματον (for *Ariſtotle* and his followers diſtinguiſh them, aſcribing to the former what unexpectedly happens to deliberating or deſigning, and to the latter what happens

Differunt autem fortuna et casus, quia casus latius patet. Quod enim a fortuna est, casu est: sed non omne casu a fortuna. Arist. Ausc. l. ii. c. 4.

pens to inanimate or undeſigning beings) has done this or that; conſiderate philoſophers do not look upon fortune or chance as a true and diſtinct phyſical cauſe, but as a notional thing, which denotes that the proper agents produced the effect without an intention to do ſo, (as I have more fully declared in the fourth ſection.)

One may, for aught I know, without impertinence, refer to this our third obſervation, that many things are wont to be attributed to time; as, when we ſay, that time ripens ſome fruits, that are too early gathered; that it makes many things moulder and decay, (*tempus edax rerum*;) that it is the mother of truth; that it produces great alterations, both in the affairs of men and in their diſpoſitions and their bodies: to omit many other vulgar expreſſions, which repreſent time as the cauſe of ſeveral things, whereof really it is but an adjunct or a concomitant of the effects, (however coincident with the ſucceſſive parts of time, and ſo ſome way related to it) being indeed produced by other agents, that are their true and proper efficients.

Sometimes likewiſe, when it is ſaid that nature does this or that, we ought not to ſuppoſe that the effect is produced by a diſtinct or ſeparate being; but, on ſuch occaſions, the word nature is to be conceived to ſignify a complex or convention of all the eſſential properties, or neceſſary qualities, that belong to a body of that ſpecies whereof the real agent is, or to more bodies reſpectively, if more concur to the production of the effect. To this ſenſe we are to expound many of thoſe forms of ſpeech, that are wont to be employed, when phyſicians, or others, ſpeak of what nature does in reference to diſeaſes, or the cure of them. And, to give a right ſenſe to ſuch expreſſions, I conſider nature, not as a principal and diſtinct agent, but a kind of compounded accident, that is (as it were) made up of, or reſults from, the divers properties and qualities that belong to the true agents. And, that the name of a compounded accident may not be ſtartled at, I ſhall, to explain what I mean by it, obſerve, that, as there are ſome qualities or accidents, that, at leaſt in compariſon of others, may be called ſimple, as roundneſs, ſtraightneſs, heat, gravity, *&c.* ſo there are others that may be conceived as compounded, or made up of ſeveral qualities united in one ſubject: as, in divers pigments, greenneſs is made up of blue and yellow, exquiſitely mixed; beauty is made up of fit colours, taking features, juſt ſtature, fine ſhape, graceful motions, and ſome other accidents of the human body and its parts. And of this ſort of compounded accidents, I am apt to think, there are far more than at the firſt mention of them one would imagine. And to this kind of beings, the expreſſions, that naturiſts do on divers occaſions employ, incline me to think, that, what is called nature has a great affinity, at leaſt in reference to thoſe occaſions. On which ſuppoſition one may conceive, that, as when it is ſaid, that health makes a man eat well, digeſt well, ſleep well, *&c.* conſidering men do not look upon health as a diſtinct and ſeparate cauſe of theſe effects; but as what we lately called a compounded accident, that is, a complex of all the real and genuine cauſes of good appetite, digeſtion, ſleep, *&c.* inſomuch that health is not ſo properly the cauſe of theſe as their effect or reſult: ſo in divers things, that nature is ſaid to do, we need conceive no more than that the effects are produced by phyſical bodies and qualities, or other proper cauſes; which, when we conſider as conſpiring, or rather concurring, to produce the ſame effect, by a compendious term we call nature.

By theſe and the like ways of interpretation I thought fit to try, whether I could give an intelligible and commodious ſenſe to divers of the maxims or ſentences, and other forms of ſpeech, that are employed by thoſe that, on many occaſions, in differing expreſſions, ſay that nature does this or that, and acts thus and thus. But I confeſs, that to clear all thoſe ambiguous and unſkilfully framed axioms and phraſes, I found to be ſo intricate and difficult a taſk, that, for want of time, and perhaps too of patience,

tience, I grew weary before I had profecuted it to the utmoſt: for which reaſon, though it is not improbable that ſome light may be given in this dark ſubject by what I have been now ſaying, (as immature and unfiniſhed as it is) eſpecially if it be reflected on in conjunction with what hath been formerly delivered (in the fourth ſection) about nature, general and particular; yet I ſhall, at preſent, make but very little uſe of the things that have been now ſaid, in expounding the axioms I am particularly to conſider in this ſeventh ſection; hoping that I may, by the help of other mediums, diſpatch my work without them. And, to do it the more eaſily, I ſhall, without tying myſelf to the order wherein they are marſhalled after the beginning of the fourth ſection, treat of them in the order wherein I think their explications may give moſt light to one another, or in that wherein the papers that belonged to them were retrieved.

THE firſt of the received axioms I ſhall conſider is, that which pronounces, that *omnis natura eſt conſervatrix ſui*; where, by the word nature, I ſuppoſe they underſtand a natural body, for otherwiſe I know not what they meant. Now this axiom eaſily admits of a twofold interpretation: for either it may ſignify no more than, that no one body does tend to its own deſtruction, that is, to deſtroy itſelf; or elſe, that in every body there is a principle called nature, upon whoſe ſcore the body is vigilant and induſtrious to preſerve its natural ſtate, and to defend itſelf from the violence and attempts of all other bodies that oppugn it, or endeavour to deſtroy or harm it.

IN the former of theſe two ſenſes the axiom may be admitted, without any prejudice to our doctrine: for ſince, according to our hypotheſis, inanimate bodies can have neither appetites, nor hatreds, nor deſigns, which are all of them affections, not of brute matter but of intelligent beings; I, that think inanimate bodies have no appetites at all, may eaſily grant, that they have not any to deſtroy themſelves.

BUT, according to the other ſenſe of the propoſed axiom, it will import, that every body has, within itſelf, a principle, whereby it does deſire, and with all its power endeavour, to compaſs its own preſervation; and both to do thoſe things that tend thereunto, and oppoſe all endeavours that outward agents, or internal diſtempers, may uſe in order to the deſtruction of it.

AND as this is the moſt vulgar ſenſe of this axiom, ſo it is chiefly in this ſenſe that I am concerned to examine it.

I CONCEIVE then, that the moſt wiſe Creator of things did at firſt ſo frame the world, and ſettle ſuch laws of motion between the bodies that, as parts, compoſe it, that, by the aſſiſtance of his general concourſe, the parts of the univerſe, eſpecially thoſe that are the greater and the more noble, are lodged in ſuch places, and furniſhed with ſuch powers, that, by the help of his general providence, they may have their beings continued and maintained as long, and as far forth, as the courſe He thought fit to eſtabliſh, among other things corporeal, requires.

UPON this ſuppoſition, which is but a reaſonable one, there will appear no neceſſity to have any recourſe, for the preſervation of particular bodies, to ſuch an internal appetite and inbred knowledge in each of them as our adverſaries preſume; ſince, by virtue of the original frame of things, and eſtabliſhed laws of motion, bodies are neceſſarily determined to act on ſuch occaſions after the manner they would do if they had really an aim at ſelf-preſervation: as you ſee, that if a blown bladder be compreſſed, and thereby the included air be forced out of its wonted dimenſions and figure, it will inceſſantly endeavour to throw off and repel that which offers violence unto it, and firſt diſplace that part of the compreſſing body that it finds weakeſt; though in all this there be no appetite in the air, (as I elſewhere ſhew) no more than in the bladder, to that particular figure, to maintain itſelf in which it ſeems ſo concerned.

THUS,

THUS, it is all one to a lump of dough, whether you make it into a round loaf, or a long roll, or a flat cake, or give it any other form; for whatever figure your hands or your inſtruments leave in it, that it will retain, without having any appetite to return to that which it laſt had. So it is all one to a piece of wax, whether your ſeal imprints on it the figure of a wolf or that of a lamb. And, for brevity's ſake, to paſs by the inſtances that might be drawn from what happens to wood, and marble, and metals, as they are differently ſhaped by the ſtatuary's art and tools; I will only obſerve, that the mariner's needle, before it is excited, may have no particular propenſity to have reſpect to one part of heaven more than another; but, when it has been duly touched upon a loadſtone, the flower de-luce will be determined to regard the North, and the oppoſite extream the South: ſo that if the lilly be drawn aſide, towards the Eaſt or towards the Weſt, as ſoon as the force that detained it is removed, it will return to its former poſition, and never reſt until it regard the North. But in ſpight of this ſeeming affection of the lilly to that point of the horizon, yet, if the needle be duly touched upon the contrary pole of the ſame or another vigorous loadſtone, the lilly will preſently forget its former inclination, and regard the ſouthern part of heaven; to which poſition it will as it were ſpontaneouſly return, having been forced aſide towards the Eaſt or towards the Weſt, if it be again left to its liberty. So that though it formerly ſeemed ſo much to affect one point of heaven, yet it may, in a trice, be brought to have a ſtrong propenſity for the oppoſite: the lilly having indeed no inclination for one point of heaven more than another, but reſting in that poſition to which it was laſt determined by the prevalence of magnetical effluvia. And this example may ſerve to illuſtrate and confirm what we have been lately ſaying in general.

II. ANOTHER received axiom concerning nature is, that ſhe never fails or miſſes of her ends, *Natura fine ſuo nunquam excidit*. This is a propoſition whoſe ambiguity makes it uneaſy for me to deliver my ſenſe of it; but yet, to ſay ſomewhat, if by nature we here underſtand that being that the ſchoolmen ſtyle *natura naturans*, I grant, or rather aſſert, that nature never miſſeth its end. For the omniſcient and almighty Author of things having once framed the world, and eſtabliſhed in it the laws of motion, which he conſtantly maintains, there can no irregularity or anomaly happen, eſpecially among the greater mundane bodies, that he did not from the beginning foreſee and think fit to permit, ſince they are but genuine conſequences of that order of things that at the beginning he moſt wiſely inſtituted: as I have formerly declared in inſtances of the eclipſes of the ſun and moon; to which I could add others, as the inundations of *Nilus*, ſo neceſſary to the health and plenty of *Egypt*. And though, on ſome ſpecial occaſions, this inſtituted order, either ſeemingly or really, has been violated, as when the ſun is ſaid to have ſtood ſtill in the days of *Joſhua*, and the *Red-Sea* to have divided itſelf to give free paſſage to the *Iſraelites* led by *Moſes*; yet theſe things having been rarely done, for weighty ends and purpoſes, by the peculiar intervention of the Firſt Cauſe, either guiding or over-ruling the propenſities and motions of ſecondary agents; it cannot be ſaid that God is fruſtrated of his ends by theſe deſigned though ſeeming exorbitances by which he moſt wiſely and effectually accompliſhes them. But if by nature be meant ſuch a ſubordinate principle as men are wont to underſtand by that name, I doubt the axiom is in many caſes falſe; for though it be true, as I have often ſaid, that the material world is ſo conſtituted, that, for the moſt part, things are brought to paſs by corporeal agents as regularly as if they deſigned the effects they produce, yet there are ſeveral caſes wherein things happen quite otherwiſe.

THUS it is confeſſed, that, when a woman is with child, the aim of nature is to produce a perfect or genuine human fœtus; and yet we often ſee that nature, widely

miſſing;

miſling her mark, inſtead of that, produces a monſter: and of this we have ſuch frequent inſtances, that whole volumes have been publiſhed, to recount and deſcribe theſe groſs and deformed aberrations of nature. We many times ſee, (and I have formerly noted) that in fevers, and other acute diſeaſes, ſhe makes critical attempts upon improper days, and in theſe unſeaſonable attempts does not only for the moſt part miſs of her end, which is to cure the patient, but often brings him to a far worſe condition than he was in before ſhe uſed thoſe miſcarrying endeavours. To this may be referred the cheats men put upon nature; as when, by grafting, the ſap, that nature raiſes with intention to feed the fruit of a white thorn, (for inſtance) is by the gardener brought to nouriſh a fruit of quite another kind. So, when malſters make barley to ſprout, that *germination*, whereby nature intended to produce ſtalks and ears, is perverted to a far differing purpoſe, and ſhe deluded. And now, to annex ſome arguments *ad hominem*, we are told, that nature makes every agent aim at aſſimilating the patient to itſelf, and that upon this account the fire aims at converting wood, and the other bodies it works on, into fire. But, if this be ſo, nature muſt often miſs of her end in chymical furnaces, where the flame does never turn the bricks, that it makes red-hot, into fire; nor the crucibles, nor the cupels, nor yet the gold and ſilver, that it throughly pervades, and brings to be of a colour, the ſame, or very near the ſame, with its own, and keeps in a very intenſe degree of heat, and in actual fuſion. And even when fire acts upon wood, there is but one part of it turned into fire, ſince, to ſay nothing of the ſoot and concreted ſmoke, the aſhes remain fixed and incombuſtible. And ſo, to add another inſtance *ad hominem*, when we are told, that nature makes water aſcend in ſucking-pumps, *ob fugam vacui*, ſhe muſt needs (as I formerly noted to another purpoſe) miſs of her aim, when the pump exceeds five and thirty, or forty, feet, in height; for then, though you pump never ſo much, and withdraw the air from the upper part of the engine, the water will not aſcend to the top, and conſequently will leave a cavity, for whoſe repleniſhing ſhe was ſuppoſed to have raiſed that liquor two or three and thirty feet.

III. ANOTHER of the celebrated axioms concerning nature is, that ſhe always acts by the ſhorteſt or moſt compendious ways: *Natura ſemper agit per vias breviſſimas*. But this rule, as well as divers others, does, I think, require to be ſomewhat explained and limited, before it be admitted. For it is true, that, as I have frequently occaſion to inculcate, the omniſcient Author of the univerſe has ſo framed it, that moſt of the parts of it act as regularly, in order to the ends of it, as if they did it with deſign. But, ſince inanimate bodies, at leaſt, have no knowledge, it cannot reaſonably be ſuppoſed, that they moderate and vary their own actions, according to the exigency of particular circumſtances, wherewith they muſt of neceſſity be unacquainted; and therefore it were ſtrange, if there were not divers occurrences, wherein they are determined to act by other than the ſhorteſt ways that lead to particular ends, if thoſe other ways be more congruous to the general laws or cuſtoms eſtabliſhed among things corporeal. This I prove by inſtances taken from gravity itſelf, which is, perhaps, that quality which of all others is moſt probably referred to an inbred power and propenſion: for it is true, that, if a ſtone, or another heavy body, be let fall into the free air, it will take its courſe directly towards the centre of the earth; and, if it meet with an inclining plane, which puts it out of its way, it will not for all that loſe its tendency towards the centre, but run along that plane, by which means its tendency downwards is proſecuted, though not, as before, in a perpendicular line, yet in the ſhorteſt way it is permitted to take. Theſe obvious phænomena, I confeſs, agree very well with the vulgar axiom, and poſſibly were the chief things that induced men to frame it. But now let us ſuppoſe, that a ſmall

bullet of marble or ſteel, after having for a pretty ſpace fallen through the air, lights upon a pavement of marble, or ſome ſuch hard ſtone, that lies, as floors are wont to do, horizontal; in this caſe experience ſhews, (as was formerly noted on another occaſion) that the falling ſtone will rebound to a conſiderable height, (in proportion to that it fell from) and falling down again rebound the ſecond time, though not ſo high as before; and, in ſhort, rebound ſeveral times before, by ſettling upon the floor, it approaches as near as is permitted it to the centre of heavy bodies: whereas, if nature did in all caſes act by the moſt compendious ways, this bullet ought not to rebound at all; but, as ſoon as it found, by the hardneſs of the floor, it could deſcend no lower, it ought to have reſted there, as in the neareſt place it could obtain to the centre of the earth, whence every rebound muſt neceſſarily remove it to a greater diſtance. And ſo likewiſe, when a pendulum, or bullet faſtened to the end of a ſtring, is ſo held that the ſtring is *(præter propter)* parallel to the horizon, if it be thence let fall, it will not ſtop at the perpendicular line, or line of direction, which is ſuppoſed to reach from the nail or other prop through the centre of the bullet to the centre of the earth, but will paſs beyond it, and vibrate or ſwing to and fro, until it have paſſed again and again the line of direction, for a great while before the bullet come to ſettle in it, though, whenever it removes out of it, towards either hand, it muſt really aſcend or move upwards, and ſo go further off from the centre of the earth, to which, it is pretended, its innate propenſity determines it to approach as much and as ſoon as is poſſible. But this inſtance having been formerly touched upon, I ſhall now obſerve, to the ſame purpoſe, that having taken a good ſea-compaſs, [and the experiment ſucceeded with a naked, yet nicely poiſed, needle] and ſuffered the magnetic needle to reſt north and ſouth; if I held the proper pole of a good loadſtone at a convenient diſtance on the right or left hand of the lilly, this would be drawn aſide from the north point towards the eaſt or weſt, as I pleaſed; and then, the loadſtone being removed quite away, the lilly of the needle would indeed return northward, but would not ſtop in the magnetic meridian, but paſs on divers degrees beyond it, and would thence return without ſtopping at the meridian line; and ſo would, by its vibrations, deſcribe many arches ſtill ſhorter and ſhorter, until at length it came to ſettle on it, and recover that poſition which, if nature always acted by the moſt compendious ways, it ſhould have reſted at the firſt time that by the removal of the loadſtone he had regained it. But the truth is, that at leaſt inanimate bodies, acting without knowledge or deſign of their own, cannot ſtop or moderate their own action, but muſt neceſſarily move as they are determined by the catholic laws of motion, according to which, in one caſe, the impetus, that the bullet acquires by falling, is more powerful to carry it on beyond the line of direction, than the action of the cauſes of gravity is to ſtop it as ſoon as it comes to the neareſt place they can give it to the center of the earth. And ſomething like this happens in levity, as well as gravity; for if you take an oblong and conveniently ſhaped piece of light wood, as fir or deal, and, having thruſt or ſunk it to the bottom of a ſomewhat deep ſtagnant water, give it leave to aſcend; it will not only regain the ſurface of the water, where, by the laws of gravity it ought to reſt, and did reſt before it was forced down, but it will paſs far beyond that ſurface, and in part as it were ſhoot itſelf up into the incumbent air, and then fall down again, and riſe a ſecond time, and perhaps much oftner, and fall again, before it come to ſettle in its due place, in which it is in an æquilibrium with the water, that endeavours to preſs it upwards.

ANOTHER of the ſentences, that are generally received concerning nature, is, that ſhe always does what is beſt to be done: *Natura ſemper quod optimum eſt facit.* But of this it will not be ſafe for me to deliver my opinion, until I have endeavoured

Natura ſemper id facit quod eſt opti-

mum eorum quæ fieri poſſunt. *Ariſt. de Cælo.* l. ii. c. 4. See alſo *Ariſt. de Gen.* l. ii. c. 10. § 22.

to remove the ambiguity of the words; for they eaſily admit of two different ſenſes, ſince they may ſignify, that nature in the whole univerſe does always that which is beſt for the conſervation of it in its preſent ſtate; or that, in reference to each body in particular, nature does ſtill what is beſt, that is, what moſt conduces to the preſervation and welfare of that body. If the firſt of theſe ſenſes be pitched upon, the axiom will be leſs liable to exception: but then, I fear, it will be difficult to be poſitively made out by ſuch inſtances as will prove, that nature acts otherwiſe than neceſſarily according to laws mechanical; and therefore, until I meet with ſuch proofs, I ſhall proceed to the other ſenſe that may be given our axiom, which, though it be the moſt uſual, yet, I confeſs, I cannot admit, without it be both explained and limited. I readily grant, that the all-wiſe Author of things corporeal has ſo framed the world, that moſt things happen in it as if the particular bodies that compoſe it were watchful both for their own welfare and that of the univerſe. But I think withal, that particular bodies, at leaſt thoſe that are inanimate, acting without either knowledge or deſign, their actions do not tend to what is beſt for them in their private capacities, any further than will comport with the general laws of motion, and the important cuſtoms eſtabliſhed among things corporeal: ſo that, to conform to theſe, divers things are done, that are neither the beſt, nor ſo much as good, in reference to the welfare of particular bodies.

THESE ſentiments I am induced to take up, not only by the more ſpeculative conſiderations that have been formerly diſcourſed of, and therefore ſhall not here be repeated, but by daily obſervations and obvious experience.

WE ſee oftentimes that fruit-trees, eſpecially when they grow old, will for one ſeaſon be ſo overcharged with fruit, that ſoon after they decay and die; and even whilſt they flouriſh, the exceſſive weight of the too numerous fruits does not ſeldom break off the branches they grow upon, and thereby both hinders the maturity of the fruit, and haſtens the death of the tree: whereas this fatal profuſeneſs would have been prevented, if a wiſe nature, harboured in the plant, did, as is preſumed, ſolicitouſly intend his welfare.

WE ſee alſo in divers diſeaſes, and in the unſeaſonable and hurtful criſiſes of fevers, how far what men call nature oftentimes is from doing that which is beſt for the ſick man's preſervation. And indeed (as hath been formerly noted on another occaſion) in many diſeaſes, as bleedings, convulſions, choleras, *&c.* a great part of the phyſician's work is to appeaſe the fury and to correct the errors of nature, which, being as it were tranſported with a blind and impetuous paſſion, unſeaſonably produces thoſe dangerous diſorders in the body, that, if ſhe were wiſe, and watchful of its welfare, ſhe would have been as careful to prevent, as the phyſicians to remedy them.

ADD to all this, that if nature be ſo provident, and watchful for the good of men and other animals, and of that part of the world wherein they live; how comes it to paſs, that from time to time ſhe deſtroys ſuch multitudes of men and beaſts, by earthquakes, peſtilences, famine, and other anomalies? And how comes it ſo often to paſs in teeming women, that, perhaps by a fright, or a longing deſire, or the bare ſight of any outward object, nature ſuffers herſelf to be ſo diſordered, and is brought to forget her plaſtic ſkill ſo much, as, inſtead of well-formed infants, to produce hideous monſters, and thoſe oftentimes ſo miſhapen and ill-contrived, that not only themſelves are unfit to live one day, or perhaps one hour, but cannot come into the world without killing the mother that bare them. Theſe and ſuch other anomalies, though (as I have elſewhere ſhewn) they be not repugnant to the catholic laws of the univerſe, and may be accounted for in the doctrine of God's general providence;

yet they would ſeem to be aberrations incongruous enough to the idea the ſchools give of nature, as of a being that, according to the axiom hitherto conſidered, does always that which is beſt. But it is time that we paſs from that to the examen of another.

THOUGH I have had occaſion to treat of vacuum in the fifth ſection, yet I muſt alſo ſay ſomething about it in this, becauſe I there conſidered it but as it is employed by the Peripatetics and others to ſhew the neceſſity of the principle they call nature. But now I am to treat of it, not ſo much as an argument to be confuted, as on the ſcore of its belonging to a very plauſible axiom to be conſidered; although I fear that, by reaſon of the identity of the ſubject, (though conſidered in the fifth ſection and here to differing purpoſes) I ſhall ſcarce avoid ſaying ſomething or other coincident with what has been ſaid already.

V. THE word vacuum being ambiguous, and uſed in differing ſenſes, I think it requiſite, before I declare my opinion about the generally received axiom of the ſchools, that *natura vacuum horret*, (or, as ſome expreſs it, *abhorret à vacuo*) to premiſe the chief acceptions in which I have obſerved the term vacuum to be made uſe of: for it has ſometimes a vulgar, and ſometimes a philoſophical or ſtrict, ſignification. In common ſpeech, to be empty, uſually denotes, not to be devoid of all body whatſoever, but of that body that men ſuppoſe ſhould be in the thing ſpoken of, or of that which it was framed or deſigned to contain; as when men ſay, that a purſe is empty, if there be no money in it; or a bladder, when the air is ſqueezed out; or a barrel, when either it has not been yet filled with liquor, or has had the wine or other drink drawn out of it. The word vacuum is alſo taken in another ſenſe by philoſophers, that ſpeak ſtrictly, when they mean by it a ſpace within the world (for I here meddle not with the imaginary ſpaces of the ſchoolmen, beyond the bounds of the univerſe) wherein there is not contained any body whatſoever. This diſtinction being premiſed, I ſhall inform you, that taking the word vacuum in the ſtrict ſenſe, though many, and, among them, ſome of my beſt friends, preſſed me to a declaration of my ſenſe about that famous controverſy, *an detur vacuum*, becauſe they were pleaſed to ſuppoſe I had made more trials than others had done about it; yet I have refuſed to declare myſelf, either *pro* or *contra*, in that diſpute: ſince the deciſion of the queſtion ſeems to depend upon the ſtating of the true notion of a body, whoſe eſſence the Carteſians affirm, and moſt other philoſophers deny, to conſiſt only in extenſion, according to the three dimenſions, length, breadth, and depth or thickneſs; for, if Mr. *Des Cartes*'s notion be admitted, it will be irrational to admit a vacuum, ſince any ſpace, that is pretended to be empty, muſt be acknowledged to have the three dimenſions, and conſequently all that is neceſſary to eſſentiate a body: and all the experiments, that can be made with quickſilver, or the machina Boyliana (as they call it), or other inſtruments contrived for the like uſes, will be eluded by the Carteſians, who will ſay, that the ſpace deſerted by the mercury, or the air, is not empty, ſince it has length, breadth, and depth, but is filled by their materia ſubtilis, that is fine enough to get freely in and out of the pores of the glaſſes, as the effluvia of the loadſtone can do. But though, for theſe and other reaſons, I ſtill forbear (as I lately ſaid I have formerly done) to declare either way in the controverſy about vacuum, yet I ſhall not ſtick to acknowledge, that I do not acquieſce in the axiom of the ſchools, that nature abhors a vacuum.

FOR, firſt, I conſider, that the chief, if not the only, reaſon, that moves the generality of philoſophers to believe that nature abhors a vacuum, is, that in ſome caſes, as the aſcenſion of water in ſucking-pumps, *&c.* they obſerve that there is an unuſual endeavour, and perhaps a forcible motion, in water and other bodies, to oppoſe a

vacuum. But I, that ſee nothing to be manifeſt here, ſave that ſome bodies, not devoid of weight, have a motion upwards, or otherwiſe differing from their uſual motions, (as in determination, ſwiftneſs, *&c.*) am not apt, without abſolute neceſſity, to aſcribe to inanimate and ſenſeleſs bodies, ſuch as water, air, *&c.* the appetites and hatreds that belong to rational, or at leaſt to ſenſitive, beings; and therefore think it a ſufficient reaſon to decline employing ſuch improper cauſes, if, without them, the motions, wont to be aſcribed to them, can be accounted for.

2. IF the Carteſian notion of the eſſence of a body be admitted by us, as it is by many modern philoſophers and mathematicians, it can ſcarce be denied but that nature does not produce theſe oftentimes great, and oftner irregular, efforts to hinder a vacuum; ſince it being impoſſible there ſhould be any, it were a fond thing to ſuppoſe that nature, who is repreſented to us as a moſt wiſe agent, ſhould beſtir herſelf, and do extravagant feats, to prevent an impoſſible miſchief.

3. IF the atomical hypotheſis be admitted, it muſt be granted, not only that nature does not abhor a vacuum, but that a great part of the things ſhe does require it, ſince they are brought to paſs by local motion; and yet there are very many caſes, wherein, according to theſe philoſophers, the neceſſary motions of bodies cannot be performed, unleſs the corpuſcles, that lie in their way, have little empty ſpaces to retire, or be impelled into, when the body, that puſhes them, endeavours to diſplace them. So that the effatum, that nature abhors a vacuum, agrees with neither of the two great ſects of the modern philoſophers.

BUT, without inſiſting on the authority of either of them, I conſider, that, for aught appears by the phænomena employed to demonſtrate nature's abhorrency of a vacuum, it may be rational enough to think, either that nature does not abhor a vacuum, even when ſhe ſeems ſolicitous to hinder it; or that ſhe has but a very moderate hatred of it in that ſenſe wherein the vulgar philoſophers take the word vacuum.

FOR if we conſider, that in almoſt all viſible bodies here below, and even in the atmoſpherical air itſelf, there is more or leſs of gravity or tendency towards the centre of our terraqueous globe, we may perceive, that there is no need that nature ſhould diſquiet herſelf, and act irregularly, to hinder a vacuum; ſince, without her abhorrence of it, it may be prevented, or repleniſhed, by her affecting to place all heavy bodies as near the centre of the earth as heavier than they will permit. And even without any deſign of hers, not to ſay without her exiſtence, a vacuity will be as much oppoſed, as we really find it to be, by the gravity of moſt, if not of all, bodies here below, and the confluxibility of liquors and other fluids: for by virtue of their gravity, and the minuteneſs of their parts, they will be determined to inſinuate themſelves into and fill all the ſpaces that they do not find already poſſeſſed by other bodies, either more ponderous in ſpecie than themſelves, or, by reaſon of their firmneſs of ſtructure, capable of reſiſting or hindring their deſcent. Agreeably to which notion we may obſerve, that, where there is no danger of a vacuum, bodies may move as they do when they are ſaid to endeavour its prevention: as if you would thruſt your fiſt deep into a pail full of ſand, and afterwards draw it out again, there will need nothing but the gravity of the ſand to make it fill up the greateſt part of the ſpace deſerted by your fiſt; and if the pail be repleniſhed, inſtead of ſand, with an aggregate of corpuſcles more minute and glib than the grains of ſand, as for inſtance, with quickſilver or with water; then the ſpace, deſerted by your hand, will be, at leaſt as to ſenſe, compleatly filled up by the corpuſcles of the liquor, which, by their gravity, minuteneſs, and the fluidity of the body they compoſe, are determined to repleniſh the ſpace deſerted by the hand that was plunged into either of thoſe liquors.

And

And I elſewhere ſhew, that if you take a pipe of glaſs, whoſe cavity is too narrow to let water and quickſilver paſs by one another in it; if, I ſay, you take ſuch a pipe, and having (by the help of ſuction) lodged a ſmall cylinder of mercury of about half an inch long in the lower part of it, you carefully ſtop the upper orifice with the pulp of your finger, the quickſilver will remain ſuſpended in the pipe: and if then you thruſt the quickſilver directly downwards into a ſomewhat deep glaſs, or other veſſel, full of water, till the quickſilver be depreſſed about a foot or more beneath the ſurface of the water; if then you take off your finger from the orifice of the pipe, which it ſtopt before, you ſhall immediately ſee the quickſilver aſcend ſwiftly five or ſix inches, and remain ſuſpended at this new ſtation. Which experiment ſeems manifeſtly to prove, what I did long ago deviſe and do now alledge it for; ſince here we have a ſudden aſcent of ſo heavy a body, as is quickſilver, and a ſuſpenſion of it in the glaſs, not produced to prevent or fill a vacuum, for the pipe was open at both ends, the phænomena being but genuine conſequences of the laws of the æquilibrium of liquors, as I elſewhere clearly and particularly declare.

When I conſider, how great a power the ſchool-philoſophers aſcribe to nature, I am the leſs inclined to think, that her abhorrence of a vacuum is ſo great, as they believed. For I have ſhewn in the fifth ſection, that her averſion from it, and her watchfulneſs againſt it, are not ſo great, but that, in the ſenſe of the Peripatetics, ſhe can quietly enough admit it in ſome caſes, where, with a very ſmall endeavour, ſhe might prevent or repleniſh it, as I have particularly manifeſted in the fore-cited ſection. I juſt now mentioned a vacuum in the ſenſe of the Peripatetics, becauſe when the Torricellian experiment is made, though it cannot, perhaps, be cogently proved, either againſt the Carteſians, or ſome other Pleniſts, that in the upper part of the tube deſerted by the quickſilver there is a vacuum, in the ſtrict philoſophical ſenſe of the word; yet as the Peripatetics declare their ſenſe by divers of their reaſonings againſt a vacuum mentioned in that ſection, it will to a heedful peruſer appear very hard for them to ſhew, that there is not one in that tube. And as by the ſchool-men's way of arguing nature's hatred of a vacuum from the ſuſpenſion of water and other liquors in tubes and conical watering-pots, it appears, that they thought, that any ſpace here below deſerted by a viſible body, not ſucceeded by another viſible body, or at leaſt by common air, may be reputed empty; ſo, by the ſpace deſerted by the quickſilver at the top of the pipe of a baroſcope thirty-one inches long, one may be invited to doubt, whether a vacuum ought to be thought ſo formidable a thing to nature, as they imagine ſhe does, and ought to think it? For what miſchief do we ſee enſue to the univerſe upon the producing or continuance of ſuch a vacuum, though the deſerted ſpace were many times greater than an inch, and continued many years, as has divers times happened in the taller ſort of mercurial baroſcopes? And thoſe Peripatetics, that tell us, that, if there were a vacuum, the influences of the cœleſtial bodies, that are abſolutely neceſſary to the preſervation of ſublunary ones, would be intercepted, ſince motion cannot be made in vacuo, would do well to prove, not ſuppoſe, ſuch a neceſſity; and alſo to conſider, that in our caſe the top of the quickſilver, to which the vacuum reaches, does uſually appear protuberant; which ſhews, that the beams of light (which they think of great affinity to influences, if not the vehicle) are able to traverſe that vacuum, being in ſpight of it reflected from the mercury to the beholder's eye. And in ſuch a vacuum, as to common air, I have tried, that a load-ſtone will emit its effluvia, and move iron or ſteel placed in it. In ſhort, it is not evident, that here below nature ſo much ſtrains herſelf to hinder or fill up a vacuum, as to manifeſt an abhorrence of it. And without much peculiar ſolicitude, a vacuum, at leaſt a philoſophical one, is as

much provided againſt, as the welfare of the univerſe requires, by gravity and confluxibility of the liquors and other bodies, that are placed here below. And as for thoſe, that tell us, that nature abhors and prevents a vacuum, as well in the upper part of the world as the lower, I think we need not trouble ourſelves to anſwer the allegation, till they have proved it: which I think will be very hard for them to do; not to mention, that a Carteſian may tell them, that it were as needleſs for nature to oppoſe a vacuum in heaven as in earth, ſince the production of it is every where alike impoſſible.

Hippocrat. Epidem. *l.* 6. § 5. *t.* 1.

VI. I come now to the celebrated ſaying, that *natura eſt morborum medicatrix*, taken from *Hippocrates*, who expreſſes it in the plural, νυσῶν φυσιες ἰητρὸι. And becauſe this axiom is generally received among phyſicians and philoſophers, and ſeems to be one of the principal things, that has made them introduce ſuch a being, as they call nature, I think it may be time well employed, to conſider ſomewhat attentively, in what ſenſe, and how far, this famous ſentence, may, or ſhould not, be admitted.

FIRST then, I conceive it may be taken in a negative ſenſe, ſo as to import, that diſeaſes cannot be cured in ſuch perſons, in whom the aggregate of the vital powers or faculties of the body is ſo far weakened or depraved, as to be utterly unable to perform the functions neceſſary to life, or at leaſt to actuate and aſſiſt the remedies employed by the phyſician to preſerve or recover the patient. This I take to be the meaning of ſuch uſual phraſes, as, that phyſic comes too late, and that nature is quite ſpent: and in this ſenſe I readily acknowledge the axiom to be true; for, where the engine has ſome neceſſary parts, whether fluid or ſolid, ſo far depraved or weakned, as to render it altogether unable to co-operate with the medicine, it cannot be rationally expected, that the adminiſtration of that medicine ſhould be effectual; but in this, I preſume, there is no difficulty worthy to detain us. I proceed therefore to the poſitive ſenſe, whereof our axiom is capable, and wherein it is the moſt uſually employed: for men are wont to believe, that there reſides in the body of a ſick perſon a certain provident or watchful being, that ſtill induſtriouſly employs itſelf, by its own endeavours, as well as by any occaſional aſſiſtance, that may be afforded it by the phyſician, to rectify whatever is amiſs, and reſtore the diſtempered body to its priſtine ſtate of health. What I think of this doctrine I ſhall leave you to gather from the following diſcourſe.

I CONCEIVE then in the firſt place, that the wiſe and beneficent Maker of the world and of man, intending, that men ſhould, for the moſt part, live a conſiderable number of years, in a condition to act their part on the mundane ſtage; He was pleaſed to frame thoſe living automata, human bodies, that, with the ordinary ſuccours of reaſon, making uſe of their exquiſite ſtructure fitted for durableneſs, and of the friendly, though undeſigned, aſſiſtance of the various bodies, among which they are placed, they may in many caſes recover a ſtate of health, if they chance to be put out of it by leſſer accidents than thoſe, that God, in compliance with the great ends of his general providence, did not think fit to ſecure them from, or enable them to ſurmount. Many things therefore, that are commonly aſcribed to nature, I think, may be better aſcribed to the mechaniſms of the macrocoſm and microcoſm, I mean, of the univerſe and the human body. And, to illuſtrate a little my meaning by a groſs example or two, I deſire you will conſider with me a ſea-compaſs, wherein the excited magnetic needle, and the box that holds it, are duly poiſed by means of a competent number of oppoſite pivats: for though, if you give this inſtrument a ſomewhat rude ſhake, you will make the box totter, and encline this way and that way, and at the ſame time drive the points of the magnetic needle many degrees to the eaſt,

or

or to the weſt; yet, the conſtruction of the inſtrument and the magnetiſm of one main part of it are ſuch, that if the force, that firſt put it into a diſorderly motion, ceaſe from acting on it, the box will, after ſome reciprocations, return to its horizontal ſituation; and the needle, that was forced to deviate, will, after a few irregular motions to this and to that ſide of the magnetical meridian, ſettle itſelf again in a poſition, wherein the flower-de-luce ſtedfaſtly regards the north. And yet this recovery to its former ſtate is effected in a factitious body, by the bare mechaniſm of the inſtrument itſelf, and of the earth, and other bodies, within whoſe ſphere of activity it is placed. But becauſe many have not ſeen a mariner's compaſs, I will add a leſs appoſite, but more obvious and familiar example: for if, when an empty balance is duly counterpoiſed, you ſhall, by your breath or hand, depreſs one of the ſcales, and thereby, for the time, deſtroy the *Æquilibrium*; yet, when the force is once removed, the depreſſed balance will preſently aſcend, and the oppoſite will deſcend; and, after a few motions up and down, they will both of them, of their own accord, ſettle again in an exact *Æquilibrium*, without the help of any ſuch provident internal principle, as nature; the abſence of whoſe agency may be confirmed by this, that the depreſſed ſcale does not at firſt ſtop at the horizontal line, beneath which it was firſt depreſſed, (as it ought to do, if it were raiſed by an intelligent being) but riſes far above it. If it be here objected, that theſe examples are drawn from factitious, not from merely phyſical bodies; I ſhall return this brief anſwer, and deſire, that it be applied not only to the two freſhly mentioned examples, but to all of the like kind, that may be met with in this whole treatiſe. I ſay then, in ſhort, that divers of the inſtances we are ſpeaking of are intended but for illuſtrations, and that others may be uſeful inſtances, if they ſhould be no more than analogous ones; ſince examples drawn from artificial bodies and things may have both the advantage of being more clearly conceived by ordinary underſtandings, and that of being leſs obnoxious to be queſtioned in that particular, in which the compariſon or correſpondence conſiſts: and I the leſs ſcruple to employ ſuch examples, becauſe *Ariſtotle* himſelf and ſome of his more learned followers make uſe of divers compariſons drawn from the figures and other accidents of artificial things, to give an account of phyſical ſubjects, and even of the generation, corruption, and forms of natural bodies. This advertiſement premiſed, I purſue this diſcourſe it interrupted, by adding, thus in a human body the cauſes, that diſorder it, are oftentimes but tranſient; whereas the ſtructure of the body itſelf, and the cauſes, that conduce to the preſervation of that ſtructure, are more ſtable and durable, and on that account may enable the engine to out-laſt many things that are hoſtile to it. This may be ſomewhat illuſtrated, by conſidering, that ſleep, though it be not properly a diſeaſe, eaſily becomes one, when it frequently tranſgreſſeth its due bounds; and even whilſt it keeps within them, it does, for the time it laſts, hinder the exerciſe of many functions of the body more than ſeveral diſeaſes do; and yet, according to the common courſe of things, the matter, that locked up the ſenſes, being ſpent, the man of himſelf recovers that ſenſible and active ſtate, on whoſe ſcore he is ſaid to be awake. But to come ſomewhat cloſer to the point, we ſee, that many perſons, who get a præternatural thirſt with over-much drinking, get rid of it again in a few days by forbearing ſuch exceſſes; and many, that by too plentiful meals are brought to a want of appetite, recover, as it were, of courſe, by a ſpare diet, in a few days; the renewed ferment, or menſtruum of the ſtomach, being able in that time to concoct by little and little, or expel the indigeſted aliments or peccant humours, that offended the ſtomach, and cauſed the want of appetite.

AND here I desire to have it taken notice of, as a thing, that may be considerable to our present purpose, that I look not on a human body, as on a watch or a hand-mill, *i. e.* as a machine made up only of solid, or at least consistent parts; but as an hydraulical, or rather hydraulopneumatical engine, that consists not only of solid and stable parts, but of fluids, and those in organical motion: and not only so, but I consider, that these fluids, the liquors and spirits, are in a living man so constituted, that in certain circumstances the liquors are disposed to be put into a fermentation or commotion, whereby either some depuration of themselves, or some discharge of hurtful matter by excretion, or both, are produced, so as, for the most part, to conduce to the recovery or welfare of the body.

AND that even consistent parts may be so framed, and so connected with other parts, as to act, as it were, *pro re nata*, varying their motions as differing circumstances make it convenient they should be varied, I purposely shew in another paper. To this I might altogether refer you; but, in regard the thing is a paradox, and lays a foundation for another not inferior to itself, I shall here borrow thence one instance, not mentioned that I know of by others to this purpose, that may both declare my meaning, and confirm the thing itself. I consider then, that what is called the pupil or apple of the eye, is not (as it is known) a substantial part of the organ, but only a round hole or window made in the uvea, at which the modified beams of light enter, to fall upon the chrystalline humour, and thence be refracted to the bottom of the eye, or seat of vision, to make there an impression, that is usually a kind of picture (for it is not always a neat one) of the object. Now the wise and all-foreseeing Author of things has so admirably contrived this instrument of sight, that, as it happens to be employed in differing lights, so the bigness or area of the pupil varies; for when the light is vivid, and would be too great, if all the beams were let in, that might enter at an aperture as large as the usual, the curtain is every way drawn towards the middle, and thereby the round window made narrower; and, on the other side, when the light is but faint, and the object but dimly illustrated, there being more light requisite to make a sufficient impression at the bottom of the eye, the curtain is every way drawn open, to let in more light: and when the eye is well constituted, this is regularly done, according as the organ has need of more or less light. Of this some late masters of optics have well treated, and I have spoken about it more fully in another place. And the truth of the observation you may easily find, if you look upon the eyes of a boy or a girl (for in young persons the change is the most notable) when the eyes are turned from looking on dark objects towards bright or more illuminated ones. And I have found the variation yet more conspicuous in the eyes of a young cat, as I elsewhere particularly relate. So that, referring you to the writings already pointed at, I shall only add in this place, that these various motions in the eye are produced by mere mechanism, without the direction, or so much as knowledge or perception of the rational soul. And, upon the like account it is, that other motions, in several parts belonging to the eye, are produced, as it were spontaneously, as occasion requires. And so, as to the fluid parts of the body, we find, that, according to the institution of the Author of things, when healthy women are of a fit age, there is a monthly fermentation or commotion made in the blood, which usually produces a kind of separation, and then an excretion, advantageous to the body.

AND that you may the better make out what I meant by the disposition, or tendency, of the parts, to return to their former constitution, I shall desire you to consider, with me, a thin and narrow plate of good steel, or refined silver; for, if one end of it be forcibly drawn aside, the changed texture of the parts becomes such,

or the congruity and incongruity of the pores, in reference to the ambient æther, that endeavours to permeate them, is made ſuch, that, as ſoon as the force, that bent it, is removed, the plate does, as it were, ſpontaneouſly return to its former poſition: and yet here is no internal watchful principle, that is ſolicitous to make this reſtitution, for otherwiſe it is indifferent to the plate what figure it ſettle in: for, if the ſpringy body ſtand long bent, then, as if nature forgot her office, or were unable to execute it, though the force, that held the ſpring bent, be removed, it will not endeavour to regain its former ſtraightneſs.* And I have tried in a ſilver plate, that if you only heat it red-hot, and let it cool, if you put it into a crooked poſture, it will retain it; but barely with two or three ſtrokes of a hammer, which can only make an inviſible change of texture, the plate will acquire a manifeſt and conſiderable ſpringyneſs, which you may again deprive it of, by ſufficiently heating it in the fire, without ſo much as melting it.

But, to return to the diſcourſe, formerly begun, about diſtempers wont to be harmleſs by being tranſient, we may obſerve, that the third or fourth day after women are brought to bed there is commonly a kind of fever produced, upon the plentiful reſort of the milk to the breaſts; for which cauſe, this diſtemper is, by many, called the fever of milk; and this is wont, in a ſhort time, to paſs away of itſelf, as depending upon cauſes far leſs durable, than the œconomy of the woman's body. And if it be objected, that theſe are not diſeaſes, becauſe they happen according to the inſtituted courſe of nature; I will not now diſpute the validity of the conſequence, though I could repreſent, that the labour of teeming women, and the breeding of teeth in children, happen as much according to the inſtitution of nature, and yet are uſually very painful, and oftentimes dangerous; but I will rather anſwer, that if the troubleſome accidents, I have alledged, cannot ſerve to prove, they may at leaſt to illuſtrate, what I aim at. And I ſhall proceed to take notice of a diſtemper, that phyſicians generally reckon among diſeaſes, I mean the flowing of blood at the hæmorrhoidal veins: for, though oftentimes this flux of blood is exceſſive, and ſo becomes very dangerous, and therefore muſt be checked by the phyſician, (which is no great argument, that a being, wiſe and watchful, manages this evacuation); yet frequently, if not for the moſt part, the conſtitution of the body is ſuch, that the ſuperfluous or vitiated blood goes off, before it has been able to do any conſiderable miſchief, or perhaps any at all, to the body. And ſo we ſee, that many coughs, and hoarſeneſſes, and coryzas are ſaid to be cured, that is, do ceaſe to trouble men, though no medicine be uſed againſt them, the ſtructure of the body being durable enough to out-laſt the peccant matters, or the operation of thoſe other cauſes, that produce theſe diſtempers.

It is a known thing, that moſt perſons, the firſt time they go to ſea, eſpecially if the weather be any thing ſtormy, are, by the unwonted agitations, which thoſe of the ſhip produce in them, (aſſiſted perhaps by the ſea-air, and ſmells of the ſhip) caſt into that diſeaſe, that, from the cauſe of it, is called the ſea-ſickneſs, which is ſometimes dangerous, and always very troubleſome, uſually cauſing a loſs of appetite, and almoſt continual faintneſs, a pain in the head, and almoſt conſtant nauſeouſneſs, accompanied with frequent, and oftentimes violent vomitings; which ſymptoms make many complain, that, for the time, they never felt ſo troubleſome a ſickneſs; and yet uſually, after not many days, this diſtemper, by degrees, is maſtered by the powers of the body, tending ſtill to perſevere in their orderly and friendly courſe, and ſuppreſſing the adventitious motions, that oppoſe it, and the ſick perſon recovers without other help. And ſo, though perſons unaccuſtomed to the ſea, whether they be ſick or no, are, by the inconvenient motions of the ſhip, uſually brought to a kind

of habitual giddineſs, which diſpoſes them to reel and falter, when they walk upon firm ground; yet, when they come a-ſhore, they are wont in no long time to be freed from this uneaſy giddineſs, without the help of any medicine; the uſual and regular motions of the parts of the body obliterating by degrees in a few days (I uſed to be free from it within ſome hours) that adventitious impreſſion, that cauſed the diſcompoſure. To the ſame purpoſe we may take notice of that, which happens to many perſons, who riding backwards in a coach are not only much diſtempered in their heads, but are made very ſick in their ſtomachs, and forced to vomit, as violently and frequently, as if they had taken an emetic; and yet all this diſorder is wont quickly to ceaſe, when the patient leaves the coach, without the continuance of whoſe motion (that continues a prepoſterous one in ſome parts of the patient) the diſtemper will quickly yield to the more ordinary and regular motions of the blood, and other fluids of the body. So, when in a coach, or elſewhere, a man happens to be brought to faintneſs, or caſt into a ſwoon, by the cloſeneſs of the place, or the over-charging of the air with the fuliginous reeks of men's bodies; though the diſeaſe be formidable, yet, if the patient be ſeaſonably brought into the free air, the friendly operation of that external body, aſſiſting the uſual endeavours or tendency of the parts of the patient's body to maintain his life and health, is wont quickly to reſtore him to the ſtate he was in before this ſudden ſickneſs invaded him. Divers things, that happen in ſome diſeaſes, may be groſsly illuſtrated, by ſuppoſing, that into a vial of fair water ſome mud be put, and then the vial be well ſhaken, for the water will be troubled and dirty, and will loſe its tranſparency, upon a double account; that of the mud, whoſe opacous particles are confounded with it; and that of the newly generated bubbles, that ſwim at the top of it: and yet to clarify this water, and make it recover its former limpidneſs, there needs no particular care or deſign of nature, but, according to the common courſe of things, after ſome time the bubbles will break and vaniſh at the top, and the earthy particles, that compoſe the mud, will, by their gravity, ſubſide to the bottom, and ſettle there, and ſo the water will become clear again. Thus alſo muſt, which is the lately expreſſed juice of grapes, will for a good while continue a troubled liquor; but though there be no ſubſtantial form to guide the motions of this factitious body, yet, according to the courſe of things, a fermentation is excited, and ſome corpuſcles are driven away in the form of exhalations or vapours, others are thrown againſt the ſides of the caſk, and hardened there into tartar, and others again ſubſide to the bottom, and ſettle there in the form of lees; and by this means leave the liquor clear, and, as to ſenſe, uniform. And why may not ſome depurations and proſcriptions of heterogenous parts be made in the blood, as well as they are uſually in muſt, without any peculiar and ſolicitous direction of nature?

THERE is indeed one thing, to which the ſentence of nature's being the curer of diſeaſes may be very ſpeciouſly applied, and that is the healing of cuts and wounds, which, if they be but in the fleſh, may oftentimes be cured without plaiſters, ſalves, or other medicines, but, not to mention hæmorrhages and ſome other ſymptoms, wherein the chirurgeon is fain to curb or remedy the exorbitancies of nature, this healing of the *ſolutio continui* ſeems to be but an effect or conſequent of that fabric of the body on which nutrition depends: for the alimental juice, being, by the circulation of the blood and chyle, carried to all parts of the body to be nouriſhed, if it meets any where either with preternatural concretions, or with a gap made by a cut or wound, its particles do there concrete into a kind of baſtard-fleſh, or ſome ſuch other body, which that juice, in the place and other circumſtances it is in, is fitted to conſtitute. Thus we ſee, that not only wens and ſcrophulous tumors are nouriſhed in the body, but miſ-ſhapen molas do by nutriment grow in the womb,

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as well as embrios feed there. And, to come closer to the present argument, we see, that in wounds proud-flesh, and perhaps funguses, are as well produced and entertained by the aliment brought to the wounded part, as the true and genuine flesh; so that either nature seems much mistaken, if she designs the production and maintenance of such superfluous and inconvenient bodies; or the surgeon is much to blame, who is industrious to destroy them, though oftentimes he cannot do it, without using painful corrosives. But, for aught appears, nature is not so shy and reserved in her bounty, but that she sends nourishment to repair as well things, that do not belong to the body, as genuine parts of it, as to restore flesh to wounded parts; as may appear by warts and corns, that grow again after they are skilfully cut. And I remember I have seen a woman, in whose forehead nature was careful to nourish a horn about an inch and more in length, which I fully examined, whilst it was yet growing upon her head, to avoid being imposed upon.

But, besides the diseases hitherto discoursed, there are many others, as well acute as chronical, wherein it is confessed, that nature alone does not work the cure; so that as to these, (which are more numerous than the former) I may well pretend, that the aphorism, that makes nature the curer of diseases, is not true, otherwise than in a limited sense. But because I know it is pretended, that even in these diseases nature is the principal agent, by whose direction the physician acts in subserviency to her designs, and physicians themselves (whether out of modesty or inadvertence, I now inquire not) are wont to acknowledge, that they are but nature's ministers; I think it necessary to consider briefly, what sense is fit, according to our doctrine, to be given to these assertions, to make them receivable by us.

But, to make way for what we are to say on this occasion, it may be fit to observe, that one great cause of the common mistakes about this matter is, as hath been partly intimated already, that the body of a man is looked upon, rather as a system of parts, whereof most are gross and consistent, and not a few hard and solid too, than as, what indeed it is, a very compounded engine, that, besides these consistent parts, does consist of the blood, chyle, gall, and other liquors, also of more subtil fluids, as spirits and air; all which liquors and fluids are almost incessantly and variously moving, and thereby put divers of the solid parts, as the heart and lungs, the diaphragma, the hands, feet, *&c.* into frequent and differing motions: so that, as, when the constitution or the motions, that in a sound body do regularly belong to the fluid parts, happens the former to be depraved, or the latter to grow anomalous, the engine is immediately out of order, though the gross solid parts were not primarily affected; so, when by proper remedies (whether visible or not) the vitiated texture or crasis of the blood or other juices is corrected, and the inordinate motions, that they and the spirits are put into, or, that they also put the consistent parts into, are calmed and rectified, the grosser and more solid parts of the body, and so the whole animal œconomy, if I may so call it, will be restored to a more convenient state. Thus we see, that in many hysterical women, by the fragrant effluvia of a *Spanish* glove, or some other strong perfume, the spirits and *genus nervosum* being affected, several disorderly symptoms are produced, and oftentimes the motion of the blood is so stopt and abated, that any pulse at all is scarcely to be felt, nor respiration discerned, and the whole engine, unable to sustain itself, falls to the ground, and lies moveless on it's and yet we have often, by barely holding to the patient's nostrils a vial full of very strong spirit, or volatile salt, or sal-armoniac, or of hartshorn, in less than a quarter of an hour, sometimes in a few minutes, restored women in that condition to their senses, speech, and motion.

We are also here to consider, what I have formerly inculcated, that the œconomy of the human body is so constituted by the divine Author of it, that it is usually fit-

ted to laſt many years, if the more general laws, ſettled by the ſame Author of the univerſe, will permit it: and therefore it is not to be wondered at, that in many caſes the automaton ſhould be in a condition to concur, though not with knowledge and deſign, to its own preſervation, when, though it had been put ſomewhat out of order, it is aſſiſted by the phyſician's hands or medicines to recover a convenient ſtate.

AND if it be objected, that the examples, that have been in this paſt diſcourſe frequently drawn from automata, are not adequate, and do not fully reach the difficulties we have been ſpeaking of, I ſhall readily grant it, provided it be conſidered, that I avowedly and deſervedly ſuppoſe the bodies of living animals to be, originally, engines of God's own framing, and conſequently effects of an omniſcient and almighty artificer. So that, it is not rational to expect, that in the incomparably inferior productions of human ſkill, there ſhould be found engines fit to be compared with theſe, which in their protoplaſts had God for their author. Not to mention (what yet may be conſiderable in reference to the laſtingneſs of human life) that a man is not a mere mechanical thing, where nothing is performed for the preſervation of the engine, or its recovery to a good ſtate, but by its own parts, or other agents, acting according to mechanical laws without counſel or deſign; ſince, though the body of a man be indeed an engine, yet there is united to it an intelligent being (the rational ſoul or mind) which is capable, eſpecially if inſtructed by the phyſician's art, to diſcern, in many caſes, what may hurt it, and what may conduce to the welfare of it, and is alſo able (by the power it has to govern the muſcles and other inſtruments of voluntary motion) to do many of thoſe things it judges moſt conducive to the welfare and ſafety of the body, it is joined with. So that a man is not like a watch, or an empty boat, where there is nothing but what is purely mechanical; but like a manned boat, where, beſides the mechanical part (if I may ſo ſpeak) there is an intelligent being, that takes care of it, and both ſteers it, or otherwiſe guides it, and when need requires, trims it; and, in a word, as occaſion ſerves, does what he can to preſerve it, and keep it fit for the purpoſes it is deſigned for.

THESE things being premiſed, I think the phyſician (here ſuppoſed to be free from prejudices and miſtakes) is to look upon his patient's body, as an engine, that is out of order, but yet is ſo conſtituted, that, by his concurrence with the endeavours, or rather tendencies, of the parts of the automaton itſelf, it may be brought to a better ſtate. If therefore he find, that in the preſent diſpoſition of the body there is a propenſity or tendency to throw off the matter, that offends it, and (which ought to be ſome way or other expelled) in a convenient way, and at commodious places; he will then act ſo, as to comply with, and further, that way of diſcharge, rather than another: as, if there be a great appearance, that a diſeaſe will quickly have a criſis by ſweat; he will rather further it by covering the patient with warm cloaths and giving ſudorific medicines, than by endeavouring to carry off the peccant matter by purging or vomiting, unſeaſonably hinder a diſcharge, that probably will be beneficial. And in this ſenſe men may ſay, if they pleaſe, that the phyſicians are miniſters or ſervants of nature; as ſeamen, when the ſhip goes before a good wind, will not ſhift their ſails, nor alter the ſhip's motion, becauſe they need not. But to ſhew, that it is, as it were, by accident, that the phyſician does, in the forementioned caſe, obey nature, (to ſpeak in the language of the naturiſts I reaſon with), I need but repreſent, that there are many other caſes, wherein the phyſician, if he be ſkilful, will be ſo far from taking nature for his miſtreſs, to direct him by her example, what ſhould be done; that a great part of his care and ſkill is employed to hinder her from doing what ſhe ſeems to deſign, and to bring to paſs other things very different from, if not contrary to, what ſhe endeavours.

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THUS, though nature in dropſies importunately crave ſtore of drink, the phyſician thinks himſelf obliged to deny it; as he does what they greedily deſire, to his patients of the green-ſickneſs, or that diſtemper they call pica, though the abſurd and hurtful things, as very unripe fruit, lime, coals, and other incongruous things, be earneſtly longed for. Thus alſo the chirurgeon does often hinder nature from cloſing up the lips of a wound, as ſhe would unſkilfully do, before it be well and ſecurely healed at the bottom. So the phyſician does often, by purging or phlebotomy, carry off that matter, that nature would more dangerouſly throw into the lungs, and expel by frequent and violent coughs.

And ſo, if a nerve or tendon be pricked, the chirurgeon is fain, with anodynes, and other convenient medicines, to prevent or appeaſe the unreaſonable tranſports of nature, when, being in a fury, by violent and threatning convulſions, ſhe not only much diſorders, but endangers, the patient. And ſo likewiſe, when in thoſe evacuations, that are peculiar to women, nature affects, in ſome individuals, to make them by undue and inconvenient places, as the nipples, the mouth, or the eyes, whereof we have divers inſtances, among the obſervations collected by *Schenckius*, or related by other good authors; the phyſician is careful, by bleeding the patient in the foot, and by uſing other means, to oblige nature to alter her purpoſe, and make the intended evacuations by the proper uterine veſſels: and though, according to the inſtitution of nature, as they ſpeak, there ought to be a monthly diſcharge of theſe ſuperfluities, and therefore, whilſt this is moderately made, the phyſician does rather further than ſuppreſs it, yet if, as it often happens in other patients, nature overlaſhes in making thoſe evacuations, to the great weakning or endangering the ſick perſon, the phyſician is careful, by contemporating medicines and other ways, to correct nature's exorbitancy, and check her profuſeneſs of ſo neceſſary a liquor, as the blood. Other inſtances, more conſiderable, than ſome of theſe hitherto mentioned, might be given to the ſame purpoſe; but I forbear to do it, becauſe, there being ſome, though perhaps very needleſs, controverſies about them, I could not make out their fitneſs to be here alledged, without more words, than I am now willing to employ about unneceſſary proofs, fearing it might be thought I have dwelt too long already upon the explication of one aphoriſm. I ſhall therefore only obſerve in ſhort, that I look upon a good phyſician, not ſo properly as a ſervant to nature, as one, that is a counſellor and friendly aſſiſtant, who, in his patient's body, furthers theſe motions and other things, that he judges conducive to the welfare and recovery of it; but as to thoſe, that he perceives likely to be hurtful, either by increaſing the diſeaſe, or otherwiſe endangering the patient, he thinks it is his part to oppoſe or hinder, tho' nature do manifeſtly enough ſeem to endeavour the exerciſing or carrying on thoſe hurtful motions.

Schenck. Obſervat. l. iv. pag. m. 633. & ſeq.

ON this occaſion, I ſhall take notice of the practice of the more prudent among phyſicians themſelves, who being called to a patient ſubject to the flux of the hæmorrhoids, if they find the evacuation to be moderate, and likely either to benefit the patient on another account, (as in ſome caſes it is), or at leaſt to end well, they do, as ſome of them ſpeak, commit the whole buſineſs to nature; that is, to ſpeak intelligibly, they ſuffer it to take its courſe, being encouraged to do ſo, in ſome caſes, by the doctrine of *Hippocrates*, and in others by experience: but if the evacuation prove to be too laſting, or too copious, they then are careful to hinder nature from proceeding in it, and think themſelves obliged to employ both inward and outward means to put a ſtop to an evacuation, which may bring on a dropſy, or ſome other formidable diſeaſe. And if it be ſaid, that nature makes this profuſion of ſo neceſſary a liquor as blood, only becauſe ſhe is irritated by the acrimony of ſome humour mixed with

Hippocrat. Lib. vi. Aphor. xi.

with it; I ſay, that this anſwer, which, for ſubſtance, is the very ſame, that naturiſts may be compelled to fly to on many occaſions, is in effect a confeſſion, that nature is no ſuch wiſe being as they pretend; ſince ſhe is ſo often provoked to act, as it were, in a fury, and do thoſe things in the body, that would be very miſchievous to it, if the phyſician, more calm and wiſe than ſhe, did not hinder her. So that, notwithſtanding the reverence I pay the great *Hippocrates*, it is not without due caution and ſome limitations, that I admit that notable ſentence of his, where he thus ſpeaks; * *Invenit natura ipſa ſibi-ipſi aggreſſiones:* and after three or four lines, *Non edocta natura & nullo magiſtro uſa, ea quibus opus eſt facit.* Which, I fear, makes many phyſicians leſs courageous and careful than they ſhould, or perhaps would be, to employ their own ſkill on divers occaſions, that much require it.

* *Hippoc.* Epidem. l. vi. § 5. *text.* 2. 4.

I SHALL now add, that as, in ſome caſes, the phyſician relieves his patient in a negative way, by oppoſing nature in her unſeaſonable or diſorderly attempts; ſo, in other caſes, he may do it in a poſitive way, by employing medicines, that either ſtrengthen the parts, as well fluid as ſtable, or make ſenſible evacuations of matters neceſſary to be proſcribed by them; or (he may do it) by uſing remedies, that by their manifeſt qualities oppugn thoſe of the morbific matter or cauſes; as when by alcalies or abſorbing medicaments he mortifies preternatural acids, or diſables them to do miſchief. And, perhaps, one may venture to ſay, that, in ſome caſes, the phyſician may, in a poſitive way, contribute more to the cure even of an inward diſeaſe, than nature herſelf ſeems able to do: for if there be any ſuch medicine preparable by art, as *Helmont* affirms may be made of *Paracelſus*'s *Ludus*, by the liquor alkaheſt; or, as *Cardan* relates, that an empiric had in his time, who travelled up and down *Italy*, curing thoſe, wherever he came, that were tormented with the ſtone in the bladder; if, I ſay, there be any ſuch medicines, the phyſician may, by ſuch inſtruments, perform that, which, for aught appears, is not to be done by nature herſelf, ſince we never find, that ſhe diſſolves a confirmed ſtone in the bladder: nay, ſometimes the phyſician does, without the help of a medicine, controul and over-rule nature, to the great and ſudden advantage of the patient. For when a perſon, otherwiſe not very weak, happens by a fright, or ſome ſurpriſing ill news, to be ſo diſcompoſed, that the ſpirits haſtily and diſorderly thronging to ſome inward part, eſpecially the heart, hinder the regular and wonted motion of it, by which diſorder the circulation of the blood is hindered, or made very imperfect; in this caſe, I ſay, the patient is by nature's great care of the heart (as is commonly ſuppoſed even by phyſicians) caſt into a ſwoon, whence the phyſician ſometimes quickly frees him, by rubbing and pinching the limbs, the ears and the noſe, that the ſpirits may be ſpeedily brought to the external parts of the body; which muſt be done by a motion to the circumference (as they call it), quite oppoſite to that towards the centre or heart, which nature had given them before. But as to the theory of ſwoonings, I ſhall not now examine its truth, it being ſufficient to warrant my drawing from thence an argument *ad hominem*, that the theory is made uſe of by thoſe I reaſon with.

BY what has been diſcourſed one may perceive, that as there are ſome phænomena, that ſeem to favour the doctrine of the naturiſts about the cure of diſeaſes, ſo there are others, that appear more manifeſtly favourable to the hypotheſis we propoſe. And both theſe ſorts of phænomena being conſidered together, may well ſuggeſt a ſuſpicion, that the moſt wiſe and yet moſt free Author of things having framed the firſt individuals of mankind ſo, as to be fit to laſt many years, and endowed thoſe protoplaſts with the power of propagating their ſpecies; it thereupon comes to paſs, that in the ſubſequent hydraulico-pneumatical engines we call human bodies, when neither particular providence, nor the rational ſoul, nor over-ruling impediments interpoſe,

poſe, things are generally performed according to mechanical laws and courſes; whether the effects and events of theſe prove to be conducive to the welfare of the engine itſelf, or elſe cheriſh and foment extraneous bodies or cauſes, whoſe preſervation and proſpering are hurtful to it. On which ſuppoſition it may be ſaid, that the happy things, referred to nature's prudent care of the recovery and welfare of ſick perſons, are uſually genuine conſequences of the mechaniſm of the world, and the patient's body; which effects luckily happen to be co-incident with his recovery, rather than to have been purpoſely and wiſely produced in order to it; ſince I obſerve, that nature ſeems to be careful to produce, preſerve, and cheriſh things hurtful to the body, as well as things beneficial to it. For we ſee in the ſtone of the kidneys and bladder, that out of vegetable or animal ſubſtances of a ſlighter texture, ſuch as are the alimental juices, which, in ſucking children (who are obſerved to be frequently ſubject to the ſtone in the bladder) are afforded by ſo mild a liquor as milk; nature ſkilfully frames a hard body of ſo firm a texture, that it puzzles phyſicians and chymiſts to tell, how ſuch a coagulation can be made of ſuch ſubſtances: and I have found more than one calculus to reſiſt both ſpirit of ſalt, that readily diſſolves iron and ſteel, and that highly corroſive menſtruum, oil of vitriol itſelf. We ſee alſo, that divers times the ſeeds or ſeminal principles of worms, that lie concealed in unwholeſome fruits, and other ill qualified aliments, are preſerved and cheriſhed in the body ſo, as, in ſpight of the menſtruum's ferments, *&c.* they meet with there, they grow to be perfect worms (of their reſpective kinds) that are often very troubleſome, and ſometimes very dangerous, to the body that harbours them; producing, though perhaps not immediately, both more and more various diſtempers (eſpecially here in *England)* than every phyſician is aware of. This reflection may very well be applied to thoſe inſtances we meet with in good * authors, of frogs, and even toads, whoſe ſpawn, being taken in with corrupted water, hath been cheriſhed in the ſtomach, until the eggs being grown to be compleat animals, they produced horrid ſymptoms in the body, that had lodged and fed them. And if, according to the received opinion of phyſicians, ſtubborn quartans are produced by a melancholy humour ſeated in the ſpleen, it may be ſaid, that nature ſeems to buſy herſelf to convert ſome parts of the fluid chyle into ſo tenacious and hardly diſſipable a juice, that in many patients, notwithſtanding the neighbourhood of the ſpleen and ſtomach, neither ſtrong emetics, nor purges, nor other uſual remedies, are able, in a long time, to diſlodge it, or reſolve it, or correct it. But that is yet more conducive to my preſent purpoſe, that is afforded me by the conſideration of the poiſon of a mad dog, which nature ſometimes ſeems induſtriouſly and ſolicitouſly to preſerve; ſince we have inſtances in approved authors, that a little foam conveyed into the blood by a ſlight hurt (perhaps quickly healed up) is, notwithſtanding the conſtant heat and perſpirable frame of the human body, and the diſſipable texture of the foam, ſo preſerved, and that ſometimes for many years, that, at the end of that long time, it breaks out, and diſplays its fatal efficacy with as much vigour and fury, as if it had but newly been received into the body.

* *Schenck.* Obſerv. lib. iii. pag. mihi 337. & ſeq.

To this agrees that, which is well known in *Italy*, about the biting of the tarantula; for, though the quantity of poiſon can ſcarce be viſible, ſince it is communicated by the tooth of ſo ſmall an animal as a ſpider, yet, in many patients, it is preſerved during a great part of their lives, and manifeſts its continuance in the body by annual paroxyſms. And I know a perſon of great quality, who complained to me, that, being in the Eaſt, the biting or ſtinging of a creature, whoſe offenſive arms were ſo ſmall, that the eye could very hardly diſcern the hurt, had ſo laſting an effect upon him, that, for about twelve years after, he was reminded of his miſchance, by

by a pain he felt in the hurt place, about the ſame time of the year, that the miſchief was firſt done him. And, in ſome hereditary diſeaſes, as the gout, falling-ſickneſs, and ſome kinds of madneſs, nature ſeems to act, as if ſhe did, with care as well as ſkill, tranſmit to the unhappy child ſuch morbific ſeeds or impreſſions of the parent's diſeaſe, that, in ſpight of all the various alterations the younger body paſſes through, during the courſe of many years, this conſtantly protected enemy is able to exert its power and malice, after forty, or perhaps fifty, years concealment. Such reflections as theſe, to which may be added, that the naturiſts make no ſcruple to ſtile that death, which men are brought to by diſeaſes, a natural death, make me backward to admit the famed ſentence of *Hippocrates* hitherto conſidered, *Morborum Naturæ Medici*, without limitations, eſpecially thoſe two, that are delivered in the fifth ſection; to which I refer you the rather, becauſe they may help you to diſcern, that divers phænomena, that favour not the received notion of a kind and prudent being, as nature is thought to be, are yet very conſiſtent with divine providence.

SECT. VIII.

I HAVE now gone through ſo many of the celebrated axioms concerning nature, that I hope I may reaſonably preſume, that the other ſentences of this kind, that my haſte makes me leave unmentioned, will be thought capable of being fairly explicated, and with congruity to our hypotheſis, by the help of the grounds already laid, ſince, with light variations, they may be eaſily enough improved, and applied to thoſe other particulars, to which they are the moſt analogous.

BUT this intimation ought not to hinder me to make a reflection, that not only is pertinent to this place, but which I deſire may have retroſpect upon a great part of the whole precedent diſcourſe. And it is this, that though we could not intelligibly explicate all the particular axioms about nature, and the phænomena of inanimate bodies, that are thought, but not by me granted, to favour them by mechanical principles; it would not follow that we muſt therefore yield up the whole cauſe to the naturiſts: for we have already ſhewn, and may do ſo yet further ere long, that the ſuppoſition of ſuch a being, as they call nature, is far from enabling her partizans to give intelligible accounts of theſe and other phænomena of the univerſe. And though our doctrine ſhould be granted to be, as well as that generally received about nature, inſufficient to give good accounts of things corporeal; yet I ſhall have this advantage in this caſe, that a leſs degree of probability may ſerve, in arguments employed but to juſtify a doubt, than is required in thoſe, that are to demonſtrate an aſſertion.

IT is true, that the naturiſts tell us, that the nature they aſſert is the principle of all motions and operations in bodies; which infers, that in explicating them, we muſt have recourſe to her. But before we acquieſce in, or confidently employ, this principle, it were very fit we knew what it is. This queſtion I have diſcourſed of in the fifth ſection; but having there intimated a reference to another place, the importance, as well as difficulty of the ſubject, invites me to reſume, in this place, the conſideration of it; and both vary and add to what I formerly noted, that I may as well inculcate as clear my thoughts about it. I demand then of thoſe, that aſſert ſuch a nature, as is vulgarly deſcribed, whether it be a ſubſtance or an accident? If it be the latter, it ſhould be declared, what kind of accident it is; how a ſolitary accident can have right to all thoſe attributes, and can produce thoſe numerous, manifold, and wonderful effects, that they aſcribe to nature; and why a complex of ſuch accidents, as are the mechanical affections of matter, (as figure, bulk, motion, &c.)

may not altogether as probably, as that accident they call nature, be conceived to have been inſtituted by the perfectly wiſe Author of the univerſe, to produce thoſe changes among bodies, which are (at leaſt for the moſt part) intelligibly referrible to them? And if things be not brought to paſs by their intervention, it were very fit, as well as deſirable, that we ſhould be informed, by what other particular and intelligible means nature can effect them better, than they may be by that complex.

But if it be ſaid, as by moſt it is, that the principle, called nature, is a ſubſtance, I ſhall next demand, whether it be a corporeal, or an immaterial one? If it be ſaid to be an immaterial ſubſtance, I ſhall further aſk, whether it be a created one, or not? If it be not, then we have God under another name, and our diſpute is at an end, by the removal of its object or ſubject, which is ſaid by the ſchools to be God's vicegerent, not God himſelf. But if nature be affirmed (as ſhe is, at leaſt by all Chriſtian philoſophers) to be a created being, I then demand, whether or no ſhe be endowed with underſtanding, ſo as to know what ſhe does, and for what ends, and by what laws ſhe ought to act? If the anſwer be negative, the ſuppoſition of nature will be of very little uſe to afford an intelligible account of things; an unintelligent nature being liable to the objections, that will a little below be met with againſt the uſefulneſs of nature, in caſe ſhe be ſuppoſed a corporeal being. And though it ſhould be ſaid, that nature is endowed with underſtanding, and performs ſuch functions as divers of the ancients aſcribe to the ſoul of the world; beſides that this hypotheſis is near of kin to heatheniſm, I do not think, that they, who ſhall with many Grecian, and other philoſophers, who preceeded Chriſtianiſm, ſuppoſe a kind of ſoul of the univerſe, will find this principle ſufficient to explicate the phænomena of it: for if we may compare the macrocoſm and microcoſm in this, as well as many are wont to do in other things, we may conceive, that, though nature be admitted to be endowed with reaſon, yet a multitude of phænomena may be mechanically produced, without her immediate intervention; as we ſee, that in a man, though the rational ſoul has ſo narrow a province to take care of, as the human body, and is ſuppoſed to be intimately united to all the parts of it; yet abundance of things are done in the body by the mechaniſm of it, without being produced by that ſoul. Of this we may alledge, as an inſtance, that, in ſleep, the circulation of the blood, the regular beating of the heart, digeſtion, nutrition, reſpiration, *&c.* are performed without the immediate agency, or ſo much as the actual knowledge, of the mind: and, when a man is awake, many things are done in his body, not only without the direction, but againſt the bent of his mind; as often happens in cramps and other convulſions, coughing, yawnings, *&c.* Nay, though ſome brutes, as particularly apes, have the ſtructure of many parts of their bodies very like that of the analogous ones of human bodies; yet that admirable work of the formation and organization of the fœtus, or little animal, in the womb, is granted by philoſophers to be made by the ſoul of the brute (that is therefore ſaid to be the architect of his own manſion) which yet is neither an incorporeal, nor a rational ſubſtance. And, even in a human fœtus, if we will admit the general opinion of philoſophers, phyſicians, divines and lawyers, I may be allowed to obſerve, that the human body, as exquiſite an engine as it is juſtly eſteemed, is formed without the intervention of the rational ſoul, which is not infuſed into the body, till this hath obtained an organization, that fits it to receive ſuch a gueſt; which is commonly reputed to happen about the end of the ſixth week, or before that of the ſeventh. And this conſideration leads me a little further, and prompts me to aſk, how much, by the ſuppoſition or knowledge of the mind, (at the newly mentioned time) we are enabled to explicate the manner, how the forementioned functions of an embryo are performed, when at the end of ſix or ſeven weeks the rational ſoul ſupervenes and comes to be united to this living engine?

AND if it be urged, that nature being the principle of motion in bodies, their various motions, at leaſt, which amount to a conſiderable part of their phænomena, muſt be explained by having recourſe to her; I anſwer, that it is very difficult to conceive, how a created ſubſtance, that is immaterial, can, by a phyſical power or action move a body; the agent having no impenetrable part, wherewith to impel the corporeal *mobile*. I know, that God, who is an immaterial ſpirit, ought to be acknowledged the primary cauſe of motion in matter, becauſe (as we may juſtly with *Monſieur Des Cartes* infer) motion not belonging to corporeal ſubſtance, as ſuch, this muſt owe that to an incorporeal one. But then, I conſider, that there is that infinite diſtance between the incomprehenſible Creator, and the leaſt imperfect order of his creatures, that we ought to be very cautious, how we make parallels between him and them, and draw inferences from his power and manner of acting to theirs; ſince he, for inſtance, can immediately act upon human ſouls, as having created them; but they are not able ſo to act upon another. And I think it the more difficult to conceive and admit, that, if nature be an incorporeal ſubſtance, ſhe ſhould be the greater mover of the mundane matter, becauſe we ſee, that, in a human body, the rational ſoul, (which the ſchool-philoſophers aſſert to be an immaterial ſpirit) though vitally united to it, can only determine the motion of ſome of the parts, but not give motion to any, or ſo much as regulate it in moſt. And if nature be ſaid to move bodies in another than a phyſical way, I doubt, whether the ſuppoſition of ſuch a principle will be of much uſe to phyſiologers in explicating phænomena; ſince I ſhall ſcarce think him an inquiſitive or a judicious doctor, who ſhould imagine, that he explains, that it gives an intelligible and particular account of the aſtoniſhing ſymptoms of thoſe ſtrange diſeaſes, that divers very learned and ſober phyſicians impute to witchcraft, when he ſays, that thoſe ſtrange diſtortions and convulſive motions, for inſtance, and other prodigious effects, were produced by a wicked immaterial ſpirit, called a devil. But having to this purpoſe ſaid more in another paper, which you may command the ſight of, I ſhall not trouble you with it here.

THE paſt diſcourſe oppoſes their opinion, who aſſert nature to be an immaterial creature; but becauſe it is thought, that a greater number of philoſophers, at leaſt among the moderns, take her to be corporeal, I ſhall now addreſs my diſcourſe to their hypotheſis. And though I might object, that, if nature be a body, it may be demanded, how ſhe can produce, in men, rational ſouls, that are immaterial beings, and not capable to be produced by any ſubtiliation or other change of matter whatſoever? yet, waving this objection, I ſhall firſt demand, whether thoſe, I reaſon with, believe nature, though corporeal, to act knowingly, *i. e.* with conſciouſneſs of what ſhe does, and for pre-deſigned ends; or elſe to be blindly and neceſſarily moved and directed by a ſuperior agent, endowed with (what ſhe wants) an excellent underſtanding; and then I ſhall repreſent a few things, appliable to ſome one or other of the two anſwers, that may be made, and ſome to both.

AND firſt, the Carteſians would aſk, how, if nature be a corporeal ſubſtance, we can conceive her capable of thinking? and, which is more, of being a moſt wiſe and provident director of all the motions, that are made in the corporeal world?

SECONDLY, a philoſophizer may juſtly aſk, how a corporeal being can ſo pervade, and, as it were, com-penetrate the univerſe, as to be intimately preſent with all its minute parts, whereof yet it is ſaid to be the principle of motion?

THIRDLY, he may alſo demand, whence nature, being a material ſubſtance, comes itſelf to have motion, whereof it is ſaid to be the principle? ſince motion does not belong to matter in itſelf, and a body is as truly a body, when it reſts, as when it moves. And if it be anſwered, that the firſt cauſe, that is, God, did at firſt put it into

into motion; I reply, that the ſame cauſe may, at leaſt as probably, be ſuppoſed to have put the unqueſtioned mundane matter into motion, without the intervention of another corporeal being, in whoſe conception (*i. e.* as it is matter) motion is not involved.

FOURTHLY, it may likewiſe be aſked, how the laws of motion come to be obſerved or maintained by a corporeal being? which, as merely ſuch, is either uncapable of underſtanding them, or of acting with reſpect to them, or at leaſt is not neceſſarily endowed with any knowledge of them, or power to conform to them, and to make all the parts of the unqueſtioned mundane matter to do ſo too.

FIFTHLY, and I do not ſee, how the taking in ſuch an intelligent and undeſigning principle will free our underſtandings from great difficulties, when we come to explicate the phænomena of bodies: for, as is elſewhere noted, if nature be a bodily creature, and acts neceſſarily, and (if I may ſo ſpeak) fatally, I ſee no cauſe to look upon it but as a kind of engine; and the difficulty may be as great to conceive, how all the ſeveral parts of this ſuppoſed engine, called nature, are themſelves framed and moved by the great Author of things, and how they act upon one another, as well as upon the undoubted mundane bodies; as it is to conceive, how, in the world itſelf, which is manifeſtly an admirably contrived automaton, the phænomena may, by the ſame Author (who was able to endow bodies themſelves with active power, as well as he could, on other ſcores, make them cauſes) be produced by virtue, and in conſequence, of the primitive conſtruction and motions, that he gave it (and ſtill maintains in it) without the intervention of ſuch a thing, as they call nature: for this, as well as the world, being a corporeal creature, we cannot conceive, that either of them act otherwiſe, than mechanically. And it ſeems very ſuitable to the Divine Wiſdom, that is ſo excellently diſplayed in the fabrick and conduct of the univerſe, to employ in the world, already framed and compleated, the feweſt and moſt ſimple means, by which the phænomena, deſigned to be exhibited in the world, could be produced. Nor need we be much moved by hearing ſome naturiſts ſay, that nature, though not an incorporeal being, is of an order ſuperior to mere matter; as divers of the ſchoolmen teach the things, they call material forms to be: for who can clearly conceive an order or kind of beings, that ſhall be real ſubſtances, and yet neither corporeal nor immaterial? Nor do I ſee, how the ſuppoſition of this unintelligible, or at leaſt unintelligent being, though we ſhould grant it to have a kind of life or ſoul, will much aſſiſt us to explicate the phænomena; as, if a man be acquainted with the conſtruction of mills, he may as well conceive, how corn is ground by a mill driven by the wind or by a ſtream of water, which are brute and ſenſeleſs beings, as he can by knowing, that it is kept at work by a horſe, who, though an animated being, acts in our caſe but as a part of an engine, that is determined to go round, and who does neither intend to grind the corn, nor know that he grinds it.

AND in this place (though perhaps not the very fitteſt) I may queſtion, with what congruity to their maſter's doctrine, the ſchool-philoſophers teach, that nature is the principle of motion in all the bodies they call natural. For, not to urge, that thoſe great maſſes of ſublunary matter, to which they give the name of elements, and the mixed bodies, that conſiſt of them, are, by divers learned men, ſaid to be moved to or from the center of the earth, by diſtinct internal principles, which they call gravity in the earth and water, and levity in the fire and air; and that there is aſcribed alſo to every compounded body, that quality of the two, which belongs to the element, that predominates in it: not to urge this, I ſay, conſider, that the cœleſtial part of the world does ſo far exceed the ſub-cœleſtial in vaſtneſs, that there is ſcarce any compariſon between them; and yet the generality of the Peripatetics, after

Ariſtotle, tells us, that the cœleſtial globes of light, and the vaſt orbs they ſuppoſe them to be fixed in, are moved from weſt to eaſt by the intelligences, that is, rational and ſeparate beings, without whoſe conduct, they preſume, that the motions of the heavens could not be ſo regular and durable, as we ſee they are: ſo that, in that part of the univerſe, which is incomparably vaſter than the ſublunary is, intelligences being the cauſes of motion, there is no recourſe to be had to nature, as the true and internal principle of it.

AND here it may not, perhaps, be improper to declare ſomewhat more fully a point already touched upon; namely, that, if to know what is the general efficient cauſe of motion, can much contribute to the explication of particular phænomena, the hypotheſis of thoſe naturiſts, I now reaſon with, will have no conſiderable advantage, if any at all, of ours; which derives them from the primitive impulſe given by God to matter, and from the mechanical affections of the greater and leſſer portions of it. For it is all one to him, that would declare by what particular motion, as ſwift, ſlow, uniform, accelerated, direct, circular, parabolical, *&c.* this or that phænomenon is produced, to know, whether the motions of the parts of matter were originally impreſſed on them by nature, or immediately by God; unleſs it be, that He, being of infinitely perfect knowledge, may be, more probably than a creature, ſuppoſed to have at firſt produced in matter motions beſt accommodated to the phænomena, that were to be exhibited to the world. Nor do I ſee ſufficient cauſe to grant, that nature herſelf (whatever ſhe be) produces any motion *de novo*, but only, that ſhe transfers and regulates that, which was communicated to matter at the beginning of things; (as we formerly noted, that in the human body, the rational ſoul or mind has no power to make new motions, but only to direct thoſe of the ſpirits and of the groſſer organs and inſtruments of voluntary motion). For, beſides that many of the modern naturaliſts approve of the Carteſian opinion, that the ſame quantity of motion is always preſerved in the whole maſs of the mundane matter, that was communicated to it at firſt, though it be perpetually transferring it from one part to another; beſides this, I ſay, I conſider, that, if nature produces in theſe and thoſe bodies motion, that were never before in beings; (unleſs much motion be annihilated, which is a thing as yet unproved) the quantity of motion in the univerſe muſt have for ſome thouſands of years perpetually increaſed, and muſt continue to do ſo; which is a conceſſion, that would much diſorder the whole theory of local motion, and much perplex philoſophers, inſtead of aſſiſting them, in explicating the phænomena of bodies.

AND as for the effects of local motion in the parts of the univerſal matter, which effects make a great part of the phænomena of the world; after what I have formerly declared, you will not wonder to hear me confeſs, that, to me, the ſuppoſition of nature, whether men will have her an immaterial or corporeal ſubſtance, and either without knowledge or elſe endowed with underſtanding, doth not ſeem abſolutely neceſſary, nor perhaps very uſeful, to make us comprehend how they are produced. The bodies of animals are divers of them little leſs curiouſly framed than men's, and moſt of them more exquiſitely, than, for aught we know, the great inanimate maſs of the corporeal world is; and yet, in the judgment of no mean naturaliſts, ſome of the mechanical philoſophers, that deny cogitation, and even ſenſe properly ſo called, to beaſts, do, at leaſt as intelligibly and plauſibly, as thoſe, that aſcribe to them ſouls endowed with ſuch faculties, as make them ſcarce more than gradually different from human ones, explicate the phænomena, that are obſerved in them. And I know not, whether I may on this occaſion add, that the Peripatetics themſelves, eſpecially the moderns, teach ſome things, whence one may argue, that the neceſſity of recurring to nature does not reach to ſo many things by far, as is by them ſuppoſed. For

the efformation (or framing) of the bodies of plants and animals, which are, by great odds, the fineſt pieces of workmanſhip to be met with among bodies, is aſcribed not immediately to nature, but to the ſoul itſelf, which they will have to be the author of the organization of the body, and therefore call it the architect of its own manſion; which, they ſay, that it frames by an innate power and ſkill, that ſome call plaſtic, and to which others give other names. And unto the ſame ſoul, operating by her ſeveral functions, they attribute the concoction of aliments, the expulſion of excrements, the production of milk, ſemen, *&c.* the appetitive, loco-motive, and I know not how many other faculties, aſcribed to living bodies. And, even in many inanimate ones, the nobleſt properties and operations are, by the ſame ſchool-philoſophers, attributed to what they call their ſubſtantial forms; ſince from theſe they derive the wonderful properties of the load-ſtone, the attractive faculty of amber and other electrics, and the medical virtues of gems and other mineral bodies, whether conſiſtent or fluid.

But not to inſiſt on this argument, becauſe it is but *ad hominem* (as they ſpeak), if we conſider the thing itſelf, by a free examen of the pretended explanations, that the vulgar philoſophers are wont, by recurring to nature, to give of the phænomena of the univerſe; we ſhall not eaſily look on thoſe accounts, as meriting the name of explications. For to explicate a phænomenon, it is not enough to aſcribe it to one general efficient, but we muſt intelligibly ſhew the particular manner, how that general cauſe produces the propoſed effect. He muſt be a very dull inquirer, who, demanding an account of the phænomena of a watch, ſhall reſt ſatisfied with being told, that it is an engine made by a watch-maker; though nothing be thereby declared of the ſtructure and co-aptation of the ſpring, wheels, balance, and other parts of the engine, and the manner, how they act on one another, ſo as to co-operate to make the needle point out the true hour of the day. And (to improve to my preſent purpoſe an example formerly touched upon) as he, that knows the ſtructure and other mechanical affections of a watch, will be able by them to explicate the phænomena of it, without ſuppoſing, that it has a ſoul or life to be the internal principle of its motions or operations; ſo he, that does not underſtand the mechaniſm of a watch, will never be enabled to give a rational account of the operations of it, by ſuppoſing, as thoſe of *China* did, when the Jeſuits firſt brought watches thither, that a watch is an European animal, or living body, and endowed with a ſoul. This compariſon ſeems not ill to befit the occaſion of propounding it; but to ſecond it by another, that is more purely phyſical, when a perſon, unacquainted with the mathematics, admires to ſee, that the ſun riſes and ſets in winter in ſome parts of the horizon, and in ſummer in others, diſtant enough from them; that the day, in the former ſeaſon, is, by odds ſhorter, than in the latter, and ſometimes (as ſome days before the middle of *March* and of *September*) the days are equal to the night; that the moon is ſometimes ſeen in conjunction with the ſun, and ſometimes in oppoſition to him; and, between thoſe two ſtates, is every day variouſly illuminated; and that ſometimes one of thoſe planets, and ſometimes another, ſuffers an eclipſe; this perſon, I ſay, will be much aſſiſted to underſtand, how theſe things are brought to paſs, if he be taught the clear mathematical elements of aſtronomy: but if he be of a temper to reject theſe explications, as too defective, it is not like that it will ſatisfy him, to tell him after *Ariſtotle* and the ſchoolmen, that the orbs of the ſun and moon, and other cœleſtial ſpheres, are moved by angels or intelligences; ſince to refer him to ſuch general and undetermined cauſes, will little, or not at all, aſſiſt him to underſtand, how the recited phænomena are produced.

IF it be here objected, that theſe examples are drawn from factitious, not from merely phyſical bodies, I ſhall return this brief anſwer, and deſire, that it be applied not only to the two freſhly mentioned examples, but to all of the like kind, that may be met with in this whole treatiſe, (near the beginning of which, had I remembered it, ſomething to the ſame purpoſe ſhould have had place): I ſay then in ſhort, that divers of the inſtances we are ſpeaking of are intended but for illuſtrations; and that others may be uſeful inſtances, if they ſhould be no more than analogous ones: ſince examples, drawn from artificial bodies and things, may have both the advantage of being more clearly conceived by ordinary underſtandings, and that of being leſs obnoxious to be queſtioned in that particular, in which the compariſon or correſpondence conſiſts. And I the leſs ſcruple to employ ſuch examples, becauſe *Ariſtotle* himſelf, and ſome of his more learned followers, make uſe of divers compariſons, drawn from the figures and other accidents of artificial things, to give an account of phyſical ſubjects, and even of the generation, corruption, and forms of natural bodies.

THIS advertiſement premiſed, I purſue the diſcourſe it interrupted, by adding, that thus we ſee that confirmed, which was formerly obſerved; namely, that though mechanical principles could not be ſatisfactorily employed for explaining the phænomena of our world, we muſt not therefore neceſſarily recur to, and acquieſce in that principle, that men call nature, ſince neither will that intelligibly explain them; but in that caſe, we ſhould ingenuouſly confeſs, that we are yet at a loſs, how they are performed; and that this ignorance proceeds, rather from the natural imperfection of our underſtandings, than from our not preferring nature (in the vulgar notion of it) to the mechanical principles, in the explication of the phænomena of the univerſe. For whereas *Monſieur Des Cartes*, and other acute men, confidently teach, that there are ſcarce any of theſe phænomena, that have been truly and intelligibly deduced from the principles peculiar to the Ariſtotelians and ſchool-philoſophers; it will ſcarce be denied by any, that is acquainted with phyſico-mathematical diſciplines, ſuch as optics, aſtronomy, hydroſtatics, and mechanics, more ſtrictly ſo called, but that very many effects (whereof ſome have been handled in this preſent tract) are clearly explicable by mechanical principles; which, for that reaſon, *Ariſtotle* himſelf often employs in his *Quæſtiones Mechanicæ*, and elſewhere: ſo that, if becauſe the corpuſcularian principles cannot be ſatisfactorily made uſe of to account for all that happens among things corporeal, we muſt refuſe to acquieſce in them; it is but juſt, that ſince a recourſe to what is called nature is yet more dark and inſufficient, at leaſt, we muſt reject as well the latter as the former hypotheſis, and endeavour to find ſome other preferable to both.

AND now, if it be demanded, what benefit may redound to a reader from the explications given in the foregoing ſeventh ſection? and in general, from the troubleſome, as well as free inquiry, whereof they make a conſiderable part? I ſhall anſwer, that I am not quite out of hope, that the things hitherto diſcourſed may do ſome ſervices both to natural philoſophy and to religion.

AND as to the firſt of theſe; this tract may be of uſe to the cultivators of that ſcience, by diſſuading them from employing often, and without great need, in their philoſophical diſcourſes and writings, a term, (I mean nature) which, by reaſon of its great ambiguity, and the little or no care, which thoſe, that uſe it, are wont to take, to diſtinguiſh its different acceptions, occaſions both a great deal of darkneſs and confuſedneſs in what men ſay and write about things corporeal; and a multitude of controverſies, wherein really men do but wrangle about words, whilſt they think they diſpute of things; and perhaps would not differ at all, if they had the ſkill or

luck to expreſs themſelves clearly. Beſides which ſervice, the paſt diſcourſe may do this other, to wean many from the fond conceit they cheriſh, that they underſtand or explicate a corporeal ſubject or a phænomenon, when they aſcribe it to nature; for to do that, one needs not be a philoſopher, ſince a country ſwain may eaſily do the ſame thing.

On this occaſion, I muſt not forbear to take notice, that the unſkilful uſe of terms of far leſs extent and importance, and alſo leſs ambiguous, than the word nature is, has been, and ſtill is, no ſmall impediment to the progreſs of ſound philoſophy. For not only the greateſt part both of phyſicians (though otherwiſe learned men) and of chymiſts; but the generality of phyſiologers too, have thought, that they have done their part, though not on all occaſions, yet on very many, when they have referred an effect or a phænomenon to ſome ſuch things as thoſe, that are preſumed to be real qualities; or are by ſome ſtiled natural powers, or are by others, by a more comprehenſive and more uſual name, (which therefore they here chiefly employ) called faculties; for each of which they are wont to form a name, fit for their purpoſe; though they do not intelligibly declare, what this faculty is, and in what manner the operations they aſcribe to it, are performed by it. Thus the attractive faculty aſcribed to a man, that is enabled by nature's (preſumed) abhorrence of a vacuum, to ſuck up drink through a ſtraw or pipe, has been for many ages acquieſced in, as the true cauſe of the aſcenſion of that liquor in ſuction; of which nevertheleſs the modern philoſophers, that have ſlighted explications derived merely from faculties, have aſſigned (as has been already declared) intelligible, and even mechanical cauſes. The power, that a load-ſtone has with one pole to attract (as they ſpeak) the northern point of the mariner's needle, and with the other to drive it away, is looked upon as one of the nobleſt and moſt proper faculties of that admirable ſtone. And yet I elſewhere ſhew, how in a very ſmall, indeed, but true and natural magnet, I have, by a bare, and ſometimes inviſible change of texture, given that extreme of the magnet, that before drew the ſouthern point of the needle, the power to draw the northern, and to the oppoſite extreme, the power to drive it away; ſo much does even this wonderful attractive faculty, as it is called, depend upon the mechanical ſtructure of the mineral, and its relation to other bodies, among which it is placed, eſpecially the globe of the earth, and its magnetical effluvia.

But becauſe in another paper I purpoſely diſcourſe of what naturiſts call faculties, I ſhall here content myſelf to note in general, that the term faculty may, indeed, be allowed of, if it be applied as a compendious form of ſpeech, but not as denoting a real and diſtinct agent; ſince in reality the power or faculty of a thing is (at leaſt) oftentimes but the matter of it, made operative by ſome of its mechanical modifications; [I ſay ſome, becauſe the complex of all makes up its particular nature]. And with how little ſcruple ſoever men commonly ſpeak of faculties, as ſuppoſing them to be diſtinct and active principles; yet this condition does not neceſſarily belong to them: for ſometimes, if not frequently, the effect of what is reputed a natural power or faculty, is produced by the texture, figure, and, in a word, mechanical diſpoſition of the agent, whereby it determines the action of a remoter agent to the produced effect. Thus in a clock, to make the balance vibrate, to point at the hour, to make, at ſet times, the hammer ſtrike upon the bell, are but different effects of the weight or ſpring, that ſets and keeps the engine in motion. And ſo a key may either acquire or loſe its power of opening a door, (which, perhaps, ſome ſchoolmen would call its aperitive faculty) by a change, not made in itſelf, but in the locks it is applied to, or in the motion of the hand, that manages it. And leſt it ſhould be objected, that theſe inſtances are taken wholly from artificial bodies, I ſhall add,

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that when a clear piece of native chryſtal has obtained, as it often does, a good priſmatical ſhape, and is, in a due poſition, expoſed to the ſun-beam, its figuration, by enabling it to refract and reflect thoſe beams after a certain manner, gives it a colorific faculty, whereby it is enabled to exhibit that wonderful and pleaſing variety of colours, that emulate, if not ſurpaſs, thoſe of the rain-bow. And ſo in a concave metalline looking-glaſs, though there ſeem to be many diſtinct faculties, ſuch as that of reflecting, inverting, magnifying divers objects, and melting, burning, *&c.* ſeveral bodies; yet all theſe powers are but the genuine conſequences of the figure, capacity and ſmoothneſs, which are mechanical affections of the matter of the ſpeculum. And indeed, if I judge aright, (though what I am going to ſay will ſeem a paradox) *yet many qualities of very many bodies are but laſting diſpoſitions to be thus or thus wrought upon by the action of external agents*, and alſo (perchance) to modify that action; as we ſee, that the power of making an eccho, that is obſerved in divers hollow places, is nothing but the mechanical diſpoſition their figure and reſiſtance gives them to reflect a ſound. And, to reſume the lately mentioned inſtance of a key, we may add, that, by bare poſition, either end of it, eſpecially if the key be long, may be made to acquire or loſe a tranſient magnetic faculty from the effluvia of that great magnet, the earth; and that alſo the ſame key may, in a few moments, acquire a durable magnetiſm, by a mechanical change received from the loadſtone, as is known to thoſe, that are any thing verſed in the philoſophy of that wonderful mineral.

AND to me it ſeems likely, that one main reaſon, why learned men have aſcribed ſuch inherent and active powers, as they call faculties, to ſo many bodies, is, becauſe that not being converſant enough with natural and artificial things, they did not duly perpend, how great a difference there may be between a body conſidered abſolutely, or by itſelf, and the ſame body conſidered in ſuch circumſtances, as it may be found in. For in ſome caſes a phyſical body may have ſtrange things juſtly aſcribed to it, though not as it is ſuch a body conſidered ſimply, or unaſſociated with other bodies; but as it is placed among congruous ones, and makes the principal or moſt operative part of a compounded body, or of the complex of bodies it is joined with, and which are of ſuch determinate ſtructures, as are convenient for the phænomena to be exhibited. This may be analogically ſeen in what happens to a ſpring; for if, being bent, it is held in one's hand, or crouded into a box, it is but a ſimple thing, that does only, by its expanſive endeavour, ſtrive to remove the bodies, that keep it compreſſed: but in a curious watch, it may, by virtue of the ſtructure of that engine, become the principle of I know not how many differing, and perhaps contrary, motions among the parts of it, and of many notable phænomena and effects exhibited or produced thereby. This reflection may perhaps be improved, if I here add, that, in many bodies, a fluid ſubſtance, determined to convenient motions, may be equivalent to an internal ſpring, eſpecially if it be aſſiſted by friendly external agents. This may be illuſtrated by conſidering, that if one, that plays ſkilfully on a flute, blow out of his mouth into the open air, he will but turn it into a vapid aerial ſtream; but if this wind duly paſs into the inſtrument, and be modified there by the muſician's fingers and ſkill, the ſimple ſtream of air may be formed into very various and melodious tunes. Thus gunpowder artificially tempered, though, if it be fired in the open air, it will give only a rude and ſudden flaſh, that preſently vaniſhes; yet, if it be ſkilfully diſpoſed of in rockets, and other well-contrived inſtruments, and then kindled, it will exhibit a great and pleaſing variety of ſhining bodies and phænomena, that are juſtly admired in the beſt ſort of artificial fire-works. A phyſical inſtance alſo, in favour of our analogical or vicarious ſprings (if I may ſo call them)

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is afforded me by the bulbs of onions, and the roots of aloes, commonly called ſempervive, and ſome other vegetables, which in the ſpring being expoſed to the air, the juices and ſpirits contained in them, will be ſo agitated by the warmth of that ſeaſon, and ſo modified by the particular ſtructure of the more firm parts, that, though neither earth nor rain co-operate, they will ſhoot forth green ſtalks or leaves for many weeks together, as if they were planted in a good ſoil; (though the matter of theſe green productions be furniſhed by the radical parts themſelves, as may be argued both from the manifeſt diminution of the bulb in bigneſs, and the great and gradual decrement in weight, that I obſerved in making experiments of this kind. And ſo alſo the air, which is an external fluid, concurring with the juices and ſpirits of divers inſects and other cold animals, may both be put into motion, and have that motion ſo determined by their organization, as to recover in the ſpring or ſummer, as it were, a new life, after they have lain moveleſs, and like dead things, all the winter; as we ſee in flies, that, in a hot air, quickly recover motion and ſenſe, after having loſt both, for perhaps many months. And the like change may be far more ſuddenly obſerved in them, in the warmer ſeaſons of the air, when the air is drawn from them by the pneumatic pump, and afterwards permitted to enliven them again. And to give another inſtance, that may poſſibly pleaſe better, (becauſe, as it is purely phyſical, ſo it is ſimple and very conſpicuous), though that, which the ſun-beams are wont primarily to produce be but light, and perhaps heat; yet, falling in a due manner upon a rorid cloud, they form there the figure of a vaſt bow, and, being variouſly reflected and refracted, adorn it with the ſeveral colours men admire in the rainbow.

But I muſt not farther proſecute an obſervation, that I mentioned but occaſionally, as an inſtance, whereby to ſhew, that the advancement of ſolid philoſophy may be much hindered by men's cuſtom of aſſigning, as true cauſes of phyſical effects, imaginary things or perhaps arbitrary names; among which none ſeems to have had a more malevolent influence upon phyſiology, than the term nature, none having been ſo frequently and confidently uſed, or employed to ſo many differing purpoſes. And therefore, though I would not totally forbid the uſe of the word nature, nor of expreſſions a-kin to it, in popular diſcourſes, or even in ſome philoſophical ones, where accurateneſs is not required, or ambiguity is prevented by the context; nor (to diſpatch) where it may be employed as a compendious form of ſpeech, without danger to truth, or prejudice to ſound philoſophy (in which caſes I myſelf forbear not the uſe of it); yet, I hope, our free inquiry may (ſomewhat at leaſt) conduce to the more ſkilful indagation and happy diſcovery of phyſical truths, if it can perſuade men to make uſe leſs frequently, and with more circumſpection, of ſo ambiguous, and ſo often abuſed, a term as nature; and ceaſe to preſume, that a man has well performed the part of a true phyſiologer, till he have circumſtantially or particularly deduced the phænomenon he conſiders, by intelligible ways, from intelligible principles: which he will be conſtantly put in mind of doing, or diſcover, that he hath not done it, if, by forbearing general and ambiguous terms and words, he endeavours to explain things by expreſſions, that are clear to all attentive readers furniſhed with an ordinary meaſure of underſtanding and reaſon. And this perſpicuous way of philoſophizing ſhould be not a little recommended to ingenious men, by the valuable diſcoveries, which thoſe, that have employed it, in their reſearches and explications of difficult things, have in this inquiſitive age happily made, not only about the various phænomena commonly referred to the fuga vacui, but in the hydroſtatics, optics, anatomy, botanics, and divers other parts of real learning, that I cannot now ſtay to enumerate. And thus much it may poſſibly be ſufficient to have ſaid about the ſervice our doctrine may do natural philoſophy.

As for religion, if what I have formerly ſaid in favour of it be duly conſidered and applied, the paſt diſcourſe will not appear unfriendly, nor perhaps uſeleſs, to it. And therefore, if I do here abridge what I have there ſaid, and add to it ſome conſiderations, that were fit to be reſerved for this place; I hope the doctrine we have propoſed may appear fit to do it a threefold ſervice.

1. AND in the firſt place, our doctrine may keep many, that were wont, or are inclined, to have an exceſſive veneration for what they call nature, from running, or being ſeduced, into thoſe extravagant and ſacrilegious errors, that have been upon plauſible pretences embraced not only by many of the old heathen philoſophers, but by divers modern profeſſors of Chriſtianity, who have of late revived, under new names and dreſſes, the impious errors of the Gentiles. *This* I venture to ſay, becauſe many of the heathen writers, as hath been ſhewn in the fourth ſection, acknowledged indeed a God (as theſe alſo own they do), but meant ſuch a God, as they often too little diſcriminated from matter, and even from the (*a*) world, and as is very differing from the true one adored by Chriſtians and Jews: for ours is a God, firſt, infinitely perfect; and then ſecondly, by conſequence, both incorporeal and too excellent to be ſo united to matter, as to animate it like the heathen's mundane ſoul; or to become to any body a ſoul properly ſo called; and thirdly, uncapable of being divided, and having either human ſouls or other beings, as it were, torn or carved out, or otherwiſe ſeparated from him, ſo as to be truly parts or portions of his own ſubſtance.

(*b*) Whereas, the idolaters and infidels I ſpeak of conceived, under the name of God, a being, about which they dogmatically entertained conceptions, which, though different from one another, are much more ſo from the truth.

FOR firſt, moſt of them thought their God to be purely corporeal, as, beſides what *Diogenes Laertius* and others relate, I remember *Origen* doth in ſeveral places affirm. If you will believe (*c*) *Euſebius*, the ancient Ægyptian theologers not only affirmed the ſun, moon, and ſtars, to be gods, but denied incorporeal ſubſtances, or inviſible natures, to have framed the world, but only the ſun, that is diſcoverable to our eyes. And this corporeity of God ſeems manifeſtly to be the opinion of Mr. *Hobbes* and his genuine diſciples, to divers of whoſe principles and dogmata it is as congruous, as it is repugnant to religion. But ſecondly, there are others, that allowed a ſoul of the world, which was a rational and provident being, together with the corporeal part of the univerſe, eſpecially heaven, (which, I remember, *Ariſtotle* himſelf ſtiles a (*d*) divine body, (or, as ſome render his expreſſions, the body of God): but withal, they held, that this being did properly inform this great maſs of the univerſe, and ſo

(*c*) Præp. L. iii. c. 4.

(*d*) De Cœlo l. ii. c. 3.

(*a*) Thus the Stoicks, in *Laertius*, deſcribe the world thus, *Mundus eſt, qui conſtat ex cælo & terra, atque ex illorum naturis; ſive qui conſtat ex diis & hominibus, iiſque rebus, quæ horum gratia conditæ ſunt.* And of *Chryſippus*, one of the patriarchs of that ſect, the ſame † hiſtorian in the ſame book ſays, *Puriſſimum dixit ac liquidiſſimum æthera, quem etiam primum aſſerunt Stoici eſſe deum, ſenſibiliter veluti infuſum eſſe per ea, quæ ſunt in aere, per cunctas animantes & arbores per terram autem ipſam ſecundum halitum.* To which agrees not only that noted paſſage of *Virgil*, *Principio Cælum*, &c. ——— but another, which I ſomewhat wonder learned men ſhould read with no more reflexion; ſince he there gives the ſky the very title of the high God: *Tum pater omnipotens fœcundis imbribus æther*, &c.

† *Diog. Laert.* l. vii. in *vita Zenon.*

(*b*) The error here rejected, was the opinion of many of the heathen philoſophers, and particularly of the Stoical ſect; of whoſe author * *Lacrtius* ſays, *De divina ſubſtantia Zeno ait mundum totum atque cælum.* And ſeveral ethnic philoſophers, even after the light of the goſpel began to ſhine in the world, adopted the argument of the elder Stoics, who inferred the world to be animated and rational from the nature of the human ſoul, which they thought a portion of the intelligent part of the world, that ſome of them confounded with the Deity. For the Stoics (in *Laertius*) affirm, *Mundum eſſe animale & rationale & animatum (ἔμψυχον) & intelligibile.* And it is added, *Mundum animatum eſſe, inde manifeſtum eſt, quod anima noſtra inde veluti avulſa ſit.* Thus *Seneca*, *Quid eſt autem cur non exiſtimes, in eo divini aliquid exiſtere, quæ Dei pars eſt?* So *Plutarch*, ſpeaking of the ſoul, *Non opus ſolum Dei, ſed & pars eſt; neque ab ipſo, ſed ex ipſo nata eſt.* And *Epictetus*, *Animæ ita alligatæ & conjunctæ Deo ſunt, ut particulæ ejus ſint.*

* In Vita *Zenonis.* De Vitis *Phil.* l. vii. *Epiſt.* 92. *Plutarch.* in Queſt. *Plat.* Diſſert. 1. c. 14.

was,

was, indeed, a mundane ſoul. And though ſome of our late infidels (formerly pointed at in this treatiſe) pretend to be great diſcoverers of new light in this affair; yet, as far as I am informed of their doctrine, it has much affinity with, and is little or not at all better than, that which I formerly noted out of *Lactantius* to have been aſſerted by the Stoics, and the doctrine, which is expreſſed by *Maximus* (a Pagan) to St. *Auſtin*. *Equidem unicum eſſe Deum ſummum atque magnificum, quis tam demens, tam mente captus, ut neget eſſe certiſſimum? Hujus nos virtutes per mundanum opus diffuſas multis vocabulis invocamus, quoniam nomen ejus cuncti proprium ignoremus.* Or by that famous and learned *Roman*, *Varro*, who is cited by St. *Auſtin*, to have ſaid, *Deum ſe arbitrari animam mundi, & hunc ipſum mundum eſſe Deum: ſed ſicut hominem ſapientem, cum ſit ex animo & corpore, tamen ab animo dicimus ſapientem; ita mundum Deum dici ab animo, cum ſit ex animo & corpore.* De Civit. Dei, l. vii. c. 6.

THE doctrine, by us propoſed, may, it is hoped, much conduce to juſtify ſome remarkable proceedings of Divine Providence againſt thoſe cavillers, that boldly cenſure it, upon the account of ſome things, that they judge to be phyſical irregularities, (for moral ones concern not this diſcourſe) ſuch as monſters, earthquakes, floods, eruptions of volcanos, famines, *&c.* For, according to our doctrine,

I. GOD is a moſt free agent, and created the world, not out of neceſſity, but voluntarily, having framed it, as He pleaſed and thought fit, at the beginning of things, when there was no ſubſtance but Himſelf, and conſequently no creature, to which He could be obliged, or by which He could be limited.

II. GOD having an underſtanding infinitely ſuperior to that of man, in extent, clearneſs, and other excellencies, He may rationally be ſuppoſed to have framed ſo great and admirable an automaton as the world, and the ſubordinate engines comprized in it, for ſeveral ends and purpoſes, ſome of them relating chiefly to his corporeal, and other to his rational creatures; of which ends He hath vouchſafed to make ſome diſcoverable by our dim reaſon, but others are probably not to be penetrated by it, but lie concealed in the deep abyſs of his unfathomable wiſdom.

III. IT ſeems not incongruous to conceive, that this moſt excellent and glorious Being thought fit to order things ſo, that both his works and actions might bear ſome ſignatures, and, as it were, badges of his attributes, and eſpecially to ſtamp upon his corporeal works ſome tokens or impreſſes, diſcernible by human intellects, of his divine wiſdom; an attribute, that may advantageouſly diſcloſe itſelf to us men, by producing a vaſt multitude of things, from as few, and as ſimple, principles, and in as uniform a way, as, with congruity to his other attributes, is poſſible.

IV. ACCORDING to this ſuppoſition, it ſeems, that it became the divine Author of the univerſe to give it ſuch a ſtructure, and ſuch powers, and to eſtabliſh among its parts ſuch general and conſtant laws, as beſt ſuited with his purpoſes in creating the world; and to give theſe catholic laws, and particular parts or bodies, ſuch ſubordinations to one another, and ſuch references to the original fabric of the grand ſyſtem of the world, that, on all particular occaſions, the welfare of inferior or private portions of it, ſhould be only ſo far provided for, as their welfare is conſiſtent with the general laws ſettled by God in the univerſe, and with ſuch of thoſe ends, that He propoſed to Himſelf in framing it, as are more conſiderable, than the welfare of thoſe particular creatures.

UPON theſe grounds, if we ſet aſide the conſideration of miracles, as things ſupernatural, and of thoſe inſtances, wherein the providence of the great Rector of the univerſe, and human affairs, is pleaſed peculiarly to interpoſe; it may be rationally ſaid, that God, having an infinite underſtanding, to which all things are at once in a manner preſent, did, by virtue of it, clearly diſcern, what would happen, in conſe-

quence of the laws by Him eſtabliſhed, in all the poſſible combinations of them, and in all the junctures of circumſtances, wherein the creatures concerned in them may be found. And, that having, when all theſe things were in his proſpect, ſettled among his corporeal works general and ſtanding laws of motion ſuited to his moſt wiſe ends, it ſeems very congruous to his wiſdom, to prefer (unleſs in the newly excepted caſes) catholic laws, and higher ends, before ſubordinate ones, and uniformity in his conduct before making changes in it according to every ſort of particular emergencies: and conſequently, not to recede from the general laws He at firſt moſt wiſely eſtabliſhed, to comply with the appetites or the needs of particular creatures, or to prevent ſome ſeeming irregularities (ſuch as earthquakes, floods, famines, *&c.*) incommodious to them, which are no other, than ſuch, as He foreſaw would happen (as the eclipſes of the ſun and moon from time to time, the falling of ſhowers upon the ſea and ſandy deſarts, and the like muſt do, by virtue of the original diſpoſition of things) and thought fit to ordain, or to permit, as not unſuitable to ſome or other of thoſe wiſe ends, which He may have in his all-pervading view, who, either as the Maker and Upholder of the univerſe, or as the Sovereign Rector of his rational creatures, may have ends, whether phyſical, moral, or political, (if I may be allowed ſo to diſtinguiſh and name them); divers of which, for aught we can tell, or ſhould preſume, are known only to Himſelf: whence we may argue, that ſeveral phænomena, which ſeem to us anomalous, may be very congruous or conducive to thoſe ſecret ends, and therefore are unfit to be cenſured by us dim-ſighted mortals.

AND, indeed, the admirable wiſdom and ſkill, that, in ſome conſpicuous inſtances, the divine Opificer has diſplayed in the fitting of things for ſuch ends and uſes, for which (among other purpoſes) He may rationally be ſuppoſed to have deſigned them, may juſtly perſuade us, that his ſkill would not appear inferior in reference to the reſt alſo of his corporeal works, if we could as well in theſe, as in thoſe, diſcern their particular final cauſes. As if we ſuppoſe an excellent letter about ſeveral ſubjects, and to different purpoſes, whereof ſome parts were written in plain characters, others in cyphers, beſides a third ſort of clauſes, wherein both kinds of writing were variouſly mixed, to be heedfully peruſed by a very intelligent perſon; if he finds, that thoſe paſſages, that he can underſtand, are excellently ſuited to the ſcopes, that appear to be intended in them, it is rational as well as equitable in him to conclude, that the paſſages or clauſes of the third ſort, if any of them ſeem to be inſignificant, or even to make an incongruous ſenſe, do it but becauſe of the illegible words; and that both theſe paſſages, and thoſe written altogether in cyphers, would be found no leſs worthy of the excellent * writer, than the plaineſt parts of the epiſtle, if the particular purpoſes, they were deſigned for, were as clearly diſcernable by the reader. And perhaps you will allow me to add, that by this way of ordering things ſo, that, in ſome of God's works, the ends or uſes may be manifeſt, and the exquiſite fitneſs of the means may be conſpicuous; [as the eye is manifeſtly made for ſeeing, and the parts it conſiſts of admirably fitted to make it an excellent organ of viſion] and in other, the ends deſigned ſeem to be beyond our reach; by this way (I ſay) of managing things, the moſt wiſe Author of them does both gratify our underſtandings, and make us ſenſible of the imperfection of them.

* See the Diſcourſe of Final Cauſes.

IF the repreſentation now made of providence ſerve (as I hope it may) to reſolve ſome ſcruples about it, I know you will not think it uſeleſs to religion. And though I ſhould miſs of my aim in it, yet ſince I do not dogmatize in what I propoſe about it, but freely ſubmit my thoughts to better judgments; I hope my well-meant endeavours will be, as well as the unſucceſsful ones of abler pens have been, excuſed by the ſcarce ſuperable difficulty of the ſubject. However, what I have propoſed about Providence, being

being written, rather to do a ſervice to theology, than as neceſſary to juſtify a diſſatisfaction with the received notion of nature, that was grounded mainly upon philoſophical objections; I hope our free inquiry may, though this ſecond uſe of it ſhould be quite laid aſide, be thought not unſerviceable to religion; ſince the firſt uſe of it (above delivered) does not depend on my notions about providence, no more than the third, which my prolixity about the former makes it fit I ſhould in few words diſpatch.

III. The laſt then, but not the leaſt, ſervice, I hope, our doctrine may do religion, is, that it may induce men to pay their admiration, their praiſes, and their thanks, directly to God himſelf, who is the true and only Creator of the ſun, moon, earth, and thoſe other creatures, that men are wont to call the works of nature. And in this way of expreſſing their veneration of the true God, (who in the holy ſcripture ſtiles himſelf a *jealous God*, Exod. xx. 5.) and their gratitude to Him, they are warranted by the examples of the ancient people of God, the *Iſraelites*, and not only by the inſpired perſons of the *Old Teſtament*, but by the promulgators of the *New Teſtament*, and even by the cœleſtial ſpirits; who, in the laſt book of it, are introduced praiſing and thanking God himſelf for his mundane works, without taking any notice of his pretended vicegerent, nature. Rev. iv. 2.

The CONCLUSION.

AND now, dear *Eleutherius*, you have the whole bundle of thoſe papers, that I found and tacked together, (for they are not all, that I have written) touching my free inquiry into the received notion of nature; at the cloſe of which eſſay, I muſt crave leave to repreſent two or three things about it.

1. Since this treatiſe pretends to be but an inquiry, I hope that any diſcourſes or expreſſions, that you have found dogmatically delivered, about queſtions of great moment or difficulty, will be interpreted with congruity to the title and avowed ſcope of this treatiſe; and that ſo favourable a reader, as *Eleutherius*, will conſider, that it was very difficult, in the heat of diſcourſe, never to forget the reſerves, that the title may ſuggeſt, eſpecially ſince, on divers occaſions, I could not have ſpoken with thoſe reſerves, without much enervating my diſcourſe, and being, by reſtrictions and other cautious expreſſions, tedious or troubleſome to you. But this, as I lately intimated, is to be underſtood of things of great moment or difficulty; for otherwiſe, there are divers notions, ſuppoſitions, and explanations, in the vulgarly received doctrine of nature, and her phænomena, which I take to be either ſo precarious, or ſo unintelligible, or ſo incongruous, or ſo inſufficient, that I ſcruple not to own, that I am diſſatisfied with them, and reject them.

2. Though, upon a tranſient view of theſe papers, I find, that ſeveral parcels, that came firſt into my hands, having been laid and faſtened together (to keep them from being loſt, as others had already been) before the others were lighted on, ſome of them will be met with in places, that are not the moſt proper for them; yet haſte and ſickneſs made me rather venture on your good nature for the pardon of a venial fault, than put myſelf to the trouble of altering the order of theſe papers, and ſubſtituting new tranſitions and connections, in the room of thoſe, with which I formerly made up the chaſms and incoherency of the tract you now receive. And if the notions and reaſoning be themſelves ſolid, they will not need the aſſiſtance of an exact method to obtain the aſſent of ſo diſcerning a reader, as they are preſented to; upon the ſcore of whoſe benignity it is hoped, that the former advertiſement may likewiſe paſs for an excuſe, if the ſame things, for ſubſtance, be found more than once in a tract written

written at very diſtant times, and in very differing circumſtances. For, beſides that ſuch ſeeming repetitions will not (if I be not miſtaken) frequently occur, and will, for the moſt part, be found, by being variouſly expreſſed, to elucidate or ſtrengthen the thought or argument they belong to; and beſides that the novelty and difficulty of ſome points may have made it needful, not only to diſplay, but to inculcate them; beſides theſe things, I ſay, it is very poſſible, that the ſame notion may ſerve to explicate or prove ſeveral truths, and therefore may, without impertinency, be made uſe of in more than one part of our treatiſe. And if our inquiry ſhall be thought worthy to be tranſcribed, and preſented to you a ſecond time, after I ſhall have reviewed it, and heard objections againſt it, and conſidered the things, that either you, or I myſelf, may find fault with in it; it is very poſſible, that (if God grant me life and leiſure) this tract, which, in its preſent dreſs, I deſire you would look on but as an apparatus towards a more full and orderly treatiſe, may appear before you in a leſs unaccurate method; and that my ſecond thoughts may prove more correct, more mature, or better backed and fortified, than my firſt.

3. THE ſubject of my inquiry being of great extent, as well as conſequence, it obliged me to conſider, and treat of many things, (as philoſophical, medical, theological, *&c.*) and, among them, of divers, that are not at all of eaſy ſpeculation; and I found it the more difficult to handle them well, becauſe the attempt I have ventured upon being new, and to be proſecuted by diſcourſe, many of them oppoſite to the general ſentiments of mankind, I was not to expect much aſſiſtance from any thing, but truth and reaſon. And therefore, as I cannot preſume not to need your indulgence, ſo I cannot deſpair of obtaining it, if in this my firſt eſſay, upon a variety of difficult points, I have not always hit the mark, and as happily found the truth as ſincerely ſought it. But if you ſhall (which it is very probable you will) find, that I have fallen into ſome errors, it will be but one trouble for you, to make me diſcern them, and forſake them, (eſpecially any, wherein religion may be concerned) which I have, by way of præviſion, made it the more eaſy for myſelf to do; becauſe (if my ſtyle have not wronged my intention) I have written this diſcourſe, rather like a doubting ſeeker of truth, than a man confident that he has found it.

THE

THE MARTYRDOM OF THEODORA AND OF DIDYMUS.

Such an ACCOUNT of the following BOOK, ſent with it to a FRIEND, as may ſerve inſtead of a PREFACE.

TO convince you, Sir, how much more I am concerned to have you think I can obey well, than write well, I venture to ſend you the account, (as imperfect and unpoliſhed as it is) that you are pleaſed to command of the laſt hours of *Theodora*; but I muſt beg your leave to accompany it with another account (though but a ſhort one) how I came to meddle with this ſubject, and why what I preſent you about it, is ſo much maimed, and has no more uniformity.

HAVING had occaſion many years ago to turn over a martyrology, and ſome other books, that related to the ſufferings of the primitive Chriſtians, I chanced to light on thoſe of a virgin, who, though (to my wonder) ſhe was left unnamed by the other writers, that mentioned her, ſeemed plainly to be the ſame, that is by one of them expreſly called *Theodora*. I own, I was not a little affected, at the reading of ſuch moving and uncommon adventures as hers, and finding her ſtory to be related by the author, that named both her and her lover, not only very ſuccinctly and imperfectly, but very dully too; I found myſelf tempted ſo to enlarge this ſtory, as that it might be contrived into a ſomewhat voluminous romance: but, upon ſecond thoughts, it appeared incongruous to turn a martyr into a nymph or an amazon; and I conſidered too, that (to omit what elſe might be objected againſt that ſort of compoſures) as true pearls are cordials and antidotes, which counterfeit ones, how fine ſoever they may appear, are not; ſo true examples do arm and fortify the mind far more efficaciouſly, than imaginary or fictitious ones can do; and the fabulous labours of *Hercules*, and exploits of *Arthur* of *Britain*, will never make men aſpire to heroic virtue half ſo powerfully, as the real examples of courage and gallantry afforded by *Jonathan*, *Ceſar*, or the *Black Prince*. But yet, thinking it great pity, that ſo ſhining a virtue as *Theodora*'s ſhould prove exemplary, but to her own time, and to one city; and remembring, that ſoon after the age, which ſhe ennobled, it was counted among the primitive Chriſtians an act of piety, to build fair monuments, upon the formerly abject graves of the martyrs, to repay, by honours due to their memories, the indignities and diſgraces they had ſuffered in their perſons; I thought fit to try, if I could reſcue

from more unſkilful hands than even mine a ſtory, that abundantly deſerved to be well told.

But, upon further thoughts, I ſoon foreſaw, that this taſk was not more worthy to be undertaken, than it would prove difficult to be well performed: for the martyrologiſt, having allowed ſcarce one whole page to a relation that perhaps merited a volume, had left ſo many chaſms, and ſo many neceſſary things unmentioned, that I plainly perceived I wanted a far greater number of circumſtances, than that he had ſupplied me with, to make up ſo maimed a ſtory tolerably compleat. And as the relation denied me matter enough to work upon, ſo the nature of the ſubject refuſed moſt of thoſe embelliſhments, which in other themes, where young gallants and fair ladies are the chief actors, are wont to ſupply the deficiencies of the matter. Beſides, my taſk was not near ſo eaſy, as it would have been, if I had been only to recite the intrigues of an amour, with the liberty to feign ſurprizing adventures to adorn the hiſtorical part of the account, and to make a lover ſpeak as paſſionately as I could, and his miſtreſs as kindly, as the indulgenteſt laws of decency would permit. But I was to introduce a Chriſtian and pious lover, who was to contain the expreſſions of his flame within the narrow bounds of his religion; and a virgin, who, being as modeſt and diſcreet as handſome, and as devout as either, was to own an high eſteem for an excellent lover, and an uncommon gratitude to a tranſcendent benefactor, without intrenching either upon her virtue, or her reſervedneſs. And I perceived the difficulty of my taſk would be encreaſed, by that of reconciling *Theodora*'s ſcrupulouſneſs to the humours of ſome young perſons of quality of either ſex, who were earneſt to engage my pen on this occaſion, and would expect, that I ſhould make *Theodora* more kind, than I thought her great piety and ſtrict modeſty would permit. But for all this, the eſteem I had for the fair martyr's excellencies, and the compliance I had for thoſe, that deſired to receive an account of ſo rare a perſon's actions and ſufferings, made me reſolve to try what I could do; which I adventured upon with the leſs reluctancy, becauſe, though I eſteemed it a kind of profaneneſs to transform a piece of martyrology into a romance, yet I thought it allowable enough, where a narrative was written ſo conciſely, and left ſo imperfect, as that I had to deſcant upon, to make ſuch ſupplements of circumſtances, as were not improbable in the nature of the thing, and were little leſs than neceſſary to the clearneſs and entireneſs of the ſtory, and the decent connection of the parts it ſhould conſiſt of. I ſuppoſed too, that I need not ſcruple to lend ſpeeches to the perſons I brought upon the ſtage, provided they were ſuitable to the ſpeakers, and occaſions; ſince I was warranted by the examples of *Livy*, *Plutarch*, and other grave and judicious hiſtorians, who make no ſcruple to give us ſet orations of their own framing, and ſometimes put them into the mouths of generals at the head of their armies, juſt going to give battle; though at ſuch times the hurry and diſtraction, that both they and their auditors muſt be in, muſt make it very unlikely, either that they ſhould make elaborate ſpeeches, or their hearers mind and remember them well enough to repeat them to the hiſtorians.

Encouraged by theſe liberties, which I thought I might juſtly allow myſelf, I drew up, as well as I could, what you have been told I wrote about *Theodora*. This I thought fit to divide into two parts, in the firſt whereof (which was leſs remote from being romantic) I gave ſomewhat at large the characters of them both; I mentioned the riſe and progreſs of *Didymus*'s love; the degeneracy of the then Chriſtians, which provoked Divine Providence to expoſe them to a very bloody perſecution: I declared, how *Theodora*, being involved in it, was brought before the preſident of *Antioch*; how ſhe reſolutely owned her religion before him, anſwered his arguments, and reſiſted both his promiſes and his menaces; how thereupon the judge doomed

her either to ſacrifice, or to be proſtituted in the public ſtews; how ſhe, after an eager debate in her own mind, refuſing to offer ſacrifice, was (notwithſtanding her ſilence) led away to the infamous place; how, being ſhut up there alone in a room, ſhe employed the little time, that was granted her, to conſider, whether ſhe would yet burn incenſe to the Roman idols, in fervent prayer to the true God, for a reſcue of her purity, not her life; in order whereunto, ſhe deſigned, and hoped, by reſiſtance and contumelies, to provoke her firſt aſſailant to become her murderer, rather than her raviſher.

THESE were the chief contents of the firſt book. Thoſe of the ſecond were more hiſtorical, and conſiſted of an account of the laſt hours of her life, and particularly of thoſe ſufferings, that ended in her and *Didymus*'s glorious martyrdom. This piece, having been peruſed by thoſe for whoſe ſake I wrote it, was ſo fortunate, that it having, without my leave, been ventured into ſeveral hands, as a book of a nameleſs and unknown author, it was lucky enough to be, by ſome indulgent readers, attributed to one, and by ſome to another, of the two perſons, that were at that time counted the beſt writers of diſguiſed hiſtories. But among the many hands it paſſed through, it ſeems it fell into ſome, out of which a great part of the looſe ſheets (which were not bound in a book, but only tacked together) were not to be retrieved: whether it were by the negligence, or the contempt, that ſome had of ſo unpoliſhed a work; or whether there were ſome fatality in the buſineſs, that *Theodora*'s ſufferings ſhould outlive her, and her ſtory be as ill uſed as her perſon had been. This loſs (if it can deſerve that name) I did not much regret, ſince I intended not to make the loſt papers public, and had received much greater approbation and thanks, than they merited, from the particular perſons they were deſigned for. But after I had for many years worn out, not only the ſenſe, but the memory of this loſs, it was made more troubleſome to me, than ever it was at firſt, by the earneſt ſolicitations of ſome eminent perſons, that had a great power over me, and ſome of them the repute of great judges of this kind of compoſures: for having ſeen ſeveral ſheets, that I accidentally lighted on in tumbling over ſome long neglected papers, they obliged me to cauſe thoſe old rude ſheets to be tranſcribed; and though almoſt all the firſt book was wanting, (upon which account I could not be removed from my reſolution not to trouble myſelf about it) yet there was ſo much of the ſecond book, but in parts no way coherent, little by little retrieved, that a pretence was afforded to preſs me to repair thoſe breaches, and reſtore out of my memory, or otherwiſe, a piece, which they would needs perſuade me might do ſome good, by rendering virtue amiable, and recommending piety to a ſort of readers, that are much more affected by ſhining examples, and pathetical expreſſions, than by dry precepts, and grave diſcourſes.

IF ſome of your more ſcrupulous friends ſhall object, that I have mentioned *Theodora*'s beauty more often and advantageouſly, and repreſented her lover's paſſion more pathetically, than the ſubject of the ſtory exacted, and the truth required in hiſtory would warrant; I ſhall not altogether deny the charge, being rather content to have it thought, that a youthful and heated fancy tranſported my pen ſomewhat beyond the narrow bounds of hiſtory, than that ſo pious a perſon, as *Didymus*, did not keep both his flame, and the expreſſions of it, within the limits of reaſon and religion. But though I pretend not to juſtify all that has been ſaid in the ſtrain of an encomiaſt, or a lover; yet I hope, that I may much extenuate, if not excuſe it, by repreſenting ſuch things as theſe.

THAT I have been careful, that *Theodora* ſhould not be made to do any thing, that, the great obligations ſhe had to her reſcuer conſidered, do intrench either upon her piety, or her virtue, or ſo much as upon her reſervedneſs.

THAT as for *Didymus*, I might ſay, that probably he thought thoſe celebrations, that would have been flattery to another lady, were but juſtice to a perſon ſo extraordinary, and ſo accompliſhed, as his miſtreſs; and that he thought it allowable, not to ſuppreſs the chaſte effects of a paſſion, that has not only been incident to heroes, but perhaps helped to make them ſuch. But I will rather ſay, that thoſe only are like to find much fault with his expreſſions, who conſider not, how free they are from any degree of prophaneneſs or immodeſty; and who are not accuſtomed to the reading of ſtories, where lovers are introduced, and made to praiſe and compliment in a far more bold and romantic way, than I allowed myſelf in the following paper: in which, all the deference, wherewith *Irene* as well as *Didymus* treat *Theodora*, may be accounted for by this; that I remembered to have, in ſome author or other, found mention made of a perſon about *Diocleſian*'s time, whom I took for our martyr, that was intimated to be of high quality, if not a princeſs, which title I had without ſcruple given her, if I had been half as ſure, that ſhe was a princeſs, as that ſhe deſerved to be one.

THAT perhaps I was not unwilling, both to ſhew the perſons I wrote for, that one might have glittering ideas of beauty, without being dazzled by them; and alſo to convince them, that high compliments, and paſſionate expreſſions, are no certain marks of his being really ſmitten (to ſpeak in a lover's phraſe) that can employ them; ſince I retained my wonted freedom of mind, while I was writing, and preſented them, by the mouth of *Didymus*, but what fancy, not paſſion, indited.

AND laſtly, I was induced to allow myſelf a more faſhionable ſtile, than would perhaps be ſuitable to a meer ſermon, or book of divinity; becauſe I feared, that the youthful perſons of quality of both ſexes, that I was chiefly to regard, would ſcarce be ſufficiently affected by unfortunate virtue, if the interweaving of paſſages relating to beauty and love did not help to make the tragical ſtory delightful, and the excellent ſufferers piety amiable.

IF it be objected, that in ſome of the diſcourſes of the two martyrs there are paſſages, that argue more knowledge, than is likely to have been found in lay perſons no elder than they; I anſwer, that ſuch diſcourſes indeed were ſomewhat ſtrange, if they were aſcribed to a young gallant, and a younger lady, of our degenerate times, wherein ſo many perſons of that ſort make diverſion their grand buſineſs, and, having as little leiſure, as concern, to mind any thing, but their pleaſures and petty intereſts, think it their privilege to know little of religion, and leave to meaner people the ſtudy of things ſerious and uſeful. But though among this ſort of people it were ſo difficult to find many, that would emulate ſuch knowledge and virtue, as ſhined in *Theodora*, that I fear they would not ſo much as believe them; yet among better qualified judges the lately propoſed objection will be of no great force, if it be conſidered, that *Didymus* and *Theodora* lived in the primitive and devout times of the church, and in the *Roman* empire, when the Chriſtian religion was as diligently taught by excellent divines, as frequently oppoſed by arguments, and violently aſſaulted by perſecutions. Upon which ſcores the zealous candidates of martyrdom, many of which obtained the crown of it even in their greener age, were early and ſkilfully inſtructed in the truths of their own religion, and furniſhed with good arguments, both to defend it, and confute the erroneous opinions and impious worſhips of their heathen adverſaries: nor is it any wonder, that they ſhould think that religion worth ſtudying, that they thought worth dying for. I will not here examine, whether the ignorance wont to be imputed to women be their fault, or that of their accuſers; and whether it is any natural want of capacity, or rather want of inſtruction, that keeps moſt of them from knowledge, though this regards not ſexes. But without inquiry, whether it be not

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our intereſt, or our envy, that makes women what we are wont to decry them for being; I ſhall not ſcruple to own, that I have ſometimes had the honour to converſe with ladies, that convinced me, that, to attain a great proficiency of knowledge, it is not neceſſary to be a doctor of divinity, or ſo much as a man, ſince they diſcourſed of divine things with no leſs wit than piety. And to return to our martyr, if we may judge by the effects, we may reaſonably ſuppoſe, that our virgin's parents not only thought it their duty, but took much pleaſure, to cultivate ſo excellent and promiſing a ſubject as their fair daughter; ſince great advantages of nature, and general grace, ſhould rather invite, than excuſe, improvements by education; as even the garden of *Eden*, though an admirably fertile ſoil, and planted by God's own hands, was not ſo left to itſelf, but that *Adam* was appointed to dreſs it, and to keep it. And if the diſcourſes of our martyrs are ſometimes leſs ſhort, than they might have been made; I hope it may be ſome excuſe, that I was not unwilling, to lay hold now and then of the riſes afforded me by ſome occaſions, to ſhew, that romantic ſubjects are not, as too many perſons of quality think them, the only ones, that may be treated of in a gentleman-like ſtile; and that even ſome noble queſtions in divinity, and ſome of the ſeverer dictates of the Chriſtian morals, may be diſcourſed of, without the harſhneſs of the ſchool terms, or the downright plainneſs of ſome better meant, than penned, books of theology and devotion.

It is like, Sir, you will think it ſtrange, that I make ſo pious a perſon, as *Theodora*, offer her breaſt to *Didymus*'s ſword, and, by ſoliciting him to kill her, tempt him to an action, which would make her guilty of a murder, and make him greatly acceſſory to it. But poſſibly her action would not appear very ſtrange, if we were not too inclinable to eſtimate the affairs of paſt times, and remote regions, by the opinions and cuſtoms of our own age and countries. For whatever we now juſtly think of the ſinfulneſs of deſtroying a man's ſelf, whether immediately or otherwiſe, yet I muſt not deny, but that divers of the ancient Chriſtians thought it not criminal, when it was neceſſary for the preſervation of chaſtity: and, if I much miſremember not, St. *Jerom* himſelf, where he ſpeaks of the unlawfulneſs of ſelf-deſtroying, intimates, that he excepts the caſe of an inevitable danger of a rape. But my chief anſwer is, that, having found the virgin martyr's propoſal expreſly delivered by the author I was to follow, I judged it the part of an hiſtorian not to ſuppreſs it; which I acknowledge I the rather declined to do, becauſe *Theodora*'s offer was a noble evincement both of her gratitude and her generoſity. And therefore, inſtead of omitting ſo conſiderable an action of hers, I choſe rather to ſet my thoughts a-work, to find a plauſible colour for it; which whether I have happily done, by ſupplying her with the example of a prophet, who, though he would not caſt himſelf into the ſea, yet ſolicited others to caſt him, (and that having firſt bound him) I muſt leave you to judge.

I FREELY confeſs, Sir, that, if the following piece had been written by one, that I were fond of cenſuring, I could myſelf find enough in it to criticiſe upon; and ſhould object againſt it, beſides the want of uniformity throughout, that, if judged of by the ſtrict rules of art, it ought to paſs for an irregular piece. And therefore I ſhall not wonder, if nicer critics, and more verſed in exquiſite compoſures, than I pretend to be, ſhall find fault with this artleſs one of mine. But the reception, that the following papers met with, from the perſons, for whom they were chiefly written, affords me the conſolation derivable from the ingenious ſaying of that excellent wit, who declared, he had rather the diſhes ſerved up at his treat ſhould pleaſe the gueſts, than the cooks. And I might ſay too, that ſome of the paſſages, that may meet with cenſure, would perhaps eſcape it, if in writing this book many years

ago, I had not had ſome aims, that I then thought more fit to be purſued, than I now do to be declared. Yet I will not here diſſemble, that I know it may be thought by ſome, that this paper ſhould have conſiſted leſs of converſations, and more of narratives. But I choſe the way of writing I have employed, partly becauſe the authors I met with furniſhed me with ſo very few matters of fact, that, if I would have confined myſelf to relations, I muſt have comprized this piece in a very few pages, and have finiſhed it preſently after I had begun it; and partly too (and indeed much more) becauſe (as I lately began to intimate) my chief deſign was not ſo much to perform the office of a meer hiſtorian, as to take riſes, from the ſeveral circumſtances I ſhould relate, to convey unperceivedly into the minds of thoſe young perſons of quality, for whom I wrote, ſentiments of true piety and virtue: and theſe I thought would not ſo happily gain admittance and entertainment, if they were preſented in a ſcholar-like diſcourſe, or a profeſſed book of devotion, as when they were taken, not from common places, but from the nature of the things and perſons introduced, and without formality inſtilled by the occaſional diſcourſes of a young gentleman and fair lady, for whom the beauty and the merit aſcribed to the ſpeakers had given the hearers a great eſteem and kindneſs. And I ſhall not ſcruple to own, that I, who value time above moſt other things, did not think it worth the expence of mine, to give myſelf the trouble of writing a book, only to give others a divertiſement in reading it. And whilſt I was converſing with ſuch excellent company, as our noble martyrs, and meditating on ſuch ſerious ſubjects as are death, and the worth of that heavenly religion, for whoſe ſake they deſpiſed it; I found myſelf incited, and thought myſelf obliged, to aim leſs at the pleaſing of ſome few nice exactors of regularity, than to poſſeſs many readers with high and noble ſentiments of the Chriſtian religion, and the ſublime dictates of it; and thereby both elevate their minds to a generous contempt of all they can loſe and ſuffer for it, and fill them with bright ideas of heroic virtue, and of the much brighter glories, that will crown it. By ſuch reflections I was induced not to omit ſome paſſages, that ſeemed likely to further the main ends I purſued, though I foreſaw, that perhaps ſome rigid judges would ſay, that they might have been ſpared. For as I writ not a romance, wherein authors are wont to aim no higher, than to delight the delicate readers, and eſcape the critical ones, by making their compoſures diverting and regular; ſo I preſumed, that to employ a more uſeful, though leſs faſhionable way of writing, was allowable for me, who ought to endeavour, in ſuch a piece as this, rather to propoſe patterns of virtue, than models of ſkill or eloquence; and to think it more ſucceſsful, if the readers ſhall, upon peruſing it, imitate our excellent martyrs piety, than if they ſhould only applaud their hiſtory; which both as to ſtile and reaſonings is freely ſubmitted to your judgment by,

SIR,

Your moſt, &c.

The MARTYRDOM of THEODORA.

BOOK II.

CHAP. I.

THOUGH it may ſeem ill-natured to leave the chaſte *Theodora* in ſo deplorable a condition, yet it is requiſite to do ſo for a while, that we may learn what was attempted to reſcue her out of it.

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IT is not to be doubted, but that *Didymus* was not long kept a ſtranger to the barbarous uſage ſhe had ſuffered. That of ſo illuſtrious a lady could not but make a great noiſe, and reach a multitude of ears, and eſpecially thoſe of ſo concerned a perſon as *Didymus*; the wounds of lovers tender hearts giving them oftentimes ſecret preſages of approaching misfortunes relating to their love; as many other wounded men have the unhappy privilege of being able, by feeling of pain, to diſcern ſuch approaches of ill weather, as affect not unhurt men.

Didymus therefore being quickly too much aſcertained of the unwelcome news of the diſtreſs of his fair miſtreſs, was too generous a lover to deliberate, whether he ſhould expoſe his life for her reſcue; his deliberation being only about the means, how to make ſo difficult an attempt a proſperous one. In order to this he happily finds out one of the officers of the guards, that were placed about the infamous houſe to which *Theodora* was condemned, who, having been his fellow ſoldier in the *Roman* armies, he hoped would, either for the ſake of virtue or of *Didymus*, be prevailed with to further ſo handſome a deſign as his.

WHEREFORE addreſſing himſelf to this commander, with a very obliging and yet civil freedom: Generous Septimius, ſays he, I cannot but look upon it as one of the chief advantages I have obtained by venturing my life in the *Roman* camps, that I had the happineſs to be acquainted with you there, and to be a ſpectator of your gallantry; which did not only then raiſe me to a deſire of imitating it, but allows me now to own a requeſt to you, that none but a gallant perſon ought to be entruſted with, or would eaſily grant. Generous *Didymus*, replies the *Roman*, when I accompanied you in following our propitious eagles, I found ſo great a contentment in your acquaintance, and ſo ſtrong a ſpur to glory in your examples, that I looked upon the advantage of having been your fellow ſoldier, as preferable to the honour of leading the moſt numerous troops I may at any time command; and ſhall think all the hazards I then expoſed myſelf to, abundantly rewarded, if any power they have procured me may enable me to do you ſervice: tell me then frankly, in what caſe, and after what manner, you would have it employed for you; and as I aſſure myſelf, that ſo virtuous a friend as *Didymus* will deſire nothing but what is juſt, ſo he may aſſure himſelf not to be refuſed any ſervice, that is but dangerous.

OUR lover, emboldened by ſo encouraging a declaration, firſt made him a very grateful acknowledgement for it, and then proceeded to ſay: If you have ever had the happineſs to be acquainted with *Theodora*, or ſo much as to have ſeen her, it would be needleſs, as well as improper, for me to offer at giving you a character of her, which you muſt needs think injurious to her: but if you have not, the ſhortneſs of the time will only permit me to aſſure you, that not only ſhe has given me thoſe ſentiments of her excellencies, that I never had, nor ever thought myſelf capable of having, for any of her ſex; but that in other perſons, ſtrangely indiſpoſed to admit ſuch impreſſions, ſhe has often excited ſuch wonder and ſuch flames, as very rarely have been produced in other men, and, perhaps, more rarely been merited by other women.

THIS admirable perſon, for exerciſing, among other virtues, that of an invincible conſtancy to her religion, and refuſing to ſacrifice to *Venus*, *Flora*, and ſome other of thoſe deities, whom her perfections might, though her religion did not, exempt from adoring, is by your ſavage preſident condemned to be expoſed to the public luſt; and a party of thoſe gallant Roman ſoldiers, that uſed to be ſo glorioufly led on by you, to win battles, conquer kingdoms, and enlarge at once the fame and limits of the empire, are now employed to captivate innocent virgins, and defend their brutiſh raviſhers. You may eaſily gueſs by this, continues he, that my requeſt is like to prove

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an earneſt one; that you would pleaſe to treat with ſome of thoſe ſoldiers of yours, in whom you think you have the greateſt intereſt, and diſpoſe them to aſſiſt me in reſcuing *Theodora* out of ſo infamous a priſon, and accept from me greater recompences for doing a handſome action, than they can expect from the preſident, for doing a barbarous one. I hope I need not tell you, in the haſte this affair requires, that all poſſible care will be taken to keep you from being endangered by *Theodora*'s deliverance; nor will I add, how inexpreſſible an obligation you will lay on me, to heighten my gratitude to ſome proportion to your favours; becauſe I know it muſt neceſſarily fall ſhort of them, and are due to a perſon, that loves to do gallant actions for their own ſake, and had rather have great debts of gratitude remain due to him, than paid to him: wherefore I ſhall only mind you, that the time is ſo ſhort, that if your aſſiſtance be not as quick as obliging, I fear it will be as ineffectual. I ſhall quicken you only by aſſuring you, that, when you act for the accompliſhed *Theodora*, you act for a perſon, that has a right to all that beauty and virtue can give one a title to.

WITH the ſame freedom, replies *Septimius*, with which you have owned to me your religion, I declare to you, that mine is that of my country, and my anceſtors; and that I worſhip thoſe propitious deities, that have made the Romans the conquerors of the world, and rewarded thoſe, that adored them, with an univerſal monarchy. But though I exceedingly approve ſo triumphant a religion, yet I confeſs to you, that I do not like the ways, that the preſident takes to propagate it; ſuch cruel methods being apt to make the world ſuſpect, that our beſt argument is force; and whilſt the perſecutors think it a glorious thing to ſee the temples filled at any rate, I had rather ſee in them fewer but ſincere votaries, than have them thronged with ſuch puſillanimous diſſemblers, as would not come in, unleſs they were ſcared in thither. And though terrors and torments work ſometimes upon the weaker ſort of Chriſtians, yet the more reſolute do ſo often deſpiſe them, that our perſecutions convert not thoſe unhappy perſons, but frequently ſtagger many of our own; and I confeſs freely to you, *Didymus*, that all the Chriſtians arguments work leſs with me, than our inhuman manner of confuting them. But I do not only diſapprove, but deteſt, this infamous practice of our preſident; which makes him loſe not the reſpect only and the pity, but the common humanity we owe to women, and think to do the goddeſſes a ſervice by diſfiguring their faireſt images here below with the moſt ſhameful of blemiſhes. I cannot bring myſelf to imagine, that ſuch gentle deities can like ſuch barbarous worſhippers, who not only immolate to them the lives of men, but, what is far more precious, the virtue and honour of women; for if I could believe they like ſuch ſacrifices, I ſhould think them unworthy of any ſacrifice at all. You will eaſily therefore, *Didymus*, credit me, that I was abſent, when my ſoldiers were put by the inſolent judge upon ſo mean an employment. He durſt not have offered to have obtruded it upon them, had I been there; or if he had, I had dared to uſe him as his inſolence had deſerved. But without loſing time in paſſionate expoſtulations, about things made remedileſs by being paſt, let us ſpeedily apply ourſelves to the reſcue of *Theodora*. For, though I have heard ſtrange things of her, and ſuch as made me think fame a great flatterer, if not a frontleſs liar, yet I believe the reports about *Theodora*, as I believe the Delphic oracles, now that I find ſo undeniable a teſtimony of her merit, as her being your miſtreſs. I will therefore without delay prepare ſome ſoldiers to aſſiſt you in her reſcue, and I cannot doubt the ſucceſs in an attempt made to ſerve a diſtreſt beauty, and a generous friend. If there be occaſion, you need not doubt of my more openly appearing for you; for how highly ſoever ſuch an action may provoke the preſident, or even the Emperor, I hope to let

you ſee, that you have truſted a Roman, a perſon, that had rather be the object, than the miniſter, of their cruelties, and would not be acceſſary to ſuch a miſemployment of abſolute power, to be made a ſharer in it.

As ſoon as *Septimius* had ended theſe words, he did, to prevent thoſe acknowledgements he ſaw *Didymus* was about to make him, take that gallant youth by the hand; and leading him towards the place, where he expected to find the ſoldiers he moſt confided in, he entertained him in the way about the hopefulleſt expedients for the compaſſing of his admirable miſtreſs's reſcue. And having afterwards ſent for the two perſons he thought likelieſt to be prevailed on, to a convenient place, near to that, to which they had brought *Theodora*; he briefly, but pathetically, declaring to them, how much the brave *Didymus* was his friend, and how much he deſerved to be ſo, enflamed them with indignation at the ſavage preſident's diſgracing them, by ſo infamous an employment, as they were now about; and then aſſured them of rewards from *Didymus*, ſuitable to the liberality of ſo generous a perſon: after which withdrawing himſelf, to give *Didymus* a ſhort account how far he had proceeded, he left the reſt to be compleated by him; who, prompted by his native liberality, and his high concern, did not ſtay to cheapen his miſtreſs's liberty, but, with the haſty paſſion of a lover, proffered them more than even *Septimius*'s promiſes gave them reaſon to expect; nor would he have declined to embrace any articles of agreement they could have propoſed, though the parting with his life had been one, ſo *Theodora*'s deliverance were another.

THE ſenſe theſe ſoldiers had of the affront put on them by the preſident, joined with the ambition they had to pleaſe their loved commander, and the gratitude his friend's profuſe bounty had lately obliged them to, made them quickly accommodate *Didymus* with a military habit, and prepare ſome of their comrades to allow him the firſt admittance into her chamber; partly by ſharing ſome of the newly received preſents among them, and probably by repreſenting him to them, when thus prepared, as a perſon, who, having been paſſionately in love with *Theodora*, and been ſcornfully ſlighted by her, was deſirous, at any rate, to ſatisfy at once his appetite and his revenge. And, by this means, before that ſhort time was expired, that had been, as an act of grace, allowed the diſconſolate virgin, to deliberate, whether ſhe would yet comply with the judge, an entrance into her chamber was permitted to her lover; who (in order not only to his preſent, but further deſign) had purpoſely cloſed the vizor of his helmet; upon which ſcore, not being knowable by his fair miſtreſs, he met from her the reception we have formerly related.

CHAP. II.

THOUGH in the ſad condition, wherein our diſguiſed lover found his deſolate miſtreſs, her ſorrow and her fears did ſomewhat cloud her beauty, yet they could not hinder her looks from being ſo charming and majeſtic, as to create leſs pity than reſpect. Wherefore with geſtures, wherein this was as viſible as he could make it, he told her, without approaching too near, Do not, madam, I beſeech you, add to your other troubles, the apprehenſion, that, becauſe I appear in the circumſtances of a raviſher, I come to commit a rape. *Theodora* is ſo great an ornament to the Chriſtian religion, and her purity is an ornament ſo dear to *Theodora*, that heaven will not permit, either that *Antioch* ſhould be robbed of one, or ſhe of the other; and therefore that Providence, which you have ſo generouſly truſted, has ſent me to your reſcue, which, after the care I have taken to diſpoſe things without doors, it will not be difficult to compaſs, if you pleaſe to make uſe of the military habit I have brought hither,

hither, to diſguiſe and convey yourſelf hence. Nor need you be ſolicitous what will become of me, for I am under the ſame care of the ſame Providence, that now juſtifies your reliance on it, by providing for your eſcape: and I, that found means to come in hither, may be ſucceſsful in attempting a retreat; or, if I ſhould not ſucceed in it, I ſhall not miſs the joy of paying my duty, where I had the moſt deſire and cauſe to do it, and ſhall leave the world with the ſatisfaction of having highly obliged it, by the preſervation of the moſt accompliſhed perſon in it. And, madam, (continues *Didymus*) that you may not doubt the willingneſs, or the intentions, wherewith this offer is made you, be pleaſed to know, that it comes from the now fortunate *Didymus*, who juſtly thinks, that, in aſpiring to your acceptance of it, he does leſs proffer a ſervice, than beg a favour, that will not only be a full recompence, but a high obligation.

THE name of *Didymus*, and diſcourſe ſo ſuitable to it, made by him, that aſſumed it, ſoon diſſipated the diſmal apprehenſions his habit and her circumſtances had given her: ſhe knew ſo well his courage, his virtue, and his love, that nothing unlawful or mean, was to be feared; but the boldeſt things, if they were as noble as hazardous, might juſtly be expected from him; ſo that this attempt did perhaps as much oblige her, as it ſurprized her. Wherefore, as ſoon as ſhe had recompoſed her lately diſordered thoughts, ſhe told him, with looks ſerene enough to let him ſee how much ſhe truſted him; This action, generous *Didymus*, is of a nature ſo extraordinary, that my ingratitude would be ſo too, if my ſenſe of it were not. To own and reſcue a perſecuted and affronted maid, and to do it with more hazard than you need run in the Roman armies, to purchaſe fame and honours, is an action ſo diſintereſted, and ſo unexampled, that I want words to celebrate it, as well as merit to deſerve it, and power to requite it: but I admire ſo rare an effect of virtue (continues ſhe) can conſent to the deſtruction of its author. No, generous *Didymus*, it is enough, that the virtues of Chriſtians be treated as crimes by the Romans; they muſt not meet the like uſage from *Theodora:* ſhe muſt not purchaſe a life, that ſhe values as little herſelf as others have cauſe to do, at ſo high a rate, as your partial charity perſuades you to ſet upon it: for even thoſe, that do now moſt pity me, would repine at the preſervation of my life, if it ſhould coſt that of a hero; eſpecially, if I ſhould deſignedly be acceſſary to ſo great a loſs; which, accompanied with a public indignation, and my own reproaches for my ingratitude, would certainly make that life a burden to me, that at ſo dear a rate you would preſerve as a bleſſing. But——

HERE *Theodora* was going to proceed, when her grieved lover, fearing that, if ſhe did ſo, ſhe might make ſome declaration unfavourable to his wiſhes, thought fit to endeavour to prevent it, by ſaying to her, with a profound reſpect, Ah, madam, do not make your miſtaken compaſſion more cruel to me, than the ſeverity of the Romans themſelves, which we Chriſtians juſtly tax, can poſſibly be: for they will but, in a few moments, take away that life, which you would, at once, protract and render miſerable. Do not, I beſeech you, madam, (continues he) think my ſervices meritorious, becauſe they are paid you in this place, and in your perſecuted condition: no, madam, *Theodora* has prerogatives enough to make many leſs unworthy (though not more zealous) than I, ambitious to ſerve her, in what circumſtances ſoever Providence ſhall think fit to place her. Whatever the Romans, that worſhip fortune and victory as goddeſſes, and find their proſperity the powerfulleſt argument to ſupport and ſpread their religion, may think of ſufferings embraced for conſcience ſake; ſure we Chriſtians, that adore a crucified Saviour, who, as He *took upon Him the form of a ſervant*, was put to death between two thieves, as a ſlave and a malefactor too, ought not to let any perſecutions, or indignities, leſſen our veneration or concern for thoſe that chuſe to ſuffer for Him, and imitate as well as own

own Him, whatever it coſt them. Nor, madam (purſues *Didymus*) needs your having been brought to this place make you think yourſelf at all diſhonoured, in the opinions of thoſe that can make juſt eſtimates of things: they look on ſufferers for truth with his undeceivable eyes, that, by one of the pen-men He inſpired, having mentioned thoſe perſons, that, for religion's ſake, were impriſoned, deſtitute, tormented, affronted, forced in the ſkins of beaſts, to wander like them in deſerts, and lodge in dens, honours them with this character and teſtimony, more glorious than all the panegyrics of orators, and laurels of conquerors, that the world was not worthy of them: and ſuch judges will think Venus an infamous courtezan, though the Romans adore her in their temples; and will not think *Theodora* the leſs excellent perſon, for having been condemned, on the ſcore of virtue, to a ſcandalous place. Honour were a mean thing, and not worthy to have its loſs much feared, or regretted, if we could forfeit it without having forſaken virtue, and much more, if we could be deprived of it for having cloſely followed her. Nothing can blemiſh true reputation, that cannot be declined without manifeſt injury to religion, which juſtifies our acting whatever it impoſes. The angels themſelves, that were ſent to *Sodom*, ſcrupled leſs to go thither, than to diſobey Him, that made it their duty to do ſo; nor were polluted by entering into that abominable place; and, being attempted by the brutiſh inhabiters of it, carried thence the angelical purity wherewith they came thither.

DIDYMUS thought fit to ſay what has been repeated, that he might conſole ſo chaſte a virgin as *Theodora*, who had ſtill enjoyed, as well as merited, a ſpotleſs reputation, by aſſuring her, that the barbarous affront ſhe had been expoſed to, for conſtancy to her religion, had not, among unbyaſſed judges, leſſened the high eſteem her former life had juſtly given them of her virtue: but he would not diſcourſe long of a ſubject ſo nice, that it was difficult not only to inſiſt on it, but ſo much as to mention it, without being uneaſy to ſo tender a modeſty as hers he was ſpeaking to. Upon which account, paſſing on to another argument, he told her, Theſe things I have mentioned, madam, to let you ſee, how little I can pretend to merit by the circumſtances of the duty I pay you; and conſequently, how little you need ſcruple to accept of my further ſervice, without which my paſt endeavours will be uſeleſs to us both: and give me leave to own to you, madam, that it was not without much trouble, as well as ſurprize, that I heard the incomparable *Theodora*'s merit ſo much injured, as to have the valuableneſs of my life put into the balance with that of her's, nay, and made to preponderate. Alas, madam, there are legions, that, as well as I, dare expoſe their lives to the greateſt hazards, and run greater dangers for ſome deſpicable pay, or a few worthleſs leaves, than I do to ſerve my religion, and the faireſt profeſſor of it. Every day affords thouſands of ſuch men as I; elſe the Roman camps would not be ſo frequently recruited, and thoſe numbers, that fall in breaches, or in battles, would not have their rooms ſo ambitiouſly ſupplied by men, that ſee them do ſo. But ſuch perſons as attain to be both the ornaments of their religion and the honour of their ſex, muſt be ſo excellent, and are ſo rare, that it is not every age that produces ſo much as one of them. Such exemplary ladies, do as well improve as ennoble the times and places they live in; the reſpect and love men have for them, makes their good counſels very perſuaſive; the lovelineſs of their perſons is ſo diffuſed to their actions, as, by making men forward to take them for examples, adds to their virtues both a great ſplendor and a powerful influence. That *Theodora* is not only one of that ſmall number, but eminent in it, nothing but her preſence, could keep it from being uneaſy for me to evince: but, madam, (continues he) though in ſuch circumſtances, as mine, your ſcrupulous modeſty may keep men

ſilent, yet it ought not to keep them from being juſt. Your profound humility may draw a curtain, that may hide your virtues from your eyes; but, in the eyes of others, it cannot but increaſe their number, and exceedingly add to their luſtre. You need not therefore, madam (purſues he) ſcruple to receive the ſervice I aſpire to do you, upon an injurious apprehenſion, that it is above reward, whilſt indeed it pretends not to any at all, except the ſatisfaction and honour, that will be inſeparable from the performance itſelf. Here *Didymus* pauſed for ſome moments, being ſenſible, how difficult a taſk he was entering upon; ſince it was, without prejudicing his love, to own to his miſtreſs herſelf, that he did not ſerve her upon the ſcore of that: but however, the ſincerity of his affection, and the great deſire he had to make his perſuaſions prevalent, haſtened him to prevent her anſwer, by thus proſecuting his diſcourſe: It is true, madam, that *Theodora*'s perfections did not miſs in me, to have the operation, that they are wont to have upon thoſe, that enjoy the opportunities of conſidering them: and if ſhe had been in a diſtreſs greater than that ſhe is now in, though her religion had not at all contributed to bring her into it, I ſhould joyfully have expoſed myſelf to a greater hazard, than I now run, to reſcue her from it. But, madam, that is not our caſe; for that, which now brings me hither, is none of thoſe ſentiments, that, if I were poſſeſſor of a crown, would bring me to lay that and myſelf at your feet, and think myſelf more happy in your acceptance of it, than in all the advantages and prerogatives that could belong to it: for, madam, the reſolution, that led me hither, was not inſpired by the fair, but by the devout and virtuous *Theodora*. If ſhe had no charms, but thoſe, that cannot be ſeen with bodily eyes, or if her viſible beauty were but moderate, or none at all; her exemplary piety and unſhaken conſtancy, ſhining in ſuch extraordinary expreſſions of them, as ſhe has this day given, would make me think myſelf unworthy of life, if I ſhould ſtick at hazarding it to ſave ſo precious a one as her's, and what I knew ſhe would far more unwillingly loſe; and thereby do ſome right to divine Providence, which, by ſo unexampled a reliance on it, was thought, in ſome ſort, engaged to anſwer ſo uncommon and intire a truſt. After what ſhe did for Chriſt, I did not think I could do enough for her, if I did leſs than I have endeavoured to do; and therefore, madam, (concludes he) I hope as well as beg, that you will no longer ſcruple to accept of that reſcue, that Providence offers you, by an unmercenary and moſt willing hand, but will vouchſafe to make uſe of this military garment, (at which words, *Didymus*, with great reſpect, pointed at his) and allow my endeavours, by procuring your ſafety, to ſecure my happineſs.

To this moving ſpeech, the fair perſon, that it was addreſſed to, returned this calm anſwer:

THOUGH the handſome and obliging things you have been pleaſed to ſay, generous *Didymus*, have made all the impreſſions on me that they ought to have; yet I muſt, with your pardon, freely tell you, that they naturally afford an inference, quite oppoſite to what you would conclude from them; ſince, by diſcovering more and more of your gallantry and friendſhip, they let me ſtill further ſee, how much the world would loſe, by being deprived of ſo much virtue, and how unexcuſable I, above all others, ſhould be, if I ſhould be willingly acceſſary to that loſs. Your too too exceſſive compliments I muſt not pretend to anſwer, ſince it would be too great a reflection on your judgment, as well as mine, to think you meant them for any thing more than what I have called them. But in anſwer to the ſerious part of your diſcourſe, I ſhall tell you, that, if I had proceeded in what I was going to ſay to you, when you interrupted me, I had, perhaps, prevented ſome of the things you have ſaid, by freely acquainting you (as I now mean to do) with the ſtate of my caſe, and the

intentions it ſuggeſted to me. When the inhuman preſident (continues *Theodora*) had condemned me, either to offer ſacrifice in an idol temple, or be led away to this infamous place, I was in ſuch a perplexity and agony, as can hardly be conceived, eſpecially by a perſon that is not of my ſex; for death itſelf was thought too mild an evil, to be one of thoſe, among which I was condemned to make my choice. On the one ſide, the infamy of this deteſtable place was that, which I could not think on, without the utmoſt horror and indignation; and not only my ſex and breeding, but even the dictates of more than one virtue (modeſty and chaſtity) concurred to heighten my abhorrence of it: but, on the other ſide, I remembered, that I did not vow obedience to God with any exceptions or reſerves; that I was both a diſciple and a worſhipper of a perſecuted and affronted Redeemer, for whom (though there were not an infinite inequality between our conditions) I could not ſuffer more, than He had already ſuffered for my ſake; having not only *endured the croſs*, but *deſpiſed the ſhame*, which the Jews inſolent malice, and the Romans barbarous cuſtom, had annexed to it. And I thought, that, perhaps, Providence had led me into this diſtreſs, to give me an opportunity of ſhewing, that I could do more than die for Chriſt. But I muſt not now trouble you with the various thoughts that diſtracted my mind on this diſmal occaſion, on which, all that I could ſay to thoſe, that rudely preſſed me to give a poſitive anſwer was, that of the things they propoſed, I plainly ſaw, that both were to be refuſed, and therefore I could make choice of neither. But, ſince I would make no election for myſelf, their malice ſoon made one for me, of this deteſtable place. I was ſo confounded, and, as it were, ſtunned, at the firſt ſteps they forced me to take towards it, that I ſcarce knew what to think, or what I did, ſave that I remembered, that idolatry was in the ſacred books repreſented as a moſt odious, though ſpiritual fornication; and that apoſtacy would be my own crime, whereas the conſequences of refuſing it could make me but the object of another's: and remembering myſelf to be a daughter of him, that againſt hope believed in hope, to follow God's call, I did, like him, obey, not knowing whither I went; yet having this ſatisfaction, that I acted according to the dictates of a well-informed conſcience; ſo that, whatever the way might prove, I need not fear to be miſled by cloſely following an infallible guide.

HERE the chaſte virgin's words were a little interrupted by the flowing tears, and the inevitable diſcompoſure, that were produced by the ſad remembrance of the diſtreſſed condition ſhe was recounting; but having, as ſoon as ſhe was able, ſuppreſſed thoſe viſible effects of her virtuous grief, ſhe thus purſued her diſcourſe:

REVOLVING theſe and the like thoughts in my mind, I arrived at this infamous place; and being for a while left alone in this room, to try whether yet I could be brought to change my mind; the nearer approach of what I was to endure, making it look more hideous to me, than, till then, I thought it was poſſible for any thing to appear, made me preſently think of flying for refuge to the dark ſanctuary of death, and, by diſpatching myſelf, drown in my yet untainted blood both my own diſmal fears, and my perſecutor's brutiſh hopes. But then there came into my mind what I had been often taught, and, whilſt I was unconcerned, judged rational, to believe of the unlawfulneſs of killing one's ſelf upon any account whatſoever. I conſidered, that God, who made our love unto ourſelves the ſtandard of the affection we owe our neighbour, in forbidding us to deſtroy another's life, muſt be ſuppoſed much more to prohibit us that violence againſt our own. And if fratricide be juſtly liſted amongſt the blackeſt crimes, becauſe of that relation the ſlaughtered perſons have to thoſe that kill them; how criminal upon that ſcore muſt be the murder of ourſelves, where the relation is not nearer, only becauſe it is too near to be properly any at all! The ſovereign

Author and abſolute Lord of our lives having thought fit to employ us here in his ſervice, we cannot, without violating our duty to Him, deſert it, until we have performed his errand, which is, to glorify Him by our lives, till loyalty to his truth, or his commands, convince us, that we may better glorify Him by our deaths. Such conſiderations as theſe would, I hope, have reſtrained me from ending my life with a crime; but the thoughts of it were quickly ſuppreſſed, by my remembering, that in this place I was deſtitute of inſtruments to act it with. Wherefore remembering, that *Daniel* had been preſerved, though not from the lion's den, yet in it; and his three friends were not delivered from the fiery furnace, till they had been caſt into it; and having learned by thoſe examples, that no ſuccours can come too late, that God deſigns for our reſcue, I betook myſelf to prayer, as the moſt hopeful, as well as the moſt innocent courſe, I could take; and with an ardency, heightened with the extremity of my diſtreſs, I was beſeeching God, though with the loſs of my life, to preſerve a purity, that by his grace had been hitherto kept unblemiſhed, when your unexpected entrance brought me a return of thoſe prayers I had yet ſcarce uttered. Judge then, generous *Didymus*, (ſubjoins *Theodora*) by the condition I was in, how much I muſt think myſelf obliged by ſo brave and ſeaſonable an attempt to deliver me out of it.

To ſerve ſo bright a virtue, lodged in ſo noble a ſhrine, I thought, madam, (ſays *Didymus*, interrupting her) to be as much my duty, as to have found an opportunity to do it is my happineſs: and if you pleaſe to permit me, as I now hope you will, the honour and ſatisfaction of compleating my endeavours to deliver you, I ſhall much more value myſelf upon the having paid you that ſervice (though it be more proportionate to my power, than to my deſires) than if I had reſcued a Roman general, or, for ſucceſsful attempts, been made one myſelf.

WHEN thanks are purchaſed by merit, replies *Theodora*, to diſclaim a right to them, does not forfeit it, but increaſe it; nor need you make me any new profeſſions, ſince, after the teſtimonies you have given me already of your virtues, and your friendſhip, I ſhould make myſelf unworthy of them, if I doubted of their reality or greatneſs. Yes, *Didymus*, I believe what you declared of the diſintereſtedneſs of your proceedings, in the reſcue of a perſon of no greater merit than I can pretend to; ſince the circumſtances of your attempt make it appear too generous to let me ſuſpect, that the aim of it was other than noble too: and indeed, after what you have done (continues ſhe) it would ill become me to ſcruple to be further obliged by you; and therefore I ſhall venture to make you a requeſt, as ſoon as I ſhall have acquainted you with the reaſons it is grounded on.

Didymus, being ſurprized at this welcome declaration, was going with tranſports to aſſure her he could deny her nothing, nor obey her in any thing without joy, when ſhe prevented him, by thus continuing her diſcourſe: You know, my generous deliverer, that virgins have ſo great and clear a right to keep themſelves ſuch againſt all outward aſſaults, that monarchs themſelves (whoſe force is not to be by force oppoſed, when it tends but to deprive us of our lives) may be forcibly reſiſted, when they ſtrive to offer violence to our chaſtity. Since, then, an untainted purity is a jewel, that the poſſeſſors are allowed to preſerve and defend, even by uncommon ways, if others will not ſerve, and ſuch as would in other caſes be unwarrantable; though I do not, as I lately told you, think it lawful, as many do, to ſecure virginity by ſelf-murder, yet I cannot diſapprove their opinion, that allow a virgin, in caſe of extremity, to implore that death from another's hand, that ſhe is forbidden to give herſelf with her own; ſince, in ſuch a calamitous condition, heaven, by debarring her all other ways of eſcaping from defilement, ſeems to approve of this. And the ſcripture in-

forms us, that though the prophet *Jonas* held it unlawful to drown himſelf, yet he perſuaded thoſe, that ſailed with him, to caſt him bound into the ſea, when neither they nor he expected he could out-live many minutes (as indeed it was not without a miracle that he did). Wherefore, purſues *Theodora*, if you will perfect what you have ſo obligingly begun, you muſt lend me your arm and ſword, to free me by a ſpeedy death from miſchiefs much greater than it. The Romans will eaſily believe, that my reſiſtance and provocations tranſported you to a revenge, at which the barbarous uſage I have received at their hands makes it unlikely they will be much offended: the grant of my requeſt will not hinder you from being, what you are pleaſed to think a title, *Theodora*'s deliverer; for in the eſtimation of equitable judges, as well as in hers, it will ſuffice to give you a right to that title, that you have delivered her from her greateſt calamity and danger: nor will the good office I deſire be inconſiſtent with my obtaining the honour of martyrdom. St. *John* the Baptiſt, becauſe his bold zeal for the laws of religion gave the firſt riſe to thoſe perſecutions, that terminated in his death, is juſtly reckoned among martyrs, though he was privately beheaded in his priſon at the ſolicitation of a Courtezan: and if one willingly ſuffers death for the truth, or the intereſt of religion, there needs not a ſcaffold or a ſtake, and a public executioner, to make ſuch a perſon a martyr. And ſince the perſecutions, that now make havock of the church, are like to continue long; and ſince I am reſolved, by God's aſſiſtance, never to avoid them, by any either unlawful or unhandſome way; the eſcape you would perſuade me to, would but for a while delay thoſe ſufferings I ought not to ſhun, and would make them much leſs acceptable, by my having endeavoured to avoid them; eſpecially by an action ſo mean, if not criminal too, as to conſent to the loſs of an excellent perſon, that moſt generouſly expoſed himſelf for my ſafety. Deny me not therefore, concludes *Theodora*, with tears in her eyes, the laſt requeſt I ſhall ever make you; but by ſheathing your ſword here, (at which words ſhe pointed, with bluſhes, at her fair and innocent breaſt) be pleaſed, by one quick and charitable ſtroke, to perfect my deliverance, without making me ſtain it with the blood of my deliverer: free us both from eminent danger, me of being diſhonoured, and you of being tormented; and by the ſame act of friendſhip ſecure me the coronet of virginity, and procure me the crown of martyrdom. *Jonah* i. 12.

GREAT was the ſurprize, and greater was the trouble, wherewith *Didymus* heard the concluſion of this diſcourſe: in anſwer to which, as ſoon as his aſtoniſhment would permit him to ſpeak; Ah madam, ſays he, what have you ever ſeen in the unfortunate *Didymus*, that could tempt you to make him ſo ſtrange a propoſition? that I, whoſe errand hither was to venture my life in your ſervice, ſhould myſelf deſtroy the admirable perſon I came to reſcue; and that *Didymus* ſhould imbrue his guilty hands in *Theodora*'s innocent blood, to ſave one drop of which he would gladly ſhed all his own? As your piety deſerves to be the pattern of more than one age, ſo I doubt not, but that in times very remote from ours, your memory will ſhine as bright, as your virtue and your eyes do now; and then, how hideous a monſter muſt I appear to poſterity, that will look upon me as one, that could in a trice paſs from pretending to be your deliverer, to be really your murderer; and this for no other reaſon, than that you were pleaſed to manifeſt a great concern for my preſervation? And pardon me, madam, (continues *Didymus*) if I tell you, that your generoſity makes you forget ſome of your other virtues, and even of the dictates of the religion you have hitherto adorned; ſince your commands, if obeyed, would engage me to commit a crime, and make you yourſelf more than acceſſary to it. For, madam, ſince you acknowledge ſelf-murder to be unlawful, how can your commands give

give me a right to take from you a life, that you have not power to diſpoſe of? And what excuſe can I have, without ſo much as the pretence of acting under authority, to deſtroy an innocent perſon? For, madam, ſince I am to declare, why I preſume to do the thing in the world I would leaſt be put upon, to diſobey *Theodora*; give me leave to tell you, that, ſhould I execute what you require, the action would not be excuſable in either of us. For as *Adam* ſinned in doing a forbidden thing, though ſhe, that prevailed with him to do it, *was firſt in the tranſgreſſion*, and the Jewiſh prophet was torn in pieces by a lion, though he did what he was ſeduced to by the perſuaſions of a prophet; ſo the ſcripture clearly condemns *David* of murder, becauſe he killed *Uriah*, though not with his own hand, yet with the *ſword of the children of Ammon:* and the ſcripture tells us too, that God plagued the children of *Iſrael* in the wilderneſs, becauſe, as the text expreſſes it, *They made the calf, that Aaron made.* And indeed, by whatever hand innocent blood is ſhed, the guilt of it will light upon the perſon that procured it to be ſpilt. And to this I muſt add, that ſince Chriſtians are, in ſome caſes, not only permitted, but exhorted, if not commanded, *to lay down their lives for one another*; the high value and concern I juſtly have for yours, makes me conclude, that this is certainly one of thoſe caſes, and conſequently, that I may lawfully offer you a ſervice, which you perhaps cannot lawfully refuſe: ſince Providence has left you no other innocent way, than the acceptance of it, to eſcape your preſent danger. And the guilt of ſelf-murder may, for aught I know, be contracted, not only by a poſitive act, but by an inflexible refuſal of the proffered means of ſafety. Pardon me, I beſeech you, madam, purſues *Didymus*, if the great concern, I have for ſuch a perſon as *Theodora*, has extorted from me a greater plainneſs of ſpeech, than my profound reſpect for her would permit me, upon any other occaſion. And becauſe I perceive, that that, which makes you moſt ſcruple to grant my humble requeſt, is, that your ſuperlative generoſity, and what your humility perſuades you to think gratitude, make you ſolicitous for the preſervation of a life hazarded for your ſake; I muſt aſſure you, madam, that your inflexibleneſs will no way make proviſion for my ſafety: for if I ſhould be condemned by your cruel commands to leave you expoſed to the barbarous and defiling rudeneſs of thoſe brutiſh ſatyrs, that impatiently wait without, the regret and ſhame of having miſſed the honour of *Theodora*'s reſcue will give me far greater torments, than the Romans can, for having effected it. And I muſt add on this occaſion, madam, (continues he, not without ſome change of colour and voice) that ſome ſentiments (which, though I think not this a fit time or place to name, have been much confirmed and heightened by what I have this day had opportunity to obſerve) have ſo faſt tied my happineſs to your welfare, that the preſence of my ſoul is ſcarce more neceſſary to my life, than your ſafety is. Nor fancy, madam, that the belief I own of the unlawfulneſs of ſelf-murder, will ſecure my life; for there are other ways to procure death to him, that is weary of life, than his own ſword, or a draught of poiſon; ſince paſſion alone, when raiſed to a competent degree, may do the office of either of thoſe. And ſince joy itſelf, though the moſt pleaſing and friendly of the paſſions, has by its exceſs proved deſtructive of men's lives; why may not grief, and ſhame, and indignation, which are paſſions more violent, and very unfriendly to nature, be able to produce as fatal effects? And to ſhew you, madam, (continues *Didymus*) how much reaſon I have to think, that your condition diſpenſes me from obeying the dictates of your generoſity, let me, —— But before *Didymus* had annexed his reaſons, a noiſe made without gave him a hot alarm, and made him fear the patience of ſome, that waited without, would not laſt very much longer; and therefore addreſſing himſelf to *Theodora*, with a countenance as petitioning as his words,

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and eyes, in which his courage could ſcarce repreſs the tears; how long, madam, ſays he, will you upon groundleſs ſcruples neglect an opportunity, whoſe omiſſion will be irreparable? And how can you juſtify to God, the ſlighting the means his providence preſents you of eaſily ſecuring your ſafety? Ah, madam, (then concludes *Didymus*) by one quick and neceſſary reſolve, regain your liberty, preſerve your honour, and ſecure your life. But if nothing, that has relation to yourſelf alone, will move you, be pleaſed to reward the ſervices I have eſſayed to do you, with the implored grant of your own ſafety; and permit me, for this once, rather to ſerve you than to obey you. Nor need your generous ſolicitude for me hinder or retard your reſolution: the world will not blame a ſpotleſs virgin, for doing what is neceſſary to keep herſelf ſuch; nor look upon it as a part of ingratitude, to grant to one, that has done his beſt to ſerve her, a recompence, that he is ſo ambitious of, as to venture his life to obtain it at her hands. In ſhort, madam, (for the time allows me not a long diſcourſe) if your cruelty will not permit me to prevent your death, grief, and other paſſions, will not allow me to ſurvive it; and then, (ſuppoſing I ſhould fail of making a retreat) would it not be a much more happy fate, that the conſtant *Didymus* ſhould die for having ſaved the matchleſs *Theodora*, than for having loſt her?

CHAP. III.

TO theſe pathetic words he thought not fit to ſtay for an anſwer; but, retiring to a corner of the room, he diveſted himſelf of his military coat, and upon his knee preſented it to *Theodora*. She, in the mean time, reflecting upon his arguments, was by their force convinced, that the motion ſhe had made him of killing her, was grounded upon a dangerous error. And the noiſe, that had been made, in the outward room, alarming her, at leaſt as much as it had done him, let her ſee ſhe had no further time left her to deliberate. And therefore, being prevailed with, by ſupplications made in ſo perſuaſive a way, that it appeared a far leſs cruelty, even towards him, to accept, than finally to refuſe, his offer; ſhe firſt made her bluſhes and her ſilence intimate her conſent, and then declared it more expreſly, by raiſing him, and taking out of his hand what he preſented to her. And to his joy (which his foreſight that his ſucceſs would be fatal to him could not hinder from being very great) ſhe received from him inſtruction how to put it on, and permitted him (tho' not without ſtrange diſorder in her mind and looks) to aſſiſt her; for as it was abſolutely neceſſary to do it, ſo he did it with all imaginable care, to diſtreſs ſo nice a modeſty as little as was poſſible; and therefore, as ſoon as ever he had done that, with all the reſpect and decency the place and occaſion would by any means permit, all that could be done without him, he left her to do herſelf, withdrawing to a part of the room whence he could not ſee her: which retreat he was induced to make, not only out of civility and reſpect, but perchance becauſe the dangers, that threaten internal chaſtity, have this peculiar fate, that uſually thoſe perſons are moſt careful to ſhun them, that are the moſt reſolved and the beſt able to ſurmount them.

As ſoon as the mutual exchange of their habits had made it decent for them to diſcourſe together, the diſguiſed virgin, with cheeks covered with bluſhes, and with looks ſo obliging, that they alone would have recompenced *Didymus* for any leſs ſervice than that ſhe now received, addreſſing herſelf to her benefactor; If your reaſons, ſays ſhe, had not convinced me, that I could not without a crime free myſelf from my wretched condition by death, and if yet death were not the only way, by which, if I decline your generous proffer, I can poſſibly ſhun, what I far more apprehend than death, diſhonour; I ſhould not leave you in a danger, wherein only your con-

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cern for religion and for me has engaged you. But I doubt not the ſame charity, that put you upon making me your generous proffer, and preſſing me not to decline it, will make you pardon a fault, to which your own reaſons and importunity have made you highly acceſſary; eſpecially ſince I know you think a tenderneſs of honour, and an abhorrence of all defilement, to be things ſo allowable in a virgin, as very much extenuate, if not juſtify, what they require of her. And indeed I ſhall do you but right, when I thankfully acknowledge, that, in this whole tranſaction about my reſcue, your carriage has been ſuch, as would leave me no doubt, if ever I had been ſo unjuſt as to have any, of the purity and diſintereſtedneſs of your intentions, by which I am not a little confirmed in the opinion I have always had, that virtue may inſpire as noble and as hazardous enterprizes, as paſſion can. I know, that in this day's work you aimed at higher retributions, than could be expected from one in my condition; but yet I think myſelf obliged to aſſure you, that your heroic acts of virtue and friendſhip have not been exerciſed towards a perſon inſenſible of them; but that your merit and your favours have produced all the eſteem and other ſentiments, which they ought to produce in a perſon, that is not altogether incapable to diſcern and value them. And if the prayers of a diſconſolate virgin, then ſaved by you, when all the reſt of the world had abandoned her, can have any intereſt at the throne of grace, they will obtain for you bleſſings as great as your generoſity to me has been, and not leſs laſting than my ſenſe of it will be; and you will, during a long protracted life, either be allowed quietly to enjoy the glory, your many meritorious hazards of it have purchaſed, or elſe be enabled to find a happineſs in your very ſufferings, by virtue of thoſe peculiar conſolations, that are reſerved for a perſecuted condition; as anciently manna was vouchſafed the *Iſraelites*, only whilſt they were exiles in the wilderneſs. The quick ſucceſs God has been pleaſed to grant my prayers for my own deliverance, lets me not deſpair to find Him propitious to thoſe I ſhall with no leſs ardency put up for yours: but, if your charity ſhould expoſe you to further danger, I ſolemnly promiſe you, that you ſhall find I have been inſtructed, as well as obliged, by your generoſity, and would not have left you expoſed for my ſake, that I might ſhun any danger, that had threatened but my life.

AND now the mournful virgin, being to bid her accompliſhed votary a farewel, which probably enough would prove the laſt, by a manifeſt change in her countenance, and the tone of her voice, and by the multitude of tears, that fell from her fair eyes, convinced him no leſs of the trouble ſhe was in upon his account, than any verbal expreſſions could do it; though ſhe ſaid to him, in a moſt obliging manner, Farewel, my generous deliverer; and may that God, who ſees with what reluctancy I conſent to your danger, free you happily from it, and richly recompenſe that noble charity, that led you into it. I hope we ſhall yet ſee one another again upon earth: I am confident we ſhall meet joyfully in heaven, by which I muſt confeſs myſelf very highly favoured, not only in my deliverance, but in the inſtrument of it; ſince God makes me not beholden for my reſcue to any common perſon, but is pleaſed ſo to order it, that I receive the greateſt of earthly benefits from the moſt generous of men.

MADAM, replies the much troubled *Didymus*, your own unequalled perfections, and the operation they have had on me, make me ſo much yours, that your wiſhing me happy does more towards the making me ſo, than your humility will allow you to be aware of. You have too much merit, madam, to let the ſervices I have paid you, have a title to any; and what I have had the happineſs to perform, is but what was every brave man in *Antioch*'s duty to endeavour: but if your goodneſs will needs make you think, that my poor ſervices ſhould have another (for they can ſcarce have

have a greater) recompence, than you have already given them, by ſuffering them to contribute to your ſafety; and if you will vouchſafe to allow the memory of him, that did them, a room in your thoughts, (which is the happieſt ſtation it can aſpire to upon earth,) I humbly beg your faithful ſervant's image may be looked on without any troubleſome degree of pity; ſince his condition will then need none, and the idea would very much miſrepreſent the original, if it ſhould diſquiet her, whom he never approached but to ſerve her. It is ſuitable, madam, to this frame of mind, that for *Theodora*'s ſake I muſt now deny myſelf ſo much, as to haſten her departure, leſt ſome croſs accident ſhould prevent it: at which words, looking on her with a countenance, that all his courage could not keep from a diſcernible change, Farewel, ſaid he, incomparable *Theodora*; may you continue long the ornament and the pattern of your ſex; and ſince we ſee, that ſome fruits may be as well preſerved in honey, as others in brine and vinegar, may the height of your virtue be kept up, but the objects of it ſo changed, that by a ſettled proſperity you may henceforth have occaſion to exerciſe your moderation and your gratitude, inſtead of your courage and your patience. Once more farewel, concludes he, unequalled *Theodora*; and may you live but with as much contentment, as, if I ſuffer for you, I ſhall die with ſatisfaction.

THOUGH theſe moving expreſſions, and the accent, wherewith they were delivered, did very ſenſibly touch a perſon ſo well natured and grateful as *Theodora*; yet ſhe thought the fitteſt return ſhe could then make to her lover's diſcourſe, was preſently to follow the advice he was ſo earneſt to have her ſpeedily embrace: and therefore, bidding him farewel only by a look, wherein high degrees of ſorrow and gratitude were plainly mingled, ſhe immediately diſpoſed herſelf to quit that diſmal place; which then afforded a noble inſtance, how little a great mind can be hindered from diſcloſing itſelf to be ſo, by the ſtage it is obliged to act upon: for whilſt in divers of the ſtately temples of *Antioch*, whores (ſuch as Venus and Flora), and raviſhers and adulterers (ſuch as Jupiter and Mars), were ſolemnly adored in an infamous ſcene, dedicated to public luſt and violence, the ſtricteſt chaſtity was exerciſed, and martyrdom itſelf was contended for.

HAVING once ventured into the outward room, that Providence, to which ſhe had, in ſuch diſcouraging circumſtances, truſted her virgin purity, would not leave the reſcue of it incomplete; but, whilſt the waiting ruffians were eagerly contending who ſhould ſucceed the perſon they took, by the habit, to be *Didymus*, (and whoſe face they did not wonder to ſee muffled preſently after ſo ſavage an action as they ſuppoſed him to have committed) brought her ſafely out of that infamous place: whence, by the leaſt frequented paſſages ſhe knew, ſhe was quickly conveyed to the houſe of her dear friend *Irene*, which happened to be nearer than her own.

THERE, to avoid ſuſpicion, ſome of her friends and relations were met together, to lament her captivity, and join in prayer to Him, that alone could deliver her, to be directed by God how they might (if it were poſſible) contribute to her reſcue. But, though their prayers were probably made with more zeal than hope, they were not a little alarmed, when, looking out to ſee who knocked at the door, they ſaw, as they thought, a ſoldier, who would not have been quickly let in, if *Irene* had not preſumed it to be *Didymus*, who was coming to offer his ſervice to his captivated miſtreſs. But it is not eaſy to expreſs the wonder and the joy, with which they ſoon diſcovered that this was not *Theodora*'s lover, but herſelf, whoſe beauty, and her military dreſs, would have made her, had the Roman guards diſcovered her, paſs for their Pallas: nor was ſuch a habit, though improper for a virgin, unſuitable to a great, as well as chaſte conqueror.

BUT though her preſence never needed the endearment of a ſurpriſe, yet the unexpectedneſs of it at that time and place, added to the tranſports it produced, eſpecially in *Irene*, who, after a thouſand gratulations and careſſes, at length begged, in the name of the impatient company, to know, how the bleſſing, they all received in her freedom, was procured. To which reaſonable requeſt ſhe anſwered, by making a ſhort but faithful narrative of what had occurred, ſince the time ſhe was cited before the preſident, till ſhe came to take ſanctuary among them; piouſly concluding, that, as what ſhe had done not miſbecoming a Chriſtian was altogether by the aſſiſtance of divine grace, ſo the ſuccour ſhe received to bring her out of danger, was by the conduct of Divine Providence, which in her delivery made uſe of the high virtue and generoſity of *Didymus*. This relation made the company firſt return thanks and praiſes to the divine Goodneſs, which were followed by the celebrations of the happy inſtrument of it; every one, as it were, by turns, endeavouring to vye, who ſhould moſt commend ſo venturous and diſintereſted a lover: nor perhaps did *Theodora* herſelf inwardly diſſent from that grateful company; for though her modeſty and reſervedneſs kept her from declaring her ſentiments, as others did theirs, yet, perhaps, that was becauſe ſhe thought, that, having given a candid account of his deportment, her narrative had made praiſes needleſs, the hiſtory itſelf being indeed a panegyric.

AFTER the company's curioſity was ſomewhat ſatisfied by what *Theodora* had told them, and both *Irene* and ſhe had made a requeſt to a gentleman, that knew *Didymus* well, to endeavour to bring them ſpeedy notice of what had happened to him, or was like to befall him; the two excellent ladies retired to the apartment of *Irene*. There the pious *Theodora*, having devoutly paid her ſolemn thanks and praiſe, for her almoſt miraculous deliverance, to the divine Author of it, ſhe was accommodated by her friend with clothes befitting her ſex: nor was it difficult for *Irene* (though on ſo ſudden an occaſion) to furniſh her with a habit ſhe liked; for, beſides that a perſon ſo ſhaped and faſhioned as *Theodora* could make almoſt any dreſs graceful, ſhe uſed to pity the mean vanity of thoſe ladies, that could be either ambitious or proud of what they muſt owe to a taylor or a dreſſer, and affected to be taken notice of, not ſo much for what they are, as for what they wear; and therefore, though ſhe did not ſcrupulouſly decline faſhionable clothes, becauſe they were ſo, yet all the ornaments, that paſſed the limits of the modeſteſt decency, ſhe always as little valued, as ſhe needed them.

CHAP. IV.

BEFORE this rare couple returned to the reſt of the company, *Irene*'s kindneſs for *Didymus* made her think ſhe ought not to loſe this opportunity of doing good offices to her abſent friend; and therefore having (as ſhe eaſily might) brought the diſcourſe to fall upon his late performances; I hope, madam, ſays ſhe to *Theodora*, you are now ſatisfied, that the character I gave you of the greatneſs of my couſin's virtue, and the ardency of his flame, was dictated more by his merit than my friendſhip. I were very ungrateful, replies *Theodora*, if I did not willingly acknowledge his generoſity to be altogether extraordinary, and that, as he could not oblige me more highly than he has done, ſo it was not poſſible, that he ſhould do it more handſomely.

I KNOW, madam, ſaith *Irene*, that *Theodora* may freely chuſe, among all the illuſtrious youth of *Antioch*, what perſon ſhe would pleaſe to make happy: and, without conſidering her leſs obvious, though more admirable perfections, far leſs beauty than ſhe is miſtreſs of has, in our times, given the poſſeſſors a ſhare in the imperial throne, and perhaps too placed them upon the Roman altars. But yet, continues ſhe, ſince I have

I have the honour to know you too well, not to be confident, that you value piety and virtue, and a flame regulated and excited by them, above thoſe outward advantages, which weaker ſpirits are influenced by; I think I may preſume to ſay, that I know not any perſon in *Antioch*, to whom the fair *Theodora* may, with leſs condeſcenſion, vouchſafe a ſhare in her favour, than to him, that had the happineſs to give her ſo clear a proof of the ardency, the purity, and the diſintereſtedneſs of his flame.

If I had not, replies *Theodora*, with a ſomewhat diſſatisfied look, been much ſurpriſed at the beginning of your diſcourſe, I had immediately ſtopped you there, and lamented my infelicity, that *Irene*, whom I thought myſelf happy in having for my friend, allows herſelf what is ſo repugnant to true friendſhip as flattery is. I could, continues *Theodora*, (without pauſing, for fear of being prevented,) eaſily, and with the approbation of many of the beſt judges in *Antioch*, return the fair *Irene* her own compliments, if I thought fit to imitate what I cannot approve: and to ſpeak ſeriouſly, continues ſhe, neither you nor I, nor any of our ſex, ought to think ſkin-deep beauty as great a bleſſing, as it is an applauded one; for, without our fault, and in ſpight of our care to preſerve it, a thouſand accidents may, and time certainly will, ruin the loveliеſt faces, and perhaps to that degree, as not in the remains to leave it credible, that ever they were handſome. It is true, that thoſe vain men, whoſe paſſion maſters their reaſon, are wont (for the moſt part with deſigns we ought not to be proud of) to ſpeak extravagant things, and too often even prophane ones, of the beauties they profeſs to adore: but though they really meant (which they very ſeldom do) all they ſay, in praiſe of thoſe they repreſent as goddeſſes, yet I think a conſidering perſon will ſcarce be very proud of receiving that title from thoſe, who can think, that a few colours and features luckily mingled are ſufficient to make a deity. An uncommon degree of beauty, adds ſhe, expoſes the owner to extraordinary troubles, from the envy of thoſe that want it, and the importunities of thoſe that court it. And, without as much caution and watchfulneſs as turn it into a trouble, it too often proves a ſtrong temptation to thoſe that admire it, and a dangerous ſnare to thoſe that poſſeſs it. And if I had the vanity to think, what you would perſuade me to believe, I ſhould yet take beauty in a woman to be like a rich perfume, which, though it be a thing very grateful in moſt companies, and perhaps (eſpecially at firſt) very delightful to the wearer, yet does often diſcompoſe, not only ſtrangers ſhe chances to converſe with, but the beſt friend ſhe has; and not ſeldom does miſchief even to herſelf, by diſordering her head, or caſting her into fits of the mother. I beg your pardon, dear madam, ſays the fair *Irene*, with ſomewhat of ſadneſs in her looks, that, whilſt I had ſo much beauty in my eye and thoughts, I forgot, that it was in *Theodora*, accompanied with a far greater and ſcrupulous humility; and I did not apprehend, that I could be thought guilty of flattery, ſo near to a witneſs (at which words ſhe pointed to a looking-glaſs, that hung up in the room) ready to juſtify more than I had occaſion to ſay. I willingly acknowledge with you, that the amiableneſs diſcoverable by the eyes of every gazer is a thing far leſs deſirable than deſired, and procures the poſſeſſors more praiſe, than it brings them happineſs: and for my part, adds ſhe, if I had the weakneſs to believe myſelf miſtreſs of what the folly of ſome has made them flatter me with, yet I ſhould not be over-much pleaſed with a quality, that would add to thoſe harms, my frailty makes me guilty of, thoſe which I never intended; and makes ladies ſo miſchievous to thoſe that love them, that, even when they do not rob men of their innocency, they deprive them of their quiet. I confeſs therefore, madam, (continues *Irene*) that it was injurious to inſiſt upon the praiſes of a face, when, how little ſoever it can be matched in its own kind, it is accompa-

nied with ſeveral beauties of a much nobler kind: but that, which induced me to ſpeak as I did, was to let the fair *Theodora* ſee, that I was juſtly ſenſible, how great a thing I begged for my friend, when I implored for him an intereſt in her favour. And I do the leſs deſpair of the effects of your goodneſs, both to him and me, becauſe I beg them for an abſent friend, who is not in a condition to ſpeak for himſelf; and who, as I perceived by the obliging relation you were pleaſed to make of his carriage towards you, declined making you any requeſt, when his ſervices were ſo happy as not to be uſeleſs to you. His ſilence, anſwers *Theodora*, in ſuch circumſtances, had more effect on me, than his paſſionateſt ſolicitations would have produced: but the thing, I preſume, you aim at for him, is of that moment to me, that I cannot think fit to diſcourſe of it, till we can do ſo with more calmneſs and leiſure, than we can at this time expect. You know, *Irene*, that I have ſtill looked upon marriage, as one of the moſt important actions of life: and though I think they have too mean a notion of happineſs and miſery, who imagine, that one creature can make either of them the portion of another; yet I think, that not only the dictates of diſcretion, but thoſe of ſincerity and chaſtity, oblige a woman to have a great care not to enter into ſo near and indiſſoluble a relation, upon any grounds, that are not like to laſt as long as it, (and conſequently, as our lives): and therefore, a woman, that reſolves to be what ſhe ſhould be, when a wife, ought to deliberate much upon a choice ſhe can probably make but once; and not needleſly venture to embark herſelf on a ſea ſo infamous for frequent ſhipwrecks, only becauſe ſhe is offered a fine ſhip to make the long voyage with. But, continues the baſhful virgin, (not without ſome little diſorder in her looks) ſince my dear *Irene* will needs make uſe of the privilege ſhe has to know more of my thoughts, than I would diſcloſe to any other perſon in the world; our friendſhip prevails with me to tell her, that, if I were altogether at my own diſpoſal, and could be induced to admit ſuch a change of condition, as I have always been averſe from, I ſhould be more influenced in my choice by the ſhining virtues and extraordinary ſervices of *Didymus*, than by all the advantages, that either titles, or riches, or dignities, could give any of his rivals. But, my dear *Irene*, (adds ſhe) we live in ſuch times, and I, for my own particular, am beſet with ſuch circumſtances, that it were not only very unreaſonable, but wildly extravagant, for me to increaſe my commerce with the world.

For, *Irene*, continues ſhe, in my opinion, a Chriſtian does not deſerve to be happy, and a true one cannot think he is happy, whilſt the church of Chriſt is miſerable, at leaſt as far as outward calamities can make it. When I ſee the empire over-run with idolaters and perſecutors; when I ſee raviſhers and whores adored in ſtately temples, and the only worſhippers of the true God driven into corners, and purſued even thither; when I ſee ſuch as God is pleaſed to declare *the world not to be worthy of*, treated by men, as perſons not worthy to live in the world, but daily expelled out of it, with ignominy and torments: when, I ſay, (adds *Theodora*, with tears in her eyes), I conſider the general deſolation of the church, and that I am like and willing to be, not a meer ſpectator, but a ſuffering actor, in this tragedy; I cannot, in the midſt of her ſighs and groans, liſten to the unſeaſonable compliments of a lover, or think of reliſhing any contentment, that deſcends not from a place too high for perſecution to reach. In theſe ſentiments, ſubjoins ſhe, I am warranted by no leſs authority than that of an apoſtle, who, though not unfavourable to the marriage ſtate, diſadviſes thoſe women, that are free, from entering into it, at leaſt during the preſent diſtreſs, though that were in his time very much inferior to thoſe ſtreights we are now reduced to. Yet, madam, ſays *Irene*, thoſe expreſſions of friendſhip, that a conjugal relation invites, are not only made allowable by it, but commendable;

Heb. xi. 38.

mendable; and are as real duties of piety and virtue, as divers of the more abſtracted exerciſes of religion. I do not contradict that, replies *Theodora*, but look upon that very thing, as a diſſuaſive from the ſtate of life you would recommend; for if I could think fit to enter into it, it ſhould be with a reſolution to do all, that becomes me in it: and in ſuch a calamitous time as we live in, I could not do that, without coming far more, than I now am, within the world's reach; ſince I ſhould think it my duty, and perhaps be engaged upon another account, to have ſuch apprehenſions for a near friend's danger, as my own would be uncapable of giving me. And the contentment I now enjoy in a diſpoſition to quit the world without regret, would be deſtroyed, or at leaſt allayed, by an uneaſineſs to part with, what duty and inclination would, perhaps, too much faſten me to. Here *Irene* was going to interrupt her by an anſwer, when her fair friend prevented her, by thus continuing her diſcourſe; And to me it ſeems very conſiderable, that the apoſtle I lately mentioned, clearly enough intimates, that to perſevere in a virgin ſtate, in times of perſecution, gives thoſe, that prefer it, the great advantage of ſerving God more undiſtractedly; and conſequently of being more entirely and uninterruptedly employed in the direct contemplation and ſervices of an object ſo ſublime, that our mind cannot divert to another without ſtooping to an inferior one. And though it be true, that the duties of a relation may rightfully challenge a part of an engaged perſon's time and care; yet I ſee not, why one, that has no need, ſhould enter into a relation, that would make thoſe diſtracting duties neceſſary.

THOUGH *Irene* found it ſcarce poſſible to anſwer *Theodora*'s reaſons, yet her kindneſs to her abſent friend made her unwilling to loſe the opportunity their privacy gave her, to make one attempt more in his favour; which ſhe did, by ſaying to his excellent miſtreſs; But ſhall not the as faithful as unhappy *Didymus*, be allowed to hope, that if once thoſe diſmal clouds, that pour down ſhowers of blood, ſhall be happily blown over, he may have a particular ſhare in the publick joy and tranquillity? that his ſufferings ſhall end with the perſecutions of the church? that thoſe fatal reſolutions, that are ſo deſtructive to his happineſs, may ceaſe with their occaſion? that *Theodora*'s ſeverity will not outlive the *Roman* cruelty? and that her heart will not be the laſt place, where the Emperor's cruel edicts will continue to have a fatal operation.

ALAS! *Irene*, ſays *Theodora*, ſomewhat troubled to be ſo preſſed, how unſeaſonably do you now diſcourſe to me, about things relating to a time, to which very probably my life will never reach! for, ſubjoins ſhe, to deal clearly with you, I am ſo far from flattering myſelf with an expectation of thoſe halcyon days I wiſh you may live to ſee, that I ſhall not be ſurprized, if this day proves the laſt I ſhall ſpend in this world; and if before night I paſs thence into another, where the frailty and mortality, upon which marriage was founded, ceaſing, that condition of life will have no place; but will be ſucceeded by an angelical ſtate, where our friendſhips, as well as our perſons, will be transfigured, and made incomparably more perfect, than they can be here below.

CHAP. V.

THEODORA had ſcarce made an end of ſaying this, when her converſation with her fair friend was interrupted by the notice, that was given them, of the arrival of a gentleman of their religion, who brought ſome news, that it concerned them to know. This advertiſement ſoon brought back theſe two excellent ladies to the reſt of the company, to which this intelligent and inquiſitive perſon was going to give an account, which the ſadneſs of his looks prepared them to find an unwelcome one.

one. However, they liſtened to him with great attention, as well as concern; and he, after a ſhort preamble, briefly acquainted them with ſome particulars, that will hereafter be more fully related. But that, which he himſelf ſeemed moſt moved at the mention of, and which moſt affected his hearers, was this; that when the preſident had notice of *Theodora*'s eſcape, though there wanted not ſome generous men, that endeavoured by ſeveral arguments to diſſuade him from proſecuting her any further; yet he was ſo far from being prevailed with to comply with ſo reaſonable a motion, that he ſolemnly proteſted, that if ever he could get this fugitive (as he was pleaſed to call that admirable perſon) once more into his power, he would never ſtrive again to reclaim her by the fear of infamy, (a thing, which, ſaid he, I perceived ſhe deſpiſed) but by the terror of death; ſuppoſing, as he added, that ſhe would not fly from an altar to a ſcaffold, or a ſtake; and reſolving, in caſe ſhe were inflexible, to ſacrifice her to the indignation of thoſe incenſed deities ſhe had ſo obſtinately provoked.

THE former part of this diſcourſe, which related to *Didymus*, his excellent miſtreſs heard not without ſuch inward commotions, that, in ſpight of the calmneſs and reſervedneſs of her temper, they clearly enough diſcloſed themſelves in her face, by ſeveral changes of colour, which thoſe, that had lately admired the greatneſs of her courage, could not but aſcribe to that of her concern for her diſtreſſed lover. But when the relator had concluded that part of his narrative, that directly regarded herſelf, though it filled all the auditors with grief and terror, *Theodora* ſeemed to have gained a new life; ſince, in her looks, the viſible tokens of a deep ſadneſs were ſucceeded by no leſs manifeſt ſigns of joy.

WHILE the reſt of thoſe, to whom the melancholy account was given, were entertaining one another with the reflections they made upon it, *Irene* having drawn her fair friend aſide, was impatient to learn the cauſe of that pleaſing change ſhe had obſerved in her looks.

WHILST, anſwers *Theodora*, I was liſtening to the report of the imminent danger, which the generous *Didymus* was expoſed to for my ſake, I could not but be extreamly troubled to find myſelf reſtrained from attempting his reſcue, by the manifeſt danger of being by the barbarous preſident ſent back to the infamous place, whence your virtuous friend had ventured ſo much to free me: but now that the judge, by a ſolemn declaration, has tied up his own hands from tempting me by ſo juſtifiable a fear, as that of infamy; it was no wonder my looks diſcloſed ſome tokens of a joy, grounded upon ſo welcome an opportunity to exerciſe my gratitude without hazarding my honour.

WHAT? *Theodora!* ſaith *Irene*, as it were thunder-ſtruck with this unexpected anſwer, do you put ſo ſmall a value upon that wonderful deliverance, that ſcarce an hour ago you did ſo devoutly and deſervedly give thanks for, that you will ſo ſoon ruſh into greater dangers than thoſe, that required little leſs than a miracle to reſcue you from them?

I HOPE, replies calmly *Theodora*, that I ſhall never forget, nor without a deep ſenſe remember, the admirable reſcue you ſpeak of. But I take the moſt gracious part of that deliverance to conſiſt in my being reſcued from diſhonour; and think it would be much leſs obliging than it is, if it debarred me from the ſureſt and directeſt ways to glory, and if, to preſerve my external purity, it did condemn me to ingratitude towards the meritorious inſtrument of that preſervation.

OUR lives, ſaith *Irene*, being truſted to us, as well as vouchſafed us, by God, are not ſo much at our own diſpoſal, that it is allowable for us to part with them as we think fit; and it is poſſible for us to abandon them, not only when we do directly

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and violently rid ourſelves of them, but when we do thoſe things, whoſe natural conſequence is an untimely death.

I BELIEVE with you, ſaith *Theodora*, that our lives are to be reckoned among thoſe goods, that we are entruſted with, rather as ſtewards than unaccountable proprietors; and acknowledge too, that certain actions, that do not directly, may yet criminally tend to their deſtruction. But I do not think the care of our lives is committed to us, as that of our ſouls is, with ſo indiſpenſable an obligation to keep them, that it can never, upon any terms whatſoever, be lawful for us to loſe them: for I think life to be a talent, which is indeed to be carefully huſbanded and preſerved; but is committed to us, not ſo much to keep ſafe, as to negotiate with; and is entruſted to us in order to a condition better than itſelf. And therefore, if religion, or virtue, require any thing at our hands, which cannot be performed without endangering, or even loſing our lives; in that caſe to venture them, or to part with them, is a duty, and conſequently at leaſt a juſtifiable action: and this, purſues *Theodora*, I take to be my caſe, who am ſummoned by faithfulneſs to a juſt promiſe, and by gratitude to an extraordinary benefactor, to endeavour the ſaving of an innocent perſon, who is accuſed on my account, and has brought himſelf into a great danger, only for having moſt obligingly reſcued me from a greater.

BUT what, replies *Irene*, if the attempt you deſign is far more likely to deſtroy you, than to ſave *Didymus?* For the barbarous judge is ſo much an enemy to all Chriſtians, as ſuch, and ſo much incenſed againſt you, for your eſcape, and him for having been the author of it; that the cruelty of that inexorable man will make him gladly deſtroy you both, as far as human power and rage can do it; and ſo, without preſerving to the church of *Antioch* one of its ornaments, you will deprive it of another, and a greater, by denying it the influence it might receive by ſo laſting and exemplary a virtue, as may juſtly be expected in a perſon ſo pious, and ſo young, as *Theodora*.

THE experience, anſwers *Theodora*, that this very day has afforded me, forbids me to diſtruſt divine providence, and keeps me from deſpairing to find my endeavours to reſcue your kinſman ſucceſsful; if the moſt wiſe and good, as well as abſolute diſpoſer of events, ſhall not think it leſs our advantage to be reprieved, than crowned. Without preſuming therefore to foreſee events, it is my part to do what God has vouchſafed to put into my power; and it is not my duty to reſcue *Didymus*, but it is to attempt it, and thereby acquit myſelf, as far as I am able, of what I owe to my promiſe and my gratitude. If I had the vanity to think, adds ſhe, that in a perſon of my ſex and frailties, ſuch a church as that of *Antioch* could be much concerned, I ſhould think too, that the attempt I am about to make, were the beſt way to make my life ſomewhat ſignificant: for, whereas our heathen adverſaries are ſo blinded with prejudices, that they look upon all we do or ſuffer for Chriſtianity, as the effects of a kind of ſuperſtitious frenzy, that ſeizes us, and tranſports us, whenever the articles of our faith are contended for; my expoſing myſelf to their fury, rather than be wanting to the dictates of gratitude, which they, as well as we, look on as a moral virtue, may help to convince them, that our love to virtue is general, and more diſintereſted, than they thought it; ſince Chriſtians can venture and part with their lives, as well to ſhun ingratitude, as to reſiſt idolatry.

THIS gratitude, (replies *Irene*) whoſe exceſs gives you and us ſo much trouble, is a relative thing; and benefits or ſervices received ought to be requited by actions, that are acceptable to thoſe they are deſigned to gratify; but ſure not by ſuch, as we know will be unwelcome to them. And therefore, (continues ſhe) the faithfulleſt and moſt diſintereſted of your ſervants will be far more unhappy, than the *Roman*

cruelty can make him, if what he has done doth not convince you, that he can never look upon any thing, as a favour or retribution to him, that ſhall deſtroy, or ſo much as endanger his adored miſtreſs.

I WERE very unworthy, (rejoins *Theodora*) if I did not think *Didymus* capable of the higheſt ſentiments, that generoſity and friendſhip can inſpire. But he is too juſt to forbid thoſe he loves to aſpire to ſome ſhare of thoſe noble qualities, upon whoſe account, I am to conſider, not ſo much what his virtue will reliſh, as what his condition requires; there being a ſort of debts, to which mine to him belong, that ought to be the more carefully paid, the more frankly they are remitted.

THE ſorrowful *Irene* being exceeding troubled to ſee her endeavours unſucceſsful on an occaſion, upon which, of all others, ſhe moſt wiſhed to find them prevalent, was prompted by her grief to bring her eyes to the aſſiſtance of her tongue; and weeping, ſaid to her inflexible miſtreſs, If, madam, you will not have any compaſſion for the excellent *Theodora*, at leaſt take ſome pity upon the diſconſolate *Irene*; and if her arguments cannot move you, be not at leaſt inexorable to her fears. You have, (continues ſhe) vouchſafed me the honour of your friendſhip, and the happineſs of your converſation; and by both theſe bleſſings have given me ſo much eſteem and kindneſs for ſo great a benefactor, that if you deny me, what I now implore, you will turn the nobleſt parts of my happineſs upon earth into inſtruments of my infelicity; ſince, in a world deprived of *Theodora*, the deſolate *Irene* will languiſh, rather than live, if ſhe ſhould be able to ſurvive ſo great a loſs.

Theodora, whoſe reſolution and good nature were both of them extraordinary, though ſhe had courage enough to ſupport calmly her own perſonal ſufferings, yet ſhe had tenderneſs enough to be very ſenſible of thoſe of her friends. And the moving expreſſions of the ſorrowful *Irene*, together with the tears, that accompanied them, made ſuch an impreſſion on her, that though, having foreſeen this ſtorm, it did not ſurprize her, yet it did much diſtreſs her, and let her ſee, how many uneaſy victories ſhe was to gain, before ſhe could triumphantly compleat that day's work. And though after a ſhort, but ſharp, conflict, between her kindneſs and her reſolution, the latter of them prevailed, yet it was not without ſome reluctancy and commotion, that ſhe was able to return this anſwer. Ah, dear *Irene*, do not exerciſe ſo much cruelty yourſelf, whilſt you reproach me for being cruel; and do not add to the great affliction of parting with ſuch a friend as *Irene*, that of ſeeing her ſo much troubled on my account, and of ſeeing myſelf neceſſitated to the uneaſy taſk of denying a requeſt of hers. If what I owe to my religion, and to your generous couſin, would ſuffer me, upon any terms, to alter the reſolution it prompted me to; the declaration of your deſire to have me do it would have made all the arguments, you employed to perſuade me to it, unneceſſary. It is true, that among virtuous friends kindneſs may challenge much, but not to the prejudice of conſcience and reputation. I hope our friendſhip is not, and am ſure it ought not to be, barely a mutual fondneſs of two young virgins; but that virtue had a greater ſhare in making and continuing it, than ſympathy and inclination had: and it is but juſt, that a friendſhip, grounded chiefly upon virtue, ſhould be governed and regulated by it. Permit me therefore (purſues ſhe) with that freedom and plainneſs, that our friendſhip allows, to put you in mind, that in the ſtreights, wherein providence has now placed us, it calls upon us to conſider, not only that we are friends, but that we are Chriſtians too; who ought in reaſon, as well for our departing as our departed friends, to liſten to the apoſtle of the *Gentiles*, who forbids us, upon the removal of thoſe we love, to give *up ourſelves to ſorrow, as thoſe that have no hope.* Indeed, if we were *Epicureans*, that believe the ſoul as mortal as the body, or ſuch other pagans, as bury in the graves

1 Theſſ. iv. 13.

of their friends the hopes, or at leaſt the confidence, of meeting them again; we could ſcarce too bitterly deplore a ſeparation, that would certainly, or at leaſt for aught we know, prove an eternal one. But having, through the goodneſs of God, been embracers of the goſpel, and enabled, though but imperfectly, yet ſincerely, to live according to its dictates, and be ready to die for its defence; the ſame grace may keep us from fearing, that the time of our ſeparation will be laſting enough, to bear any conſiderable proportion to that eternity, which will be allowed us to enjoy each others company in. And give me leave to tell you, *Irene*, that I cannot rejoice at any expreſſions, even of your kindneſs, that are injurious to your piety, and bring your love of me into a competition with that, which ought to be as unparelleled as its object is. They love a creature too much, that think it too good to be parted with for the creator's ſervice. It is a high injury to him, to think we can loſe any thing for him, that he cannot make us a rich amends for. And I muſt not conceal my opinion, that a Chriſtian diſparages both himſelf and his profeſſion, if he complains, that any loſs can make him unhappy, while he poſſeſſes the favour of God. Wherefore, my deareſt *Irene*, (concludes ſhe) let your friendſhip alleviate my grief, by ſhewing me, how handſomely you bear your own; and prefer, I beſeech you, upon this ſad occaſion, the exerciſe of the more generous, to that of the more tender, effects of kindneſs.

ALAS! madam, ſays the diſtreſſed *Irene*, all the fine things you ſay to comfort me, produce in me an effect quite contrary to that you deſign by them; ſince they do but the more diſcover the excellency and kindneſs of the incomparable perſon I am going to be deprived of; after whoſe company I ſhall find that of the reſt of the world too inſipid, ſo much as to divert me: and therefore, if you will not grant me the bleſſing of living with you, at leaſt do not deny me the ſatisfaction of dying with you. For though martyrdom be very formidable to a frail woman, yet heaven is more deſirable to a Chriſtian; and I ſhall not fear to take a ſcaffold or a ſtake in my way, when I travel to ſuch a place, as that, in ſuch company as yours.

You know, (replies *Theodora*) as well as I, that our religion commands us to ſuffer martyrdom, when we are obliged to do it; but forbids us to thruſt ourſelves unneceſſarily upon ſo fatal and difficult a work. The apoſtles themſelves, whoſe peculiar office it was to be the heralds and champions of the goſpel, were commanded, when they were perſecuted in one city, to fly into another; and accordingly one of the moſt courageous of them, to avoid needleſs and unſeaſonable dangers, fled to *Jeruſalem* from *Damaſcus*, though, to do ſo, he was fain to be let down from the wall of this place in a baſket. And it is but reaſonable we ſhould not, without a manifeſt call of providence, venture upon a conflict, in which we do ſo much depend upon extraordinary aſſiſtances for the victory, that the ſame bold diſciple, that ſo confidently promiſed our Saviour, that he would die for him, was, in an hour or two, the firſt that renounced him. An inſpired teacher, who was ambitious to be, as he afterwards proved, a martyr, reckons it to be the gift of God, not only to believe in Chriſt, but to ſuffer for that belief. If (continues ſhe) our conditions were exchanged, and *Irene*, inſtead of me, were by divine providence ſingled out for martyrdom, I ſhould not envy her the glory, of letting many of both religions ſee, that Chriſtianity can elevate the courage of a woman to a degree, that they think appropriated to men. I would employ my prayers rather to obtain of heaven a divine ſupport of her reſolution, than an inglorious change of it; and imitating that well-natured *Iſraelite*, who not only willingly, but gladly, parted with his dear *Eſther*, when ſhe went from him to a throne, I ſhould be more ſatisfied with *Irene*'s advancement, than with her company; and if I did not prefer her happineſs to my own, it would be, becauſe indeed I

Act. xix. 25.

ſhould look upon them ſo united, that I ſhould find mine in hers. Let me then (ſays *Theodora*) conjure you by all our paſt and future friendſhip, rather to congratulate, than lament, the remove I am going to make; and be not troubled, that one, whom you have been pleaſed ſo much to love, is called to be early happy. In ſuch hazardous times as theſe, you know not how ſoon the perſecutor's ſword may ſend you after her; and, at moſt, this mortal life is too ſhort, to let our ſeparation be very long. And in the mean time, the comfortable expectation of an unchangeable ſtate, of whoſe bleſſedneſs the renewed fruition of each other, will make a part, and not the greateſt neither, may conſole you for the abſence of a perſon, that in the *interim* will be happy enough to wiſh you where ſhe is, upon much juſter grounds, than you can wiſh her where ſhe was. Let it then (concludes *Theodora*, with weeping eyes,) be a ſufficient proof of my eſteem and love of *Irene*, that I part from her with tears, when I am going to a place, where the divine oracles aſſure us, that *all tears ſhall be wiped from our eyes*, and be ſucceeded by a *fulneſs of joy*, that ſhall laſt for evermore.

Rev. vii. 17.
Pſal. xvi. 11.

CHAP. VI.

THOUGH theſe reaſonings were ſuch, as *Irene* knew not well how to anſwer, yet being uncapable of acquieſcing in any diſcourſe, that inferred it to be her duty to part with *Theodora*, ſhe reſolved to try, whether the perſuaſions of the company, (which ſhe knew would be very forward to aſſiſt her) would not be more prevalent, than hers had been: and that ſeemed an accident very friendly to her deſign, that juſt then happened, by the arrival of an intelligent gentleman, whom ſhe had a while before employed to learn news of her friend; and who, on that ſcore, had been a curious and heedful ſpectator of all, that had paſſed at the preſident's, in relation to *Didymus*, and was come to bring *Irene* an account of it. To hear this, ſhe and her ſorrowful friend were deſired to rejoin the reſt of the company; to which the high and juſt eſteem they all had of ſo brave a gentleman, as *Didymus*, gave an impatient deſire to be informed of his adventures. To ſatisfy this curioſity, the gentleman, that was to do it, did, after a ſhort pauſe, make them the following narrative.

I SUPPOSE this company needs not be informed by me of what happened to the generous *Didymus*, between the time, that the excellent *Theodora* was condemned to an infamous place, and that, wherein he had the happineſs of helping her to make an eſcape out of it: and therefore without waſting any of that little time, whereof, I fear, we may have but too great need, I ſhall proceed to inform you, that when this aſtoniſhment, occaſioned by this ſurprize of finding a young man in the eſcaped virgin's room, was a little over, and they had cloathed *Didymus* in a habit more decent to appear in before a publick aſſembly; they led him away to the judge, to whom ſome of them related, maliciouſly enough, what had paſſed, earneſtly begging juſtice of him againſt a perſon, who (they ſaid) could not but be a Chriſtian; and who was not content to be himſelf an offender againſt the laws, but had dared to reſcue another offender from the puniſhment, to which they had doomed her.

AGAINST this charge, the undaunted *Didymus* being aſked, what defence he had to make, addreſſing himſelf to the judge, made this reſolute anſwer: I ſtand accuſed of a twofold crime, of being a Chriſtian, and of *Theodora*'s reſcue: and though I cannot ſo ſoon have forgot, how heinous my accuſers have endeavoured to make them appear, yet, inſtead of denying either of them, I ſhall own, that I glory in both.

As for Chriſtianity, in an age, wherein it is ſo cruelly perſecuted, I would not have embraced the profeſſion of it, but that I was reſolved, if there were occaſion, to ſuffer for it. And therefore I ſhall neither deny what they call a crime, nor make an

apology for it, nor deprecate any infliction, (for ſo I call it, rather than puniſhment, which ſtill ſuppoſes a fault) whereto it can expoſe me. Nor could I, without being wanting to the duty of humanity, refuſe my aſſiſtance to preſerve the purity of ſo noble a ſhrine of chaſtity, as the ſavage deſigners of a rape on *Theodora* were going barbarouſly to violate. And the inward ſatisfaction of having done what became me on ſuch occaſions, will ſupport me under any ſufferings, that ſhall be drawn upon me, but by my loyalty to perſecuted truth, and my compaſſion of diſtreſſed virtue.

THE experience I have had, (anſwers the preſident) of the effects of thoſe deſperate errors you miſcall religion, makes me inclinable enough to think, that you, as well as many others of your wild ſect, have both madneſs and impiety enough to put off the apprehenſions, as well as the other common ſentiments, of human nature, and fear death, as little as you do the Gods. But ſince you pretend to be more virtuous men, and obedient ſubjects, than others, pray tell me, what you can ſay, for reſcuing a malefactor out of the hands of thoſe miniſters of juſtice, that were going to execute the ſentence of condemnation upon her?

IF, replies *Didymus*, the ſentence you ſpeak of had doomed her to death, though I ſhould moſt gladly have ſuffered it in her ſtead, yet I had deplored your cruelty, without attempting to defeat it. But I confeſs, I could not, without indignation, as well as grief, ſee ſuch a perſon as *Theodora*, who for her beauty, virtue, and other perfections, is juſtly admired by all that know her, and looked upon as the honour of her ſex, moſt injuriouſly condemned to ſo infamous and barbarous an uſage, as were unfit for the meaneſt and deſpicableſt of creatures, that belong to the ſex, whereof ſhe is the ornament. And conſidering with myſelf, that chaſtity in women, and eſpecially in virgins, is ſo much a virtue, and their right to preſerve it ſo confeſſedly inherent, that all nations agree in aſcribing to them a right to defend it, without reſerve, againſt whoſoever attempts to deprive them of it; I concluded, that to help a diſtreſſed virgin to preſerve ſo acknowledged a right, was to defeat raviſhers, rather than to oppoſe magiſtrates, and not commit a crime, but hinder the accompliſhing of one. Nor could I think, that it was againſt the Roman judges I acted, when I oppoſed perſons, whom their ſavage deſign made me look upon as the worſt ſort of Barbarians. And I did not doubt, Sir, (continues *Didymus*) that in your own breaſt, when calmer thoughts ſhall come to ſucceed thoſe, that lately poſſeſſed it, I ſhall be abſolved from an action, which kept you from diſhonouring yourſelf as much, as the exceution of your ſentence would have defiled *Theodora*; and kept you innocent as to act, from what would have made you enemies for ever, not only of the faireſt half of mankind, but of all thoſe of our ſex, that retain any ſparks either of virtue or good nature.

IF *Theodora*, (replies the preſident) were not a beauty, and one of your obſtinate ſect, I doubt you would never, for her ſake, have adventured upon ſo deſperate an attempt, as makes you not more diſobedient than obnoxious to the law.

I SEE not, Sir, (rejoins *Didymus*) why it ſhould be a diſparagement to *Theodora*'s beauty, or to the impreſſions I have received of it, that all, that it has engaged me to do, has been, with the utmoſt hazard of my life, to reſcue her purity, and deny myſelf, in the firſt place, the advantages I endeavoured to deprive others of. But the charms of her mind needed not thoſe of her face, to make me attempt to preſerve her. I have often in camps contended, not without hazard enough, with my victorious fellow-ſoldiers, to keep them from violating the chaſtity of captives, who had neither beauty to captivate others, nor any thing elſe to engage me in their quarrel, except their being innocent and diſtreſſed women. But *Theodora*, ſetting her beauty and birth aſide, has been ſo eminent, for all the good qualities and excellencies, that can accompliſh a perſon of her ſex, and eſpecially for her chaſtity, that my heart

would have reproached me for not prizing virtue enough, if I had declined ſo happy an opportunity, to expreſs the veneration I paid ſo ſhining a one, as hers. But, (purſues *Didymus*) I would not, by what I have ſaid, be thought to deny, that my religion had a ſhare in the attempt I made to ſerve a perſon, that did ſo much adorn it, and was ſo loyal to it. The Chriſtian doctrine, among many other excellent things, that it preſcribes to its embracers, teaches them, that in ſome caſes, among which ours is comprized, they *ought to lay down their lives for one another*. But, Sir, (concludes *Didymus*) you may be pleaſed to take notice, that what I acted was according to the rules of it too: for I did not oppoſe the execution of your cruel ſentence by force, but only prevented it by an innocent ſtratagem, whereby my ends were obtained without bloodſhed or violence; no man's life having been ſo much as endangered, except my own, which I never thought myſelf bound to preſerve from any danger, that piety or humanity ſummoned me to undertake.

1 John iii. 16.

THOUGH the preſident could not but be ſenſible, that *Didymus* had ſaid more for himſelf, than was expected; yet, that he might not be thought to be ſatisfied with the defence of a perſon, whom he meant to condemn, he told him; I do not think it ſtrange, that thoſe, who dare call the very worſhip of the gods ſuperſtition and idolatry, and that, which all men but yourſelves call impiety, religion, ſhould ſtyle rebellion againſt the magiſtrate, loyalty to the truth. But how induſtriouſly ſoever you ſtrive, not only to cloak a criminal action, but transform it into a virtuous one, I can eaſily, through all its diſguiſes, perceive the diſobedience and refractorineſs to civil government, that is ſo contagious, and ſo ſpread among the embracers of your ſect, that princes have no other way, but your ruin, to ſecure their own ſafety, which would be quickly endangered, if your power and numbers were half as great, as the diſloyalty of your principles and practices.

To be a ſufferer for my religion, (anſwers *Didymus*) is that, which I ſhall not ſo properly ſubmit to with reſignation, as embrace with joy: but to find my religion a ſufferer with me, if not for me, and to ſee Chriſtianity made a ſtate-crime, while it ſeverely prohibits and condemns all crimes, and none more expreſly, than diſobedience to the juſt commands of magiſtrates, is that, which I confeſs, does not a little trouble me; and therefore, Sir, I hope you will allow a perſon, that is much more concerned to keep his religion, than himſelf, from being endangered by this accuſation, to give you a righter apprehenſion, than our calumniators have done, of the innocenteſt, as well as the trueſt, religion in the world.

THOUGH, for my part, (continues *Didymus*) I think, that the liberty of ſerving God, by ſuch ways, as are not repugnant to the light, or laws of nature, or the welfare of civil Societies, is the common right of mankind, and cannot be denied man, without injuſtice; yet I do not now plead for it; and you are more concerned to look to that, than I. For if you make me ſuffer, for the innocent uſe of that right, which God and nature have granted unto all men, I ſhall but undergo a tranſient puniſhment; but you will expoſe yourſelf to an eternal, and (which is worſe) to a deſerved one. No perſons in the world can pay more obedience to the laws of their ſuperiors, than Chriſtians do. We, that can ſhed the enemy's blood, and hazard our own, as freely, and perhaps as ſucceſsfully, as any ſoldiers in your armies, ſuffer you to ſhed ours, as tamely as any ſheep you have in your folds. And ſure, we are very unhappy, as well as you very incredulous, that thoſe profeſſions of loyalty and obedience, that are not more viſibly written in our books, than frequently ſigned with our blood, cannot gain credit with you; nor our death itſelf convince you, when the wounds, that we quietly ſuffer to pierce our breaſts, would open you windows into our hearts, if ſome had not a greater mind to pierce them, than to know them. But the ſame juſt care

we

we have to obey authority, what rate ſoever the ſubmiſſions coſt us, forbids us to do thoſe things, for the refuſal whereof authority condemns us. For God being, as the only creator, ſo the ſupreme governor of man, his laws are thoſe of the trueſt ſupreme authority: and princes themſelves being his ſubjects, and but his lieutenants upon earth; to decline their commands, whenever they prove repugnant unto his, is not ſo much an act of diſobedience to the ſubordinate power, as of loyalty to the ſupreme and univerſal ſovereign. And in ſuch caſes we are no more rebels againſt the emperor, when we prefer the performance of God's laws to a compliance with his, than we ſhould be, in caſe we ſhould diſobey the orders of the governor of the province we live in, if they ſhould prove repugnant to thoſe of *Auguſtus*. And even in theſe caſes, if we cannot yield an active obedience to the commands of the civil ſovereign, we do not refuſe him the utmoſt we can conſent to, which is paſſive obedience: and when our conſciences permit us not to do thoſe, to us, unlawful things, that he commands, they enjoin us to ſuffer unreſiſtedly, whatever penalties he pleaſes to impoſe. And give me leave, Sir, to add, (ſo *Didymus* continues) that we are ſo far from making religion a cloak to the purſuit of preſent advantages, that you daily ſee us renounce them all, and our lives to boot, to maintain our loyalty to our maker, without hopes of being recompenſed, but in another world; and even there we cannot expect any, but by the ſentence of a judge, whom none can either bribe or deceive, and who is more ſevere to crimes, than any perſecutor on earth can be, to innocents. I will not tell you, purſues *Didymus*, that, on the other ſide, the aſſurance we have of the ineſtimable rewards laid up in heaven for loyalty to God and his truths, the internal applauſes of a good conſcience, are things of ſo elevating and ſatisfying a nature, that our religion can make the hearts it poſſeſſes, not only deteſt the ambition of thoſe ſubjects, that aſpire to earthly crowns, but perhaps pity the condition of thoſe princes, that poſſeſs them. But I dare, Sir, avow, that the harmleſsneſs of our principles is not more legible in our profeſſion, than in our practices and ſufferings. For the multitude of Chriſtians is ſo great, that [in your cities, your country, your courts of juſtice, your camps, and all places of publick reſort, except your temples, they are not only preſent, but numerous;] and your enemies, as well as your armies, have been ſufficiently convinced they know as well, how to kill, as die: ſo that it is only becauſe we will not forfeit our innocence, by a forbidden way of defending it, that we are expoſed to ſuch cruel ſufferings for it. And I doubt not but equitable eſtimators of things will conclude, that our calmly ſubmitting to ſuch inhuman uſages ſufficiently ſhews, that we do not deſerve them. *Tertul.*

THE judge diſcerning ſtill more clearly, that his diſcourſes made much leſs impreſſions upon *Didymus*, than thoſe of *Didymus* did upon the hearers, reſolved to break off this kind of converſation, and with a ſtern countenance, told the priſoner, that it was high time for him to remember, that he was a judge, and not a prieſt; and that therefore, though his compaſſion had hitherto invited him to employ perſuaſions, yet now their unſucceſsfulneſs obliged him to declare poſitively, that he was ſure the gods, that he and the world worſhipped, were the true ones; and that if *Didymus* did not forthwith acknowledge them to be ſo, by ſacrificing to them, he ſhould quickly feel their power, by being put to a death, his obſtinacy made him both deſerve and appear fond of.

DIDYMUS, without ſeeming to be at all moved at this rough language, calmly, as well as reſolutely, replied:

THOUGH, Sir, I am moſt ready, whenever I am called to it, to ſuffer for my religion, yet I would not be thought to expoſe myſelf, for an obſtinate denial, to hear and conſider, what may be objected againſt it. We Chriſtians, whatever wilfulneſs may be miſimputed

miſimputed to us, are not ſo fond of ſufferings, or of our own conceits, as not to be more willing to have them brought to the bar, than to be condemned there for them: and perſecuted opinions are things, which, as we do not renounce, ſo we do not embrace, for their being ſuch. Nor are we ſo blind and wilful, as to reject clear arguments, that would both inſtruct us and reſcue us too, if any ſuch could be propoſed by the embracers of your religion.

THIS I ſay, Sir, continues *Didymus*, not to contradict what you were ſaying of your being not a prieſt but a judge; but to clear conſtancy from the imputation of obſtinacy, and declare, that if we could ſee reaſons on your ſide, fitted to deliver us from error and from death, we would not be ſo mad, or ſo perverſe, as to chuſe rather to renounce life, than embrace truth. But pardon me, Sir, (ſubjoins he) if I think, that though you are commiſſioned by the ſupreme power to be a judge for life and death, yet you are not conſtituted by the ſupreme verity a judge of truth and falſhood: and therefore, I take your owning to worſhip many gods, who, by their very being many deities, are ſufficiently proved not to be true ones, for a declaration of your opinion, not a demonſtration, that it ought to be mine too. If you preſs us with arguments, we are ready to anſwer yours, and offer you ours: but when, inſtead of them, you employ threats, we do not think it proper to argue againſt them, but to deſpiſe them; ſince it is not our reaſon, that they aſſault, but our conſtancy. And therefore, give me leave to tell you, Sir, concludes *Didymus*, that the Chriſtian religion can ſo fortify and elevate the mind, and place it ſo much above the reach of a political juriſdiction, that I ſhall ſuffer your ſentence with far leſs trouble, than you will ſoon or late feel at the remembrance of your having pronounced it; and you will not find it in the power of all your executed threats, to ruin either my conſtancy, or ſo much as my joy.

THE judge, enraged to ſee his power thus deſpiſed, and, as he interpreted it, affronted by a priſoner, declared, he would defer no longer than one hour (which ſpace he allowed him to repent his errors in,) to pronounce againſt him the fatal ſentence, and commanded him to be immediately led to the place, where it was to be executed; towards which he himſelf intended to follow at ſome diſtance; whether it were to feed his cruel eyes with a ſpectacle, whoſe tragicalneſs his revenge would make acceptable to him; or to prevent any tumult or diſorders, that the courage of *Didymus*, and the eſteem and pity it had excited in the numerous by-ſtanders, might poſſibly occaſion.

CHAP. VII.

AS ſoon as the gentleman, that made the paſt diſcourſe, had ended it, the juſt idea it formed in the minds of the hearers, and eſpecially of the two ladies, of the ſingular piety and heroic courage of *Didymus*, made ſuch an impreſſion on the grateful and compaſſionate *Theodora*, as exceedingly heightned her reſolution to reſcue him, if it were poſſible, and haſtened her to begin immediately to attempt it. In order to which, having obſerved, that the hearers liſtened ſo attentively to what the relator ſaid, that they then minded nothing elſe, ſhe took that nick of time to withdraw herſelf ſilently into another room, and by a pair of back-ſtairs, conveyed herſelf out of the houſe; whence by indirect ways, (for fear of being overtaken in the ſhorteſt,) ſhe went with as much haſte and gladneſs to an almoſt certain death, as others are wont to ſhun and eſcape it with; leaving *Irene* and her other friends, no leſs amazed than troubled, when ſometime afterward they perceived her miſſing, and found all the diligence they employed to retrieve her fruitleſs: for, *Theodora*, fearing ſhe

ſhe could not long eſcape the diligence of her purſuers, unleſs ſhe haſtened to a place, where ſhe juſtly thought they would not follow her, delayed not to go directly towards the company, that ſhe was told attended the preſident in the affairs, that were tranſacting in his court. Among theſe attendants ſhe had not ſtaid long before ſhe deſcried her brave lover under a ſtrict and rude guard, but with a look ſo manly, and ſo ſerene, as ſhewed, that he deſerved another uſage, and was not in the leaſt daunted nor diſcompoſed by that he met with. This moving ſight ſo affected the generous and compaſſionate *Theodora*, that though in ſo publick place and manner ſhe could with leſs reluctancy die for *Didymus*, than ſhe could plead for him; yet her gratitude ſurmounting her baſhfulneſs, after ſome conflict within herſelf, ſhe made towards the tribunal, to which ſhe found a more eaſy paſſage than ſhe expected; for the advantageouſneſs of her ſhape and ſtature, and gracefulneſs of her motions, eaſily produced for her ſuch ſentiments in the admiring by-ſtanders, as made them with great reſpect give her way, and let her, without diſturbance, paſs on to the bar. She had but a very little while ſtaid there, before the preſident was moved by the concourſe of thoſe, whom curioſity and wonder invited to gaze on the fair ſtranger, to caſt his eyes on her; and notwithſtanding the unlikelihood, that ſhe ſhould appear there, without having been forcibly brought thither, as ſoon as, out of reſpect to his dignity, ſhe had lifted up her veil, he diſcerned, that it was ſhe, by a ſort of beauty ſo peculiar, as was not eaſily either to be met with in others, or to be forgotten by any, that had ever ſeen it.

BUT though the judge were thus ſurprized at her preſence, yet he little leſs admired her courage, than her beauty, when, with a face, wherein the bluſhes of her cheeks, and the aſſuredneſs of her looks, equally diſcovered her modeſty and her fearleſsneſs, ſhe told him, I know, Sir, that it is a very unuſual thing, for a perſon of my ſex and religion, to come to this place unſent for: but I hope you will be pleaſed to conſider, that, as the action is extraordinary, the occaſion of it is ſo too. For both virtue, the juſtice, that you ſit here to diſtribute, and gratitude founded upon the higheſt obligations, engage me to appear before you on the behalf of that brave priſoner, (at which words ſhe pointed at *Didymus*,) and preſent you the object, on which you may inflict with legal juſtice, what you cannot make him ſuffer, without being taxed of cruelty. For ſuppoſing a debt to be due to the law, yet it would be more ſevere, than juſt, to proſecute the ſecurity, now the principal offers to pay the debt. He may well be looked upon as my hoſtage, whom I now come to redeem; and it is not, Sir, your intereſt to decline the exchange, ſince by it you will preſerve a perſon, whoſe courage, engaged by his gratitude, may do ſignal ſervice in the Roman army; and ſince my eſcape was all his crime, I beſeech you let my ſurrender of myſelf obtain his abſolution.

HERE *Theodora* pauſed a while, partly to recover from the diſorder ſo unuſual and difficult an effort of her modeſty had put her into; and partly to obſerve the judge's countenance, upon his hearing, what ſhe had ſaid, and to take meaſures thence, in what ſhe was further to ſpeak. The preſident in the mean time continued ſilent, whether the longer to hear the muſick of her voice, or becauſe ſo many charms, as nature had crouded in her face, and ſo much ſadneſs, as her concern for her lover had diſplayed in her looks, had ſomewhat mollified him, as they might have done a tiger. Whereupon the fair ſuppliant hoping, that his not interrupting her proceeded from ſome relenting thoughts, reſumes her diſcourſe in theſe terms: but if, Sir, to procure the diſmiſſion of this gentleman, your juſtice had need to be ſeconded by your clemency, perhaps you never had, nor never will have, an object, whoſe merit may ſo well warrant the exerciſe of it. For his life, ever ſince he bore arms, has been employed.

ployed in the ſervice of his princes, and fearleſsly hazarded for their greatneſs. And the action, for which he is now in trouble, is ſo heroick, and ſo diſintereſted an one of courage and compaſſion, that in it he could ſcarce have any other motive, than the greatneſs of his generoſity, nor other end, than the exerciſe of it. Nor need you fear, that your clemency on this occaſion ſhould introduce a bad example; for this of *Didymus* is never like to be imitated, nor can be ſo, but by perſons too virtuous to be delinquents: and if ſuch actions be criminal, at leaſt it is unlikely they will grow common crimes. And here *Theodora* perceiving, that the impatient *Didymus* (now come again to himſelf, after the aſtoniſhing ſurprize this adventure gave him) was upon the point to interrupt her, ſhe thus prevents him. And you, brave *Dydimus*, forbear to oppoſe the accompliſhment of my juſt deſires. The courſe, that I now take, is the only, that I could take, to evidence my gratitude, and to let you ſee, that you have not exerciſed the nobleſt acts of generoſity and friendſhip towards a perſon inſenſible of the dictates of thoſe virtues. I could not (continues ſhe) but be glad to be reſcued from the ignominy of a rape; but I did not intend to be robbed of the glory of ſuffering for Chriſt; which is alſo the only means left me to evince, that I declined diſhonour, and not death, and never meant ſo much to diſoblige the world, as, for the ſake of an inſignificant maid, to deprive it of one of the moſt generous of men. You have left yourſelf but one way to increaſe your paſt favours, which is, to allow me the only real expreſſion I can make of my ſenſe of them; and that in ſuch a way, as can at moſt but make ſome little diminution of them, without pretending to make a retribution for them. If therefore (concludes ſhe) you will compleat the obligation you have laid on me, by preſerving to me the coronet of virginity, you muſt not oppoſe my obtaining the crown of martyrdom.

DIDYMUS had need of all the reſpect, that he paid his admirable miſtreſs, to keep him thus long, from interrupting a diſcourſe, that tended ſo little to his ſatisfaction; and therefore ſhe had no ſooner put a period to it, than (with a deep ſigh) he told her; Ceaſe, *Theodora*, ceaſe, to plead for the continuance of life, that you are almoſt as cruel to me, in thus endeavouring to preſerve, as you are, in thus hazarding your own. And if I durſt not hope for, from the preſident, more than I ſee I muſt, on this occaſion, expect from you, I ſhould think myſelf as perfectly wretched, as (whatever your intentions be) your proceedings are unkind. But I am confident our unbiaſſed judge is too impartial, not to diſcern in your diſcourſe, that the exceſs of your goodneſs has had the chief intereſt in the management of your plea; the caſe, about which we differ, being in itſelf ſo clear, that alone to ſtate it, is ſufficient to plead it on my behalf. For I enticed you to eſcape out of priſon, and then, at my own peril, facilitated to you the means of doing ſo: you leave me behind as a pawn to the laws, and theſe, finding me in your room, make their great miniſter, before whoſe tribunal we ſtand, doom me, for your offence, to the death deſigned for your puniſhment; which ſince I joyfully proffer myſelf to ſuffer for you, or rather, ſince you ſuffer it in me your proxy, the illuſtrious preſident is too well acquainted with his office, to need to be told, that, at leaſt in equity, the ſurety's payment diſcharges the principal from the debt; eſpecially, when he not only proffers the payment, but moſt earneſtly deſires the acceptance of it, as a great advantage to him. I hope then, great Sir, ſays he, (turning himſelf to the preſident, with additional reſpect to that he had ſhewed him before,) that you will accept of my life inſtead of hers, who deſerves a long and happy one; and that, when my ſentence of condemnation ſhall be pronounced, and gladly acquieſced in, it may free her, I am condemned for. The love of ſelf-preſervation is ſo natural, that it cannot be made capital, without affronting nature, and puniſhing as well, what men are, as what they do: and the love of purity and honour does ſo much become a chaſte

virgin, that the natural conſequences of it are too commendable to be fit to be made penal. It is I, who having deſpiſed dangers, that I might eaſily have avoided, when it was queſtion to do an illegal thing, do yet glory in the crime, that am the juſt and proper object of the rigour of your laws: and her years are yet ſo tender, and her diſpoſition ſo innocent, that ſince, if ſhe have erred, it was by my perſuaſions, if ſhe be to be puniſhed, it ſhould be in my perſon. All that ſhe has ſince alledged to appropriate my guilt, or involve herſelf in it, will, I hope, by a Roman magiſtrate be looked on, as it is indeed, as an argument of her generoſity, and not of her crime. And the Romans are too much friends to gallantry, to puniſh in a lady that virtue, that they applaud and crown even in ſoldiers.

BUT now, continues *Didymus*, I muſt addreſs myſelf to you, O *Theodora*, and muſt complain of, or at leaſt deplore, my infelicity, that after I had done and ſuffered all that I could, though it was much leſs than I would, for the preſervation of ſo dear a life as yours; you come now to hazard it, to make mine end with ſorrow. But granting you ſhould prevail in the no leſs unwelcome, than generous attempt, you are pleaſed to make, how cruel were you, to envy me at once, the two higheſt honours, that my ambition aſpired to; the glory of martyrdom, and that of *Theodora*'s reſcue! Had I as many lives as you have virtues, I ſhould eſteem them all but a cheap ranſom for a few hours of yours; ſo unlikely I am, and ought to be, to be either capable or deſirous of being preſerved by your ſuffering for my actions. And therefore, madam, if you think my little ſervices deſerve ſome recompence, ſince my higheſt contentments on earth terminate in your happineſs, there is no other way left you to reward them, but the care of your own preſervation; it being the only return that I expect or deſire of my ſervices, that you will not, by your inflexibleneſs, finally make them fruitleſs; but be content to live for his ſake, that will rejoice to die for yours.

ALL the while this noble diſpute laſted, the judge was, though not an unconcerned, yet a ſilent hearer of it; the ſtrange novelty of the conteſt, and no leſs extraordinary generoſity and gracefulneſs of the contenders, having given him an attention that kept him from interrupting them. But, when their debate had proceeded thus far, his ſtern nature, whoſe actings had been but ſuſpended by his curioſity, prompted him to tell the generous couple; I know not what preſumption makes you plead, as if each of you were the other's only judge, and had the ſupreme authority of condemning or abſolving you; and I were only an unconcerned auditor, or at leaſt ſat here to ratify the ſentence you ſhall agree upon between yourſelves: but you will quickly find to your coſt, that the Roman laws and magiſtrates are not to be trifled with.

GREAT ſir, replies *Didymus*, you much miſapprehend our conduct, if you think yourſelf ſlighted by it: for it was not want of reſpect to your authority and power, that made us diſcourſe as we did; but a ſuppoſition, not injurious to you, that you would in the exerciſe of that power manifeſt, that you deſerve it, by tempering it with two excellent virtues, that beſt become a magiſtrate, equity and clemency. This preſumption, ſir, and not any diſreſpectful one, was that, upon which we proceeded in our diſcourſe; ſtill taking it for granted, that you would not puniſh two, for that, which was indeed but the fault of one; and that if either of us were, by the other's conſent, to ſuffer, your equity, or your clemency, would prevail with you to releaſe the other.

THOUGH *Didymus* had worded what he ſaid ſo cautiouſly, that a diſcerning hearer might perceive, that his expreſſions related to the judge's dignity, not his perſon; yet that ſelf-flattery, which is but too common an attendant on men in power, making

the preſident take all theſe reſpectful words to himſelf, made him allow *Didymus*, without interruption, to proceed in his diſcourſe, and ſay; You will eaſily grant, ſir, that goodneſs, whereof clemency is a noble part, may bring a magiſtrate, who is heaven's vicegerent upon earth, as high a veneration, as power or greatneſs does; if you pleaſe to conſider, that thoſe of your religion, when they would with the moſt deference ſpeak of God, give the title of moſt good the preference to that of moſt great, ſtiling Him, as the Chriſtians likewiſe often do, *Deus optimus maximus*. Certainly, clemency is never more a virtue, nor leſs grudged at by juſtice, than when it is exerciſed towards virtuous perſons, by reſcuing them from the perſecutions of fortune, and the unintended rigour of the laws. I ſay unintended rigour, ſays *Didymus*; for I cannot think, that the Roman legiſlators, that have honoured injured chaſtity ſo much in *Lucretia*, and encouraged gallantry and other virtues, by no leſs than crowns and triumphs, meant to make the productions of chaſtity, conſtancy, and gratitude, criminal things. And though Chriſtians diſſent from others in matters of religion; yet thoſe moral virtues, that were ſo eſteemed by the Romans, do not loſe their nature, when practiſed by Chriſtians: and thoſe brave men, whoſe love to virtue made them maſters of the world, did not ſcruple to honour it in their very enemies; and did it ſo much, even in the moſt irreconcilable of them, that more than one or two ſtatues of *Hannibal* were erected at *Rome*; to which triumphant city it is perhaps more glorious to have thus honoured him, than vanquiſhed him. And ſure they, that thought *Lucretia*'s chaſtity merited ſo many ſtatues, would not think that *Theodora*'s deſerved a ſtake or a ſcaffold. This lady's actions and mine are not ſo heinous, but that in happier perſons, and milder times, they have been looked on under a notion very differing from that of criminal ones. But ſir, continues *Didymus*, addreſſing himſelf to the preſident in a very humble manner, if there muſt needs be offered up ſome ſacrifice to appeaſe the angry laws, I beſeech you to let their rigour be ſatisfied with my blood, and ſpare this harmleſs lady; to whom, if your compaſſion be needful, I hope you will not want it for an object, whoſe excellencies cannot only make it reaſonable, but meritorious. For it will preſerve to *Antioch* its faireſt ornament, and a life ſo exemplary, that to give it an untimely period, for actions, which, being laudable in their own nature, nothing but a rigid interpretation of the law can make criminal, would be to make the laws a terror, rather to the good than to the wicked. It would be thought inhuman to treat her as a delinquent, whom you may juſtly wiſh your daughters ſhould reſemble; when by the grant of what I implore, you will be ſure to receive both the thanks of her ſex, and the applauſe of ours, and, what outvalues both, the ſatisfaction of having ſaved and obliged one of the moſt admirable perſons in the world.

DIDYMUS, now perceiving that the perſon he pleaded for was preparing herſelf to interrupt him, re-addreſſed himſelf to her, and told her; Do not, madam, I beſeech you, require of my obſequiouſneſs proofs inconſiſtent with my love; and add not to my infelicity, by putting me in ſo uneaſy a condition, as to find it my duty to oppoſe your deſires. Ah! refuſe not to oblige the world, by preſerving the moſt accompliſhed it can glory in: deny me not the ſatisfaction, whereof I am ſo ambitious, of being the happy inſtrument of your deliverance; and then I may ſay, that I never could juſtly die more ſeaſonably than now, when, being at the height of all my joys, my longer life muſt of neceſſity give an ebb to my felicity; ſince, after the glory of having ſaved *Theodora*, I hope for no higher on earth, than that of dying for her. Then, perceiving her ready to renew the conteſt, he told her, (with a low voice, that the judge might not hear him, and with a ſadneſs in his looks, which ſhe, that knew his courage, could impute to nothing but his almoſt boundleſs concern for her)

Madam,

Madam, though the preſident's impatience did not call upon us to conclude our conteſt, yet my condition and reſolution ought to put a haſty period to it. For, madam, I muſt poſitively declare to you, that it would be as bootleſs as cruel, for you to think to protect my life, by the abandoning of your own; ſince to owe a life to that cauſe, would make it not only uneaſy but inſupportable to me, and conſequently uncapable of laſting: ſo that enjoining me to ſurvive you, would condemn me to a life, which, after the loſs of yours, muſt be ſpent, if it could laſt, in fruitleſly deploring that loſs. Forbear therefore, concludes he, I moſt earneſtly beſeech you, madam, to exact ſuch proofs of my obedience, that it is as little in my power to give you, as it ought to be in your will to require them; ſince for *Didymus* to ſurvive *Theodora*, is as great an impoſſibility, as it would be an unhappineſs. O admirable conteſt! where the noble antagoniſts did not ſtrive for victory, but death; or endeavoured to overcome each other, that the victor might periſh for the vanquiſhed: where ſelf-love, the moſt radical affection of human nature, is ſacrificed to a love equally chaſte and diſintereſted; and where virtue makes each of the contenders ingeniouſly ſolicitous to appear criminal, that the antagoniſt may be treated as innocent. How well does this proceeding prove that inſpired ſentence true, that *love is ſtronger than death*; ſince, in this conflict, the generous friends are by the former made rivals for the latter!

CHAP. VIII.

THE afflicted virgin, to whom theſe moving things were ſaid, finding, that ſhe ſhould but loſe her diſſuaſions on *Didymus*, thought fit to addreſs herſelf once more to the preſident; and with humble geſtures, accompanied with looks, and with a voice, that would have ſoftened any, that were not invincibly obdurate, ſhe told him, Though, Sir, the arguments uſed by this gentleman had far better proved than they have, that of us two, he is the fitteſt perſon to be condemned; yet I hope, where you preſide with ſo much authority, he will not fare the worſe for being generous; and that what he has done, will be more prevalent with you, than what he has ſaid. Ever ſince he was capable of bearing arms, he employed them in the ſervice of the Emperors; and in their camps chearfully followed the Roman eagles, wherever they durſt fly: and after his having this day hazarded himſelf ſo generouſly, out of compaſſion to a diſtreſſed virgin, what examples of gallantry may not be expected from ſuch a courage, engaged by his gratitude, when he ſhall act for the acqueſt of glory, and the ſervice of his country? If a guilty intention be neceſſary to make an action ſo, his will not be found to be criminal; ſince he did not intend the violation of any law, but to ſecond, what we are told to be the deſign of all juſt laws, which is to protect the innocent, and encourage virtue. But, if by a rigid interpretation of the law, he may be brought within the reach of it, I hope his miſdemeanor will not appear ſo great, but that your clemency may allow him all, that I beg for him, which is, that he may be permitted to repair a miſtake in the exerciſe of his virtue, by the continuation of thoſe ſervices in the Roman army, which will be far more uſeful to the public, than his death, in his preſent circumſtances, can be. To this *Theodora* would perhaps have added, (though ſhe could ſcarce have done it, without ſome reluctancy from her modeſty) The things, Sir, that he has been pleaſed to act and hazard for me, may perſuade you, that if, contrary to my prayers and hopes, you ſhould deſign ſeverity towards him, you may more ſeverely puniſh him by my death, than by more immediate inflictions on him. And it is like ſhe would have enforced her arguments and entreaties for a perſon, for whom ſhe was ſo much and ſo juſtly con-

cerned, when the preſident, vexed to find, that both of them ſo little valued life, whoſe deprivation was the moſt formidable thing he could threaten them with, prevented her, by ſaying, with a ſtern countenance, No, I will hear no more, having heard but too much already. It does not become a Roman magiſtrate to ſuffer any longer with patience, that priſoners and criminals ſhould daringly diſobey the laws, ſlight all their threats, and glory in their violation. What each of you has ſaid to prove himſelf guilty, affords abundant reaſon to condemn you both: wherefore, ſince you cannot agree among yourſelves, I will be your umpire, and give both of you what each deſires and merits. You, obſtinate maid, ſays he, turning to *Theodora*, ſhall die for having broken priſon; you diſobedient ſoldier, ſays he, to *Didymus*, ſhall die for having perſuaded and furthered her eſcape: but to ſpecify your chiefeſt crime, than which there needs no other, nor can be a greater, you both ſhall die, becauſe you are Chriſtians, and conſequently enemies to the Roman Emperors, and the gods, that made them ſo.

THIS fatal doom being pronounced, the judge ordered the condemned priſoners to be taken aſide, and ſtrongly guarded, till all things were in readineſs for their execution; which preparatives he gave order to haſten: yet finding by the diſcontented looks, and confuſed murmurs of the by-ſtanders, that the charms and innocence of *Theodora*, and the youth, courage and friendſhip, of both the no leſs generous than unfortunate priſoners, made his ſentence to be far leſs liked, than were the perſons and behaviour of thoſe it paſſed upon, declared, that whilſt he was diſpatching other public buſineſs, he permitted any, that ſhould have charity enough to make a hopeleſs attempt, to endeavour to convert thoſe obſtinate miſcreants; adding withal an intimation, that even they might ſpeed in their ſuit, if they would ſeaſonably, with incenſe in their hands, flie to the altars of the gods, and humbly implore of them pardon and ſafety.

THIS reſpite, as it expoſed the generous couple to have their conſtancy aſſaulted by infidels ambitious of making ſuch illuſtrious perſons proſelites, ſo it gave them the welcome opportunity of interchanging ſome diſcourſe with one another.

THESE conferences were begun by *Didymus*, who ſeeing himſelf upon the point of final ſeparation from his admirable miſtreſs, could not forbear feeling in himſelf ſuch diſorders, as, on all other ſad occaſions, his great courage had kept him from reſenting: and this unuſual commotion of mind, was uneaſy enough to oblige him to ſay, to the fair perſon, that occaſioned it, Though, madam, the military courſe of life I have with ſome forwardneſs purſued, has accuſtomed me to meet death in variety of formidable ſhapes and dreſſes, without being diſcompoſed by it; yet when I ſee the world going to be robbed of its nobleſt ornament, and myſelf to be deprived of the perſon I moſt love and admire in it; and when I ſee this matchleſs perſon ready to be raviſhed from us, both in the flower of her age, and by the infamous hand of an executioner, I think it were rather ſtupidneſs not to be afflicted, than any weakneſs to be deeply ſo.

I WAS, anſwered *Theodora*, ſo fully ſatisfied before of your friendſhip and compaſſion, that this new grief of yours, as it is a very needleſs proof of them, ſo it is a very unwelcome one: for, if I were to allow any thing to grieve me, when I am entering into *the fulneſs of joy*, it ought to be, that I find your good-nature renders this ſeemingly diſtreſſed condition of mine very uneaſy to you, which, through God's aſſiſtance, is very little ſo to me; and yet will be leſs ſo, if, congratulating rather than deploring our martyrdom, you will eaſe me of the juſteſt and greateſt part of my grief, that conſiſts in being unhappily acceſſary to yours, and ſeeing you needleſly troubled at mine. That circumſtance, adds ſhe, of my death, which I perceive much afflicts

you,

you, might, in my opinion, more juſtly leſſen, than aggravate your ſorrow: for I look upon it rather as a favour, than an infelicity, that I am early removed out of the world, where I ſee, and ſuffer, and (which is worſt of all) do ſo much ill. To be early reſcued from the ſnares of a dangerous and perſecuting age, and preſerved *from the evil to come*, is rather a privilege, than a calamity, to thoſe that are duly ſenſible, as I deſire to be, that one can never arrive unſeaſonably at heaven, nor be too early happy. And, in this perſuaſion (continues *Theodora*) I am confirmed by conſidering, that the firſt of thoſe, who are recorded to have religiouſly deceaſed, in the old teſtament, and in the new, juſt *Abel* and *John the Baptiſt*, both of them died young, and periſhed by the hands of thoſe that perſecuted them for their piety: and even that ſpotleſs Lamb of God, *who did no ſin*, but by his ſatisfaction, precepts, and example, *takes away the ſin of the world*, was ſacrificed almoſt in the flower of his age; ſo little is it an unhappineſs, or a mark of God's diſfavour, to eſcape the toils and dangers of a troubleſome navigation, by an early, though by a boiſterous wind, blown into the port. And if it could become a woman to encourage a hero, I ſhould exhort both you and myſelf too, generous *Didymus*, (continues ſhe) to entertain our preſent condition with ſentiments becoming Chriſtians. And, as it does not trouble me directly, ſo it ought not to trouble you upon the ſcore of ſympathy, that I am ſecured from the hazards and inconveniencies of age; but be pleaſed to make uſe of that courage, now at the end of your days, that you have conſtantly expreſſed in the courſe of your life; and do not, I beſeech you, repine, either that you or I is to fall by the hand of an executioner: for that ſeeming, and but ſeeming ignominy, was the lot both of our Saviour's immediate harbinger, and of our Saviour himſelf; and when we conſider for whom, and for what we ſuffer, we may find reaſon enough to aſſume the ſentiments of the apoſtles, who, after having been miſuſed by the Jewiſh council, *went from their preſence rejoycing, that they had been thought worthy to ſuffer for his name*; for whom we are going to ſuffer the like things: for, *Didymus*, God's gracious providence has not left us to periſh, by lingering or tormenting ſickneſs, or troubleſome old age, nor yet for ſome common cauſe, or ſome unimportant end; but all in our fate is noble; and what to others is meer death, a debt due to nature, or the puniſhment of ſin, to us is martyrdom, the nobleſt act of Chriſtianity, and ſhorteſt way to everlaſting glory. Acts v. 41

A DISCOURSE, that reliſhed ſo much more of a martyr than of a virgin, gave *Didymus* a riſe to continue a converſation, by which he found himſelf as well aſſiſted as charmed; and therefore obſerving the ſerenity of his miſtreſs's looks to be little inferior to the beauty of her face, and remembering what inſtances ſhe had that day given of an altogether extraordinary piety and courage, was, by the ſentiments theſe reflections produced in him, prompted to tell her; I ſhould be juſtly inconſolable, madam, to ſee myſelf and the world upon the point of being deprived of ſo admirable a perſon, as *Theodora* has, by this day's various trials, manifeſted herſelf to be, if I were not confident, that my loſs will be as ſhort as great; and that, in the ſtate we are now entering upon, I ſhall be allowed what approaching death will deny me in this, and ſhall find in heaven the endearing happineſs of converſing with her more freely, than our perſecutions and her reſervedneſs would here permit. For, madam, (continues he) I am friend enough to my own felicity, to believe aſſuredly, that thoſe, who ſhall be happy enough to meet in heaven, will know one another there, and have their joys heightened by the remembrance of what paſt between them upon earth. For, in the bleſt ſtate we are haſtening to, our faculties, and conſequently our memory, will not only be gratified with ſuitable objects, but be improved by enlarged capacities; and even in a condition ſhort of that we this day expect, men's knowledge has been

advanced.

advanced, at leaſt as much as is neceſſary for our knowing one another, without the helps, that are ordinarily requiſite to make us do ſo. As ſoon as ever *Adam* ſaw *Eve*, he could confidently ſay of her, that *ſhe was bone of his bone, and fleſh of his fleſh.* When *Noah* awaked from his ſleep, he could tell, that during his ſleep, his younger ſon had behaved himſelf irreverently towards him. When our Saviour was tranſ-
Matt. xvi. 4. Luke ix. 31. figured on mount *Tabor*, the three choſen diſciples, that attended him, preſently knew *Moſes* and *Elias*, whom they had never ſeen before, in ſpite of the diſguiſe, that the
1 Theſſ. ii. 19, 20. glory they appeared in put upon them. St. *Paul* tells his Theſſalonians, they ſhall be his joy and crown, before their common Lord: to the truth of which it ſeems requiſite, that both the preachers and the converts ſhall be publickly known at that great appearance, and *aſſembly of the firſt-born, whoſe names are written in heaven*; and conſequently, that men there ſhall know one another. Our divine Redeemer, continues *Didymus*, teaches us, that there is joy in the preſence of the holy angels over a repenting ſinner; which argues, that whether they know of his converſion in a more intuitive way, or by the information of thoſe angels, that are ſometimes ſent to this lower world about human affairs, they yet have a knowledge of particular perſons, and take notice of particular things, that concern them. And, which makes exceedingly for my preſent purpoſe, he introduces *Abraham* in paradiſe, calling upon the uncharitable rich man to remember what his own and *Lazarus*'s differing ſtates had been upon earth: and, which is yet more, to ſhew, that even in the place of utter darkneſs and torment, the memory of paſt things and perſons is not obliterated; the rich man is introduced, as remembering not only *Lazarus*, but his own five brothers, and their dangerous condition.

THE pauſe, that *Didymus* made after theſe words, invited *Theodora* to tell him, Since, generous *Didymus*, I have obſerved our ſoundeſt teachers to be of differing opinions about the ſubject of your diſcourſe, and that they do not look upon it as an article of faith, either that the bleſſed do, or that they do not, know one another in heaven; I preſume I may be allowed to think, that if they do, (which I know is the moſt received opinion) they do it in likelihood with other ſentiments, than we commonly imagine. For when the beloved diſciple teaches, that, though *we be here the Children of God, it does not yet appear what we ſhall be*; and adds only in general, that, *when our Saviour*, or that bleſſed ſtate, *ſhall be manifeſted*, we ſhall be like him: when, I ſay, I reflect on this, and ſome things of the ſame import, I am prone to fear, that we judge too much of our future glorious ſtate, by wrong meaſures taken from our preſent frail and mean condition. And I am apt to think, that we muſt ſtay till we come to heaven, before we ſhall frame ideas ſuitable to the prerogatives of its bleſſed inhabitants. I think our notions will then be raiſed, as well as our duſt, and our love, and other affections, will be transfigured, as well as our bodies. If we know one another, though our mutual love may perhaps be greater than it ever was on earth, yet it will not be upon the former accounts, but will be as well better grounded, as better regulated. That external beauty, purſues the fair ſpeaker, that here is ſo much doted on, and over-valued, will there be found ſo much inferior to that of every glorified body, that the difference and degrees of it will be very inconſiderable, and unable to make differing impreſſions on thoſe, that ſhall remember them: as the refulgent ſplendor of the ſun obſcures all the ſtars, and keeps our eyes from being any more affected by the greateſt and brighteſt, than by any of the reſt: ſo that our kindneſs to one another will be very little grounded upon external qualities, which will there either ceaſe, or be eclipſed; nor upon ſecular relations, which will there affect us far leſs, than our being nearly related to our common Lord; our reſemblance to whom will be the chief, as well as juſteſt ground of our mutual eſteem

and affection. When children of the ſame parents have been early parted, and long bred in diſtant places, though, when they are grown men and women, they chance to meet again, it is obſerved, that at firſt they knew not one another any more than mere ſtrangers; and when they are informed of their relation, it is not the little accidents, that happened to them at play, nor ſome features, that perhaps pleaſed one of them in the other's face, but are now very much changed by time and growth, that produce their new kindneſs; but the knowledge, that they are children of the ſame father, and their finding in each other perſonal qualities, fit to adorn their preſent ſtate, and thereby to challenge kindneſs and eſteem. And if ſome years abſence can produce ſo great a change, as to make our neareſt relations unknowable by us, and make us look with pity on the fondneſſes, that trifles produced in us in our infancy; what changes, may we think, muſt be made on thoſe, that converſed together upon earth, when after numerous ages, they ſhall meet in heaven, with minds as much changed and improved, as their bodies will then be? Shall we not, by the grounds of a virtuous complacency, be more affected and united, than we are now by natural relations, or by external beauty, and thoſe other trifles, that here produce the greateſt fondneſſes?

But *Theodora*, (anſwers the ſurprized *Didymus*) can you be ſo rigid as to think, that pure and virtuous affections cannot be admitted into heaven? ſince the ſcripture informs us, that not only joy and deſire are to be found even among the angels, (who are ſaid to rejoice at a ſinner's converſion, and deſire to pry into the myſteries of our religion) but care and actings for oppoſite ends; (as when the angel of *Perſia* withſtood *Michael*, and the angel, that talked to *Daniel*.)

I DO not abſolutely deny, *Theodora* replies, that the bleſſed know one another in heaven: and, ſays ſhe, with a light change of colour, I am ſo far inclined to believe it is true, as, for *Didymus*'s ſake, to wiſh it ſo. But, as I lately told you, I am not apt to think, the ſentiments occaſioned by that knowledge will be ſuch, as moſt men imagine. Beſides thoſe reaſons, that you have ingeniouſly laid together, I think your perſuaſion of the ſaints mutual knowledge the more probable, becauſe it ſeems not readily conceivable, how, at the great day of judgment, the juſtice of God, in rewarding and puniſhing particular virtues and crimes, can be manifeſted to the world, without diſcovering the perſons, by whom they were performed; ſince perſonal circumſtances do very much alter the nature of moral actions. And ſince the happy reſidents in heaven will have an eternity allowed them to converſe with one another in, it ſeems highly probable, that in their various conferences they will meet with, at leaſt ſome time or other, occaſions, that by leſs ſagacity than their enlightened minds will then be endowed with, may be improved to the diſcovery of the perſons they were formerly acquainted with. But on the other ſide, (continues *Theodora*) we ſhall have ſuch noble and charming entertainments to employ our attention, as will engroſs it from the little and deſpicable objects, (as we ſhall then think them) that now amuſe or buſy us; as when we behold ſuch a pompous ſolemnity as a Roman triumph, the variety of ſplendid and magnificent objects, that ſucceſſively preſent themſelves to our view, make us ſo intent upon thoſe ſurprizing ſpectacles, that even the neareſt and deareſt relations, though perhaps gazing at the ſame ſight, out of the ſame windows, are apt to forget one another. And (continues ſhe) even when the ſaints actually know and remember one another; they may love and converſe, upon terms very differing from thoſe, that were ſuitable to their mortal condition. Yes, *Didymus*, (adds ſhe) as there will be no difference of ages and ſexes, in heaven, as there are on earth; ſince all ſhall there be *like the angels*, and have *bodies conformed to the glorious body of their Redeemer*: ſo the rational friendſhips, that will be practiſed in that happy

place.

place, will receive their meaſures from the new and perſonal excellencies of their friends; from their being rivals in the love of God; and from their differing degrees of reſemblance to him, that is the *brightneſs of his glory, and the expreſs image of his perſon.* But, concludes *Theodora*, we need not ſpend more time in diſcourſing conjecturally about queſtions, wherein the change we are now going to make, will ſoon bring us to be reſolved. And, in the mean time, we may well reſt ſatisfied with this aſſurance, that ſince heaven is a place, or ſtate, where we ſhall be bleſſed with the *fulneſs of joy*; to know and converſe with each other will be there found, either a part of our felicity, or not neceſſary to it.

CHAP. IX.

WHILST *Didymus* and his excellent miſtreſs ſtood waiting, till the infamous miniſters of the preſident's cruelty had prepared all things requiſite to the execution of his barbarous ſentence; among thoſe many Roman ſoldiers, that were aſſembled there, to be ſpectators of the approaching tragedy, an officer, whom his own gallantry had ſtrongly inclined to ſympathize with a perſon, in whom he ſaw that quality ſo eminent, thought himſelf obliged to attempt the diſſuading him from perſiſting in ſo fatal a reſolution, as he had taken. Wherefore, approaching our martyr, with very obliging looks and geſtures, and drawing him aſide, The gods, ſays he, can bear me witneſs, generous youth, that it is not without ſome amazement, and more trouble, than any affliction of my own has been wont to give me, that I ſee the poſſeſſor of ſo much gallantry upon the point to be deſtroyed by an unhappy conſtancy, which, though in other caſes a virtue, muſt, being exerciſed againſt the gods, become a crime. And therefore, I cannot but ardently wiſh, that after having ſhewn ſo much patience and courage, you would at length expreſs your prudence too, by letting yourſelf be perſuaded to a compliance, that may reſcue you at once from impiety and from death.

AN advice, anſwers *Didymus*, that is propoſed with ſo much kindneſs and civility, and yet preſſed but by ſuch unſatisfying reaſons, does juſtly deſerve my thanks for it, but not my compliance with it: for the argument you bring againſt my conſtancy to the truth, is only, that my perſiſting in it will coſt me my life; which is a proof indeed, that the religion I profeſs, will lead me into danger, but none at all, that it has miſled me into error.

IT is altogether extrinſic and accidental to a religion's being true or falſe, that its embracers happen to be encouraged by preferments, or expoſed to perſecutions. Fear is but an ill counſellor in matters of religion, unleſs it be the fear of chuſing a bad one, or living unworthy of a good one. He deſerves not the bleſſing of having made a good choice among religions, that does more ſeek, in his choice, the concernments of his life, than of his ſoul. And as it is only for its being the true one, that we ſhould make choice of our religion; ſo, having once choſen it, nothing ſhould make us deſert it, but a conviction of its being erroneous, and conſequently of its wanting that truth, whoſe appearance made us embrace it. If therefore, you can ſhew me, that the Chriſtian religion is falſe, or that yours is better; I am not ſo in love with wandring, as to go on in a wrong way, becauſe I once have, by weakneſs or misfortune, been miſled into it. But if your arguments be but menaces, or any thing, that is of that ſort, which can only manifeſt, that the power is on your ſide, but do not at all evince, that the truth is not on mine; I muſt look upon what you urge, as not deſerving to be complied with, but contemned. And if it were not my cuſtom never to take any thing ill, that I think is meant well, I ſhould eſteem

myſelf not a little injured, by the argument you employ to make me abandon Chriſtianity; ſince, if a perſon leſs civil and gallant had made uſe of it, I ſhould conclude, that he muſt ſuppoſe me a coward, to hope by ſuch perſuaſions to make a proſelyte. And though I were leſs aſſured, than I am, of the truth of the religion I have always owned; yet would I not for all the world, on this occaſion, by profeſſing yours, deſert it; leſt by forſaking it, when I am threatened for ſticking to it, I ſhould procure myſelf a diſquieting temptation to ſuſpect, that I did not deal ſincerely and impartially in chuſing a religion, ſince I made choice of one, that I judged not worthy to be died for.

You miſtake my intentions, generous *Didymus*, replies the Roman, if you think I pretended to fright you into apoſtacy: my virtue would as little allow me to have ſo unworthy a deſign, as your courage would permit a hope, that it ſhould be ſucceſsful. But looking upon myſelf, as having made a right choice in that worſhip of the gods, I make profeſſion of, I could not think it injurious to you to perſuade you, rather to live in the profeſſion of a true religion, than to die for that of a falſe one. And ſince my concern for your ſafety, and the little time you have to deliberate, oblige me to ſpeak freely to you; I cannot but wonder, that a perſon, that hath courted honour at the rate you have done, ſhould loſe himſelf, for one, whom the moſt ſacred perſons of his own nation crucified as a malefactor; and who has been ſo ill-natured, as to invite his followers, both by expreſs words, and by the nature of the religion he framed, which could not but be perſecuted, to involve themſelves with him in the like unhappy fate.

THE notions (replies *Didymus*, ſomewhat nettled at this diſcourſe) that idolaters frame to themſelves, of the nature of the Chriſtian religion, are commonly as erroneous, as the ways they take to confute it are improper, and inhuman; and they are uſually no leſs miſinformed about the grounds and myſteries of our religion, than they are miſtaken about the objects of their own adorations. It is true, that the divine perſon I adore, being ſent from God his father to be the great prophet and reformer of the world, did, with a prophetic freedom, as well as authority, ſharply rebuke the ſuperſtitions of the Jewiſh ſcribes and phariſees, among whom he converſed; and did not more unmaſk their hypocriſy, and reproach their practices, by the light of his doctrine, than by the ſhining actions of a moſt exemplary and unblemiſhed life. And his holineſs having exaſperated theſe impious hypocrites, that found their authority undermined, and their perſons diſcredited by him; as their malice was too great, not to attempt the deſtruction of ſuch an enemy, ſo his conſtancy was too great, to ſuffer him to decline the greateſt dangers, by declining to perſiſt in the wonted exerciſe of his virtues; whereby he thus became expoſed to a death, which he foreſaw, and frequently foretold, and which he alſo willingly underwent, to procure everlaſting life for thoſe, who ſhould believe in him, and ſtrive to imitate him.

AND that his death, whereunto he ſubmitted to expiate the ſins of others, was not inflicted on him for his own, was evident, by his being abſolved, not only by the very judge, to whom a criminal fear of his accuſers indicted the ſentence he pronounced againſt him, but by that ſupreme and infallible judge, God himſelf; who declared by aſtoniſhing prodigies, both in heaven and earth, how much he was diſpleaſed with thoſe, that put his ſon to death; and by raiſing him from the dead, within three days, to an immortal life, proclaimed, how dear he was to him, and gave him power to make his followers partakers of that glorious condition he himſelf was advanced to. So that (continues *Didymus*) thoſe champions of his, whom he vouchſafes to ſingle out from the reſt of his followers, and call to martyrdom, have reaſon enough to look upon that call, as an invaluable honour, and a privilege: ſince,

as they are thereby made more conformable to him, in chearfully dying for truth and conſtancy; ſo they will be made more plentiful ſharers in thoſe ineſtimable advantages, that his own meritorious martyrdom procured him. Yes, for thoſe, to whom he vouchſafes the power and honour of ſuffering for him, and of imitating him, for the intereſt of truth and piety, he does not only reſerve ſuch future recompences, to crown their love and fidelity, but often gives them here ſuch happy foretaſtes, in a perfect aſſurance of it, that I cannot but look upon it, as a vaſt acceſſion to that immenſe love, that made him die for us, that he calls and enables us to die for him.

I CONFESS, (*Didymus* adds in purſuit of his diſcourſe) that, as he took upon him the form of a man, ſo he ſuffered himſelf to be uſed as good men too often are. But his miraculous power and goodneſs ſufficiently proclaimed, that he was not thrown down from heaven to earth, as your Vulcan is ſaid to have been; but that he deſcended from heaven, to make men live an heavenly life: nor did he, like many of your deities, eſpecially your *Jupiter*, aſſume an human ſhape, to do actions below the dignity of human nature; but he taught men a doctrine, worthy, as well as likely, to be brought from heaven; and gave them an exemplary life, whoſe imitation would fit them to be tranſlated thither; and then ſubmitted to the torments and infamy of the croſs, to purchaſe for his followers, by his death, that heavenly condition, for which he had qualified them by his ſpirit and his life.

THE Roman officer, not yet quite diſcouraged by the unſucceſsfulneſs he had hitherto met with in his attempt, reſolved to proſecute it yet farther, by ſaying, The ſame reaſon, that ſomewhat leſſens my wonder at your deſpiſing death for your erroneous religion, increaſes my admiration at your unconcernedneſs to avoid the kind of death that threatens your obſtinacy. For though the love of glory may invite a gallant man, like *Didymus*, to part with his life for the attainment of it; yet that ſame heroic paſſion ought to make thoſe it poſſeſſes, more apprehenſive, than others, of thoſe extremities, wherein death is accompanied with infamy, and made juſtly terrible with ignominious circumſtances; of which, none can be more diſgraceful, than the receiving it at the baſe hand of a common executioner.

THE weakneſs and examples of your gods (replies *Didymus*) have too much ſeduced you, to make eſtimates of good and evil by thoſe popular and pitiful meaſures, that I cannot but think very unworthy to be acquieſced in by a Chriſtian; who, to merit that title, muſt be ſomewhat more than an ordinary man. We judge of good and evil actions by the laws of God and right reaſon, not by thoſe of men in power; and therefore do not think, that conſtancy ceaſes to be a virtue, and conſequently an honourable, not a diſgraceful quality, becauſe legal tyrants will call it obſtinacy, and condemn men for it to the ſame puniſhments, that are allotted to diſhonourable actions. The reſpect our religion commands us to pay to a civil magiſtrate, though a perſecutor, permits us not by force to reſiſt his unjuſt ſentences. But this ſubmiſſion of ours does not at all keep his ſentences from being unjuſt, nor forbid us to think them ſo; and conſequently leaves us the ineſtimable ſatisfaction of our conſciences, that inwardly abſolve us, when outward judges condemn us. And for proof of this, you cannot but have taken notice, that, whereas truly criminal perſons, being conſcious of their own guilt, either deny what they are accuſed of, or endeavour by all means to palliate it, and to avoid the being condemned for it; we Chriſtians, on the contrary, do not only confeſs, what you call a crime, but glory in it, and do not deprecate the fate, that attends our conſtancy. Nor can it fright us from undergoing death for a glorious cauſe, that we muſt receive it from an infamous hand. For that, by which we eſtimate it, is, the quality of the action, that procures it, not the

the condition of him, that is employed to inflict it: and so we can consider with joy for what, we are not much troubled to see by whom, it is that we suffer; being satisfied, that the executioner's hand may destroy a malefactor, but cannot make one; and if the cause, that brings the man to the scaffold, be not culpable, the place can not make the death that is there suffered, infamous: nay, and if virtue leads him thither, the instruments of his death cannot keep it from being glorious; since this demonstrates the sufferer's unshaken constancy to be insuperable, not only by death, but by that, which many have embraced death to shun, the contempt of the generality of men. Your gallant Roman commander, *Attilius Regulus*, is much less remembered and celebrated for all his military exploits and attempts, than for the cruel death he suffered by order of the Carthaginians, to whom, in performance of a promise, he yielded himself up, with expectation of some such barbarous usage as he met with. And sure, as a submission to indignities was a duty not meanly glorious in him, to shun the breaking of his word to his enemies; the like resignation of themselves, will not, by unbiassed judges, be thought an action dishonourable in Christians, to prevent the violation of their faith solemnly given, not to a savage enemy, but to a divine friend, who has already, without any obligation to do it, suffered more shame for them, than the sublimity of his condition leaves it possible for them to suffer for him. And though that Greek philosopher, *Socrates*, whom your own oracles, with more of truth than they are wont to be guilty of, pronounced the wisest of men, was by his own fellow-citizens condemned to die by poison brought him by the hand of an executioner: yet since that sentence was nót occasioned by his crimes, but his virtues, the deadly draught did not destroy his fame with his life; and poisoned not his reputation, which it extremely heightned, but that of his accusers, and his judges; whom after ages have looked upon, as worse criminals than ever they condemned, and more unworthy persons, than those they employed to execute their sentence. And for my part, (continues *Didymus*) some passages of our sacred records encourage me to expect, that, if a posthume fame be such a blessing as many imagine, the indignities we suffer now will hereafter procure it us. For I cannot but hope, and methinks I foresee, that the Roman eagles will one day stoop to the cross of Christ; and the temples of your false deities will be consecrated to the service of the true God. The sword of the civil magistrate, which is now the great and only successful argument on your side, will be then in Christian hands, which I wish may never employ it against your religion, whose ruin will not require the active opposition of power, but the bare withdrawing of its preserving support. And then posterity, more enlightned and more just, will read the history of those destroyers of the baptized (which is, at least, the innocenter) part of mankind, with the same resentments, with which they will read the havocks made by wars, plagues, massacres, and other publick calamities.

CHAP. X.

THESE replies of *Didymus* made an end of convincing the person, that occasioned them, that our martyr's resolution was not to be shaken, either by threats or persuasions.

BUT yet the officious Roman cherishing some hope, that if *Didymus* should see his mistress ready to be killed by an infamous hand, that beauty, which had conquered his heart, would soften it, and thereby make it capable of relenting impressions; thought fit to make one address more, and tell him, It is not without extreme regret, that I see your inflexible obstinacy defeat all my endeavours to procure your safety.

But though your miſtaken gallantry may make you think it unhandſome in a ſoldier, to diſclaim a threatened opinion, that he once adhered to, leſt the change ſhould be imputed to fear or levity; yet I hope you will not think, that the ſtrict rules of that deſtructive gallantry ought to oblige a young lady, in whoſe ſex courage is, at leaſt, an unrequired, if not an altogether improper, virtue: and therefore, I hope you will not refuſe to ſecond my endeavours to perſuade her not to throw herſelf out of a world, of whoſe grandeurs and pleaſures her tranſcendent beauty promiſes her an extraordinary ſhare, as well as her youth fits her to reliſh them perfectly, and enjoy them long.

DIDYMUS, though at firſt ſomewhat ſurprized at this motion, took no long time to return anſwer, by ſaying; I confeſs I cannot partake of the trouble you are pleaſed to expreſs, for the not prevailing of your endeavours to alter my reſolutions; for though the advice you preſſed upon me, was obliging in you to give, yet it would have been criminal for me to take it.

AND as for what you propoſe, in reference to *Theodora*, I muſt deſire to be excuſed from making myſelf acceſſary to your deſign of tempting her: for, in my opinion, he, that ſolicits another to what he believeth a crime, doth become guilty of one; ſo that, as to what concerns *Theodora*, without being at all ſure of ſhaking her virtue, I ſhould moſt certainly ruin my own innocence. Yet I cannot think, (ſays the Roman, interrupting him,) but if you would enforce my perſuaſions with yours, the intereſt you have in her would prevail to make her rather accept of life, than deny a perſon, that ſhe owes ſo much to, and does not leſs highly, than juſtly, value.

IF (replies *Didymus*) I ſhould yield to uſe ſo criminal means, as to give her an example of the apoſtacy you would have me invite her to: the attempt would be leſs improbable: but for me to perſuade her to what I am juſt going to give a convincing proof, that I believe to be worſe than death, would make her both hate me and deſpiſe me. And to convince you, that ſuch a motion as you would have me make, would loſe me all the ſhare I may have in her good opinion, I will dare to own to you, that if I thought her capable, I ſay not of endeavouring to ſeduce me, but of being ſeduced by me, my eſteem of her would alter upon her change. And though I could not deny my wonder to ſo rare a maſter piece of nature, as is her viſible part; yet there would be a vaſt difference betwixt a meer admiration of external beauty, which muſt become the trophy of age or death, and that high veneration, that I now pay to that admirable perſon's intrinſic worth and unconquerable virtue.

NOR ſhould you doubt (continues *Didymus*) of the entertainment, that ſuch a piety as hers would give ſuch a motion as you would have me make; ſince it would juſtly give her a higher reſentment of my ſolicitations, than of all the importunities of her heathen perſecutors: for theſe do but adviſe her to decline danger, by embraceing what they think truth; whereas that, which you would have me to perſuade her to, is to purchaſe her ſafety, by renouncing, what I, as well as ſhe, know to be truth: and I doubt not, that ſuch a proceeding would ſo highly offend her, as to enable her, by a bare pardon, to acquit herſelf of thoſe reſpects and ſervices of mine, to which poſſibly a perſon of her goodneſs vouchſafes ſome title to her gratitude.

THERE IS (replies the Roman) ſo great a difference betwixt the caſe of a reſolved ſoldier, that thinks himſelf in point of reputation engaged not to retreat, and that of a young lady, from whom no reſoluteneſs, much leſs obſtinacy, can be expected, that I muſt yet think our joint perſuaſions, though unaſſiſted by your example, would with-hold her from death, now ſhe is near enough to it to ſee the horrors of it.

NAY,

NAY, (rejoins *Didymus*) I did not ſpeak what I have been ſaying about my own averſeneſs, that I might hinder you from trying your fortune, if you think fit, with *Theodora*'s virtue. I do not envy her conſtancy (whoſe ſucceſſes have been hitherto no fewer than its trials) the honour of gaining more than one victory in one day. But what I have been ſaying, was to give you one reaſon of my refuſing to join with you in your propoſed attempt; againſt which I ſhall now offer this other reaſon, that I think it little leſs than impoſſible it ſhould ſucceed. For I thought I had already ſatisfied you, that as to my intereſt in *Theodora*, if it were much greater, than you, for want of knowing us both, imagine; ſo great a miſ-employment of it, would make me juſtly forfeit it; and perſuaſions, that would ſeduce her to apoſtacy, inſtead of making her follow the advice, would make her but deteſt the adviſer. And as to the hopes you ground on her ſeeing herſelf upon the point of paſſing out of the world; let me tell you, that the ſevere exerciſes, to which her ſtrict piety hath long accuſtomed her, have ſo diſingaged her affections from temporal things, that, being already mortified to the pleaſures and vanities of the world, death can now do no more, but free her from the troubles and perſecutions of it. She hath employed a great part of her life, in preparing herſelf to part with it joyfully, whenever nature and virtue ſhall require it; and ſhe will find it very eaſy to lay it down for religion, now ſhe is in a ſuffering condition, when in her moſt flouriſhing one ſhe found it enough to wean her from the love of the preſent life, that it detained her from the next. Great virtues, ſuch as her's, are like great rivers, which the nearer they come to the ſea, where they are to end their courſe, the greater they are wont to grow, and the more difficult the ſtream is to be withſtood or hindered from its progreſs. *Theodora* now looks upon herſelf, as having but one more ſtep to make, to reach that crown ſhe hath done and ſuffered ſo much for: and that glorious object viewed at ſo near a diſtance, ſo raviſhes and ſo poſſeſſes her eyes, that ſhe will doubtleſs either not ſee, or not regard, any thing, that would hinder or retard her taking poſſeſſion of it.

HERE the Roman officer, ſomewhat impatient at *Didymus*'s diſcourſe, would no longer forbear interrupting it, by telling him; To hear you ſpeak, one would imagine that you are not talking of a young lady, but of ſome ancient hero, that had been long accuſtomed to deſpiſe the frowns of fortune and keep himſelf from over-valuing her ſmiles.

HEROIC virtue (replies *Didymus*) does as little know ſexes, as doth the ſoul, wherein it properly reſides. A habitude cannot always be eſſential to the nature of an heroic action; ſince the firſt of that kind, that one does, is not the conſequent, but the beginning, of a habitude: and a ſincere and ſettled reſolution to be highly virtuous may make a woman (as well as a man) to be that, which the nobleſt ſubſequent actions can but declare her to have been. And a perſon, that, like *Theodora*, acts by the aſſiſtance, and as in the preſence, of the Deity, may, to maintain her loyalty to God, and her title to the ineſtimable rewards he hath promiſed to perſevering piety, both act and ſuffer greater things, than thoſe very heroes you talk of were put upon, by ſuch barely human motives, as cuſtom, ambition, or revenge. And particularly, as to the point of perſeverance againſt menaces, and proffers; theſe are not like to prevail againſt the conſtancy of Chriſtians much leſs poſſeſſed with divine love and hope, than *Theodora* is. And indeed, there can be nothing upon earth capable to bribe them, to let go the joys of heaven, that ſee themſelves entering upon the poſſeſſion, and find themſelves ſenſible of the ineſtimable value of them.

WHEREFORE (concludes *Dydimus*) you will not, I preſume, think it ſtrange, that I refuſe to join with you in a deſign, that I could not ſo much as attempt, either with hope, or without a crime; and that thinking it worthier of my endeavours to imitate *Theodora*'s conſtancy, than to ſeduce her from it, I chuſe rather to be a ſharer in the triumphs of her virtue, than a trophy.

CHAP. XI.

THIS reſolute concluſion obliged the Roman officer to break off a converſation, whereby he plainly ſaw there was no cauſe to hope he could ſhake the conſtancy of *Dydimus*, and much cauſe to fear, that *Dydimus*'s conſtancy and diſcourſes would ſtagger many of the heathen auditors. And therefore withdrawing himſelf, much diſcontented at the unſucceſsfulneſs of his perſuaſions, he thought it would be impious to make any interceſſion for perſons he judged invincibly obſtinate, or divert the fatal proceedings of the judge; who, having by this time made an end of thoſe other affairs, whoſe diſpatch *Theodora*'s reſpite was not to outlaſt, called for the innocent criminals, and, with a ſtern countenance and voice, demanded, whether they were yet willing to appeaſe the deities they had provoked; and, by burning incenſe to them, endeavour to atone for the affronts they had offered them; adding, that there was now no more time left for deliberating, but that they muſt immediately renounce their impious religion, or ſuffer death for it.

BUT this could not ſhake the illuſtrious priſoners conſtancy, which prompted them to make, with as much haſte as the preſident could deſire, an anſwer, that conſiſted but of a ſhort and reſolute declaration; that they had lived worſhippers of Chriſt, and had a thouſand times rather die, than ceaſe to be, or to profeſs themſelves ſuch; and that for the falſe Gods, the preſident would have them adore, they had rather be their victims, than their ſuppliants, and fall ſacrifices to them, than offer them any.

THIS bold profeſſion ſo incenſed the perſon it was made to, that he immediately gave order, that the priſoners ſhould be led away to the place of excution; and that the miniſters of juſtice, (as he miſnamed his cruelty) ſhould, without delay, go on with the preparations, that were making to deſtroy them. But while theſe officers were ſolicitous to obey thoſe commands, *Theodora* took the opportunity, to tell the generous companion of her ſufferings: It was fit, I confeſs, when we diſcourſed with infidels, to recommend the objects of our hopes, by giving them the glorious titles of crowns and triumphs; ſince being to defend the reaſonableneſs of our conſtancy, by the greatneſs of the rewards we expect for it, it was very proper to repreſent thoſe cœleſtial recompences, under the notion of ſuch goods, as thoſe we argued with acknowledged to be the moſt noble and deſirable. But, (continues ſhe) when we ſpeak of Heaven among ourſelves, give me leave to tell you, that I think we ſhould look upon it under a very differing notion; and make a wide diſparity betwixt the Chriſtian's paradiſe, and the poet's elyſium. The triumphs we ſhould moſt deſire in Heaven, ſhould be, not over our outward enemies, or perſonal ſufferings; but over ſin and ignorance, and the frailties of our natures, and the imperfections of our virtues. And the poſitive bleſſings, that ſhould moſt endear Heaven to us, ſhould be, not ſo much, that we ſhall there be crowned by Chriſt, as that we ſhall live with him, and *follow that ſpotleſs lamb, where-ever he goes*; that our gratitude itſelf ſhall be perfect, as well as the bleſſings, that engage it, ſhall be compleat; and that we ſhall have an eternal day to contemplate that ſun of righteouſneſs, without having that glorious object veiled by any interpoſing cloud, much leſs hid from us by

by the viciſſitudes of day and night. In ſhort, I think, devotion ſhould in our future ſtate aſpire to other things, than thoſe, that may be the objects of meer ambition.

AND now, generous *Didymus*, (adds *Theodora*) ſince we are entering upon the laſt ſcene of our mortal life; let us (I beſeech you) ſummon together and rouſe up all the graces and virtues we have received from heaven, and fervently implore both an encreaſe of them, and a ſupply of any, that our preſent circumſtances require; that we may go off the ſtage piouſly, as well as handſomely, and both act and ſuffer as becomes Chriſtian martyrs. Let not any cruelties or affronts of our inſulting perſecutors be able to diſcompoſe us; but let our evenneſs of mind convince them, that they can as little diſorder us in our way to heaven, as hinder us to get to our journey's end. But let not our undauntedneſs appear the effect of ſullenneſs, or fierceneſs, or of meer reſolvedneſs; but let it be ſo calm and charitable, that we may not be ſuſpected to be the martyrs, rather of our glory, or our courage, than of our religion. Let it not be thought, that we hate life, or deſpiſe it; but only that we think it a cheap purchaſe for heaven, and for the honour of owning and following a redeemer, who, to merit it for us, took the croſs in his way thither.

ADMONITIONS ſo becoming a dying Chriſtian received ſuch an entertainment, as the piety of it, and the veneration he had for the giver, might juſtly challenge from ſo devout and elevated a ſoul, as that of *Didymus*; whoſe reſolute anſwers to the Roman officer, together with his behaviour, as well ſince as before he made them, leaving his enemies no more expectation, that he could be prevailed with, either to alter his own reſolution, or tempt his miſtreſs to change hers; he was appointed to be firſt led away to execution, that the ſight of his blood might terrify *Theodora*, and fright her into a care to preſerve her own. This reſolution of his enemies did not at all leſſen his; but having eaſily obtained leave from the Roman officers, that could not but admire his gallantry, and ſomewhat compaſſionate his condition, to ſay a few words to *Theodora*, he went to that excellent perſon; and approaching her with a far greater reſpect, than he would ſhew to any power, that could but preſerve that life, which the Romans were going to take from him, he told her: Your piety, madam, and your example making me preſume, that, upon ſuch an occaſion as this, I may, with your conſent, part with a life, which, ever ſince I had the fate to ſee you, has been ſo much at your diſpoſal; I am now going without reluctancy to perform that laſt duty, whereto religion calls me. But thinking myſelf obliged to begin with the moſt difficult part of my martyrdom, before I bid farewell to the world, my inclination and reſpect brings me to take my laſt leave of the faireſt and excellenteſt perſon in it. If, madam, (ſo he proceeds) I were in a condition of paying you any further duties, my humble requeſt to you would be, to have the honour of your further commands. But ſince my condition leaves me not a capacity of ſerving you for the future, one of my laſt petitions to you muſt be, to be pleaſed to look upon my paſt ſervices, as extremely ſhort of the deſires of a perſon, that loved you with as much ardency, as your charms themſelves could kindle; and yet with ſo pure a flame, that had it been viſible, even *Theodora*'s virtue could not have diſapproved it. But madam, (continues he) although to reſcue you from the condition you are in, there is no danger ſo deſperate, that I would not joyfully attempt, if I were again at liberty, and though it were poſſible I could ſurvive you; yet I am too much concerned for the nobler part of *Theodora*, to wiſh ſhe would blemiſh ſo ſpotleſs a life to ſave it. Only, madam, give me leave to be ſo kind and charitable to the world, as to wiſh, that providence may find ſome expedient to preſerve for you both your

crown and your head; and that you may arrive ſo late at heaven, as to have time to bleſs the earth with a long and exemplary life; and may you lead it with as much tranquility, as you will with virtue; and without knowing ſo much as that trouble, which, I fear, your generous compaſſion may now and then offer to give you upon the remembrance of the faithfulleſt of your ſervants.

THESE words, and the ſad occaſion of them, having drawn ſome tears into *Theodora*'s fair eyes; though the cauſe of them made them very obliging to *Didymus*, yet his concern for her quiet preſently engaged him to help her to ſuppreſs them, by making haſte to tell her, that it was pity the ſerenity of her mind and looks, which virtue had ſtill kept calm, and even perſecutions had not been able to diſorder, ſhould be diſcompoſed by any other thing. And madam, (continues he) though being confident, that your charity will make it unneceſſary for me to beg your prayers, I was going to make it my petition to you, that you would vouchſafe now and then to caſt a thought on the memory of a perſon, to whoſe mind you were conſtantly preſent; yet I muſt now retract that humble requeſt, unleſs you are pleaſed to grant it me with this qualification; that the honour you do me, may not be diſquieting to you. For how great a bleſſing ſoever it is, to enjoy a place in your thoughts; yet an idea muſt repreſent quite another man than *Didymus*, that ſhould, eſpecially on its own ſcore, become troubleſome to *Theodora*, whoſe compaſſion is as well needleſs, as undeſired; ſince it is injurious both to herſelf and me, to look upon him as a perſon to be pitied, that is going to receive the honour and ſatisfaction to ſuffer in her ſight, what he ſuffers partly for her ſervice. And the place he implores but in her favourable, not her mournful thoughts, will give him the nobleſt and deſirableſt being, that he can have upon earth, when he ſhall be in heaven.

THE things, which *Didymus* ſaid, and the pathetical way he ſaid them in, did not leave the fair perſon, they were addreſſed to, all the unmovedneſs of mind ſhe uſed to be miſtreſs of on other occaſions. And conſidering theſe as the laſt and dying words of an accompliſhed gentleman, that had ſo highly ſerved and loved her, ſhe could not hinder her reſentments from making her, on ſuch an occaſion, remit ſomewhat of her wonted reſervedneſs. Wherefore with eyes, wherein though ſhe endeavoured to ſuppreſs tears, ſhe diſcloſed an extraordinary grief; and with looks, wherein both gratitude and obligedneſs diſplayed themſelves, ſhe told him, If I looked upon your virtue, generous *Didymus*, as one, that were but ſomewhat extraordinary, I ſhould think myſelf obliged to make excuſes, and ſeek your pardon for having been, though undeſignedly, ſo acceſſary to the early loſs of a life ſo worthy to be a long one: but what you have this day done, makes me apprehend, that ſuch diſcourſes would not be very pleaſing to one, that delights in ſuch actions. But do not think, I conjure you, that though I cannot pretend to merit or requite ſervices of ſo unuſual a ſtrain as yours, I can be inſenſible, how much I owe to them, not only upon the ſcore of their greatneſs, but upon that of the handſome and generous way, wherein you did them. For (continues ſhe, with a colour, that ſomewhat expounded the meaning of what ſhe was going to ſay) if after the virtue and gallantry you this day expreſſed, providence had thought fit to place me in a condition of making you retributions, I will allow you to think, that, in chuſing them for you, I ſhould have been very much if not unreſervedly, guided by your wiſhes. Here ſhe pauſed a while, and bluſhed; the latter, that ſhe had ſaid, what to her niceneſs ſeemed ſo much; and the former, to conſider, whether he deſerved not to have more ſaid to him. But her obliging looks did ſo well

ſecond and expound her otherwiſe ſomewhat indefinite words, that *Didymus*'s heart readily underſtood the language of her eyes; and her heart ſpoke ſo clearly in her cheeks ſomewhat, that it ſcrupled to utter by her tongue, that, expreſſing more than ſhe ſaid, without injuring her modeſty ſhe righted her gratitude; her paſſionate admirer eſteeming himſelf more highly recompenced by this permiſſion to ſuppoſe her kindneſs, than he would have done by the perfecteſt aſſurance of any other's love; and, fancying, that by the ſight of that new fire, that flaſhed in her cheeks, he could diſcern in her breaſt ſuch a reſentment of his ſervices, as involved an approbation of their cauſe, and implied a peculiarity for his perſon; he took the higheſt retribution he ever did, for the higheſt he ever could receive from a lady, whoſe beauty and reſervedneſs were ſo great, that no favour of her granting could appear little.

BUT *Theodora* quickly recovering the diſorder this merited declaration had put her into, made haſte to proſecute her diſcourſe, by adding, but it is my ſatisfaction, and will, I hope, be yours, that ſince you acted upon religion's ſcore, as well as mine, you will not want a recompence, greater than it had been poſſible for me to give you; ſince in reſcuing me upon a Chriſtian account, you have ſerved a maſter, that is able moſt richly to reward, even your performances and ſufferings. And doubt not *Didymus*, (continues ſhe) but that, when you ſhall once be poſſeſſed of a glorious and immortal crown in heaven, you will have no cauſe to be troubled at your having, upon earth, left a crown of laurel, or miſſed one of myrtle. If I were to tarry, or rather languiſh, here below, as many years as your miſtaken kindneſs makes you wiſh me; your favours have been ſo extraordinary, that, without being guilty of an ingratitude, that would be ſo too, I could never loſe the remembrance of them, nor omit paying you the higheſt acknowledgements, that the chief place, not only in my memory, but in my eſteem and friendſhip, could make you. But do not, *Didymus*, I beſeech you, think of my ſurviving you, when the holding out a few minutes longer for Chriſt will introduce me into a condition, where I ſhall ever ſee him, and never offend him. Let us then (concludes ſhe) quit the thoughts of this world, that we are going ſo ſoon to quit, and begin to fix them on thoſe joys of another, that we are going to poſſeſs for ever; and during that little time, that is requiſite to go take our crowns, let us ſummon up all our powers, to contribute to a behaviour befitting ſuch expectations. Let our laſt ſervices to religion be our nobleſt ones, that our deaths may at leaſt adorn it, if not propagate it. Let us receive the laſt effects of our perſecution, as perſons, that do not deſerve ſuch an uſage, and are above the reach of it. Let us aſpire to Chriſt's temper in his cauſe; and ſuffer like him, as we ſuffer for him: and then we need not doubt, but in ſpight of this ſhort ſeparation we are yielding to for his ſake, we ſhall joyfully, and for ever, meet again in a better place, and in an ineſtimably happier condition.

Theodora had ſcarce made an end of ſpeaking, when all things being in a readineſs to put the judge's ſentence in execution, they, to whom that infamous employment was committed, came to bring notice of it to *Didymus*; who, notwithſtanding the reluctancy he had to part with the admirable, and now obliging, *Theodora*, thinking it would miſbecome him to ſtay for being preſſed on ſuch an occaſion, delayed not, with all the reſolution he was able to aſſume, to take his laſt farewel of her. This cruel ſeparation being not to have an end before both their lives, was ſolemnized by that excellent pair with geſtures and expreſſions ſo ſenſible and moving, that declining an account, which I could not attempt to give, without ſharing very much in a

grief, that I ſhould be able, but very imperfectly, to deſcribe; I ſhall ſilently paſs over the circumſtances of this ſad ſeparation, that more troubled the generous lover, and perhaps his admirable miſtreſs too, than that of ſoul and body, whch was preſently to follow it. But *Didymus*, now finally parted from *Theodora*, whilſt he was moving towards the place of his ſufferings, did, by the aſſiſtance of him, whoſe religion called him to them, aſſume a temper of mind ſuitable to the glorious work he was going to undertake, and entirely diſpoſed himſelf, after having done all, that became a lover, to ſuffer as became a Chriſtian.

THIS was much the leſs difficult for him to do, becauſe his whole paſt life was an excellent preparative to make him act the laſt ſcene of it worthily. For (to add ſomewhat on this occaſion, to the character given of him in the firſt book,) *Didymus* was a perſon, in whom divine grace had produced ſo early a piety, that he was a well grown Chriſtian, before he was come to be a full grown man. And judging the moſt flouriſhing time of his age to be, for that reaſon, the fitteſt to be devoted to the moſt worthy of objects; he was enabled both to ſuppreſs the heats of youth, and deſpiſe the vanities of the world, even while that uſually ungoverned age made the former moſt impetuous, and gave the latter the great endearment of novelty. Nor did his being a ſoldier prove an obſtacle to his piety. The examples of *Joſhua*, *David*, *Jonathan*, and other brave warriors of the old teſtament, ſhew, that heroic valour may be accompanied with eminent piety. And the firſt proſelyte the heathen world preſented to Chriſtianity, being a captain, and continuing to be ſo after his converſion, argues, that a military ſtate of life is not inconſiſtent with the moſt innocent of religions. And for *Didymus*, as he fought not out of fierceneſs, or avarice, or ambition, but to exerciſe and improve his virtue; ſo amidſt all his military conflicts he was ſtill careful *to fight the good fight of faith:* and being taught by the holy ſcripture, that *the life of man* here on earth *is a kind of military one*, he uſed the Roman camp as a ſchool to a higher ſort of warfare; where, as the hardſhips are greater, and the victories more difficult, ſo the crowns and triumphs are incomparably more valuable and glorious. A perſon thus qualified and diſpoſed could not find it very uneaſy to part, for his religion, with a life, that he had led ſo well, and hazarded ſo often; nor to leave a world, that ſin and perſecutions embittered, and that was preſently to be left by *Theodora*, that he might paſs to a place, where they ſhould meet to be crowned. Wherefore, reſolving to ſhew, that the approach of a reputedly infamous death was not able, either to ſhake his conſtancy, or extinguiſh his charity; he diſpoſed himſelf to mingle in his laſt actions and ſufferings the courage of a Roman ſoldier, with the reſignment of a Chriſtian martyr. And accordingly, walking on towards the place of execution with a calmneſs and undauntedneſs, that could ſcarce have proceeded from a reſolution not ſtrengthened by faith; as ſoon as he came thither, he looked round about him upon the guards, and other aſſiſtants of this ſad ſpectacle, in ſuch a way, as if he rather pitied them, than liked the pity, which many of them could not but by their tears expreſs for him, and diſcourſed to them with all the gracefulneſs, that youth and courage could give ſo extraordinary a perſon. And becauſe he ſuppoſed, that (as it was uſual on ſuch occaſions of concourſe) there were among the ſpectators ſome military men, that were Chriſtians in their hearts, though they had not been called to own it publickly; he addreſſed himſelf particularly to them. And having premiſed, that he pretended not to inſtruct them as barely Chriſtians, becauſe he doubted not, but he had been prevented by the weighty and moving ſermons of divers burning and ſhining lights, and guiders of the church; he told them he would confine his advices to what was

ſuitable

ſuitable to the condition he ſhared in with them, of being Chriſtian ſoldiers. And then he briefly, but pathetically, exhorted them to all thoſe virtues and practices, that might recommend both their perſons, their profeſſion, and their religion: the laſt of which, by many arguments, (which his example made the more impreſſive) he perſuaded them, after having adorned it by their lives, to confirm, if they were called to it, by their deaths; without forgetting, that the fearful are by the ſcripture ranked with the *unbelievers*, as deſtined to the ſame place of torment; and Rev. xxi. 8. without fearing any unmerited diſgrace, ſo much as that deſerved one, threatned by the captain of their ſalvation to thoſe, that *ſhall deny him before men*. He exhorted Heb. xi. 10. them, by their courage and obſequiouſneſs to convince their unbelieving ſuperiors, that the valour of Chriſtians could be eminently active, when their religion did not confine it to be paſſive; and that when enterprizes, how dangerous ſoever, were as juſt and noble as difficult, they could emulate, if not outſhine, the gallantry of thoſe deified heroes they refuſed to worſhip. And laſtly, having preſſed them to be loyal to the Emperor, and obedient too, as far as was conſiſtent with fidelity to him, that made him ſo; he begged their prayers for himſelf, and put up ardent ones of his own, for the church, the ſtate, his perſecutors, and, particularly, for the excellent companion of his martyrdom. This ſaid, he began to do what was to be done by him, towards the deliverance of his ſoul from his body; and having done it with ſo much ſerenity of mind and looks, that he extorted an eſteem of his virtue, even from thoſe, that deſtroyed him for it; he let the executioner do his part too, (which probably was done by taking off his head) and in a moment paſſed from being a ſuffering member of the church militant, to be a happy one of the church triumphant.

CHAP. XII.

THE perſecutors of *Theodora* hoping to intimidate her by ſo tragic a ſpectacle, had conducted her to a place, whence ſhe might ſee all, that had paſſed; of which it will eaſily be believed, that ſhe had not been an unconcerned ſpectator: her virtue and kindneſs making her a ſharer in his ſufferings, by ſympathiſing with him, and by endeavouring, as far as ſhe could, to relieve him by her moſt ardent prayers; that his conſtancy under them might be divinely ſupported, and richly crowned. But while her thoughts were, with a divine grief, ſolemnizing her loſs, thoſe cruel men, that had procured it, being deſirous to make uſe of the terrifying impreſſions they ſuppoſed ſhe had received, while they were freſh and recent, advanced to *Theodora*, bringing with them the purpoſely diſfigured remains of *Didymus*; and then told her, that ſhe was now convinced, that neither youth nor gallantry was able to protect from the fatal anger of the Gods thoſe, that obſtinately refuſed to worſhip them; and therefore they expected, that, by a ſeaſonable care of herſelf, ſhe would ſhun the imitation of ſo tragical an example. To this the fair martyr replied, that ſhe was not at all ſurprized at what had paſſed, and therefore ſhe knew not, why ſhe ſhould be terrified by it. For *Didymus* and ſhe, and all other conſidering Chriſtians, that walk according to their maſter's directions, were wont deliberately to weigh the conſequences of embracing a ſtrict and perſecuted religion, before they made profeſſion of it: and having foreſeen what it might coſt them, and ſatisfied themſelves, that it deſerved a yet higher price, they were not diſcouraged nor ſurprized to be put to pay that price; eſpecially when it opened to them an immediate paſſage to the poſſeſſion of what they gave it for. She added, that if the example

of the generous martyr were to have any operation upon her, it ought not to fright her from, but confirm her in, the profeſſion of a religion, whoſe truth he thought worth dying for; and which, notwithſtanding all the handſome concerns he had for her preſervation, he would never ſpeak one word to perſuade her to decline, for the protracting of her life. His example (continues *Theodora*) lets me ſee, that no violences upon earth are able to deſtroy a courage, that is aſſiſted from heaven, and fights in view of the glories of it; and his death manifeſts, how quick the paſſage may be between this and an incomparably better life; and clearly ſhews, how ſoon the utmoſt effect of your cruelty can place thoſe, that deſpiſe it, above the reach of it. Then caſting her mournful eyes upon the ſaddeſt object, that ever they beheld; If you ſhould, ſays ſhe, be ſo inhuman, as to exerciſe any further cruelty upon this now inanimate priſon, whence his glad ſoul has eſcaped, you may intend him a miſchief, but he will not feel it, unleſs it be in the increaſe of the recompences of his martyrdom. You may, if you pleaſe, inſult over his dead body, and thoſe, whom his virtue made his friends, may ſome of them be troubled at it; but while you are triumphing at his death, and others are deploring it, I doubt not, but the welcomes and joys he receives in the bleſſed place he is gone to, make him happy enough to pity not only thoſe, that hate him, but thoſe, that pity him too. What you ſhew me, as the trophy of your power, I look upon, as that of his conſtancy; and for what you preſume to be your victory, he will be really crowned. The grave, (continues ſhe) is, I confeſs, a ſad proſpect to them, that look no further, and terminate their ſight there; but not to thoſe ſufferers for the truth, who, with the eye of faith, looking beyond it, ſee all thoſe glories on the other ſide of it, that expect them there; whereunto as ſome kind of death muſt neceſſarily be the way, ſo martyrdom of all others is the nobleſt. Wherefore, (concludes *Theodora*) you will very much miſs your aim, if you forbear bringing my conſtancy to the laſt trial, only upon hopes, that death dreſſed with unuſual horror, by being beſmeared with *Didymus*'s blood, ſhould frighten me into apoſtacy; for I am much leſs terrified by his fate, than encouraged by his example: in imitation of which I declare to you once for all, that, as I always valued this world too little, to be much afraid to part with it for a better; ſo I ſhall never be brought to quit an excellent religion for a bad one, for fear of exchanging a wretched life for a happy one.

THIS poſitive and final declaration of *Theodora* did ſo enrage thoſe, to whom ſhe made it, that finding themſelves quite diſappointed of the hopes they had to terrify her by their laſt expedient, *Didymus*'s death, they preſently led her away to participate of his fate, which they found her reſolved not to decline. And now the admirable *Theodora*, having received that cruel, but welcome command, moſt readily diſpoſed herſelf to obey it: and conſidering, how near ſhe was to put a period to all the afflictions of her life, by the glorioſeſt action it could be concluded with, and how ſoon ſhe ſhould enjoy the happineſs of entering heaven, thorough the ſtreighteſt and nobleſt gate, at which it is acceſſible; her beauty, that was before admirable, appeared more ſo than ever, being ſtrangely increaſed by the effuſions of a cœleſtial joy, that did too much abound in her heart, not to flaſh out manifeſtly in her looks, to whoſe native charms it ſuperadded ſo much luſtre and majeſty, that ſhe ſeemed (upon ſome peculiar deſign) to be newly come from the heaven ſhe was going to. So great a conſtancy and chearfulneſs of mind, upon ſo ſad an occaſion, wanted not a reſembling operation upon the generality of the wondering aſſiſtants: for though the report, that was quickly ſpread of ſo uncommon an action, as that of *Theodora*, done by ſo an extraordinary a perſon, as fame had repreſented her to be, had

had drawn a great concourſe of people, to ſee one, that acted, as well as looked ſo handſomly; yet when they had a while beheld her, and ſaw the cruel inſtruments of what ſhe was doomed to ſuffer; among that numerous throng of ſpectators there were none, that were not admirers; many, that looked on her with dazled, and few without flowing eyes; every ſort of ſpectators found ſomething in her perſon and condition, that made them mournful ones. The Chriſtians that chanced to mingle with the reſt of the crowd, lamented to ſee their religion deprived of ſo great an ornament, and ſo ſhining an example; though their grief were moderated by conſidering, that ſhe was entering into a moſt happy place, to which they might hope, ere long, to follow her. And, in the mean time, it was no ſmall credit to their religion, that a lady of her beauty had lived according to the ſtricteſt laws of it; and a perſon of her youth and ſex was ambitious to die for it. Thoſe among the ſpectators, that yet retained Roman ſpirits, and were the genuine offspring of thoſe noble anceſtors, that ſcrupled not in *Rome* itſelf, to allow public marks of honour to its greateſt enemies, could not but be troubled, to ſee ſo rare a thing as a female hero puniſhed for a generoſity, that could not ſufficiently be rewarded, and brought to an untimely, and, in popular eſtimation, ignominious end, for having followed dictates of gratitude and piety. Thoſe infidels, on whoſe ſentiments virtue had more influence than ſuperſtition, were very much diſſatisfied with the rigour of their magiſtrates; thought it a diſcredit to their religion, to uſe ſuch barbarous, and yet ineffectual courſes, to fright men into it; and they thought it an invidious ſervice to their gods, to deſtroy the faireſt maſter-pieces they had made. But thoſe, that ſeemed moſt to deplore the fair martyr's condition, were thoſe, that were diſpoſed to have their affections wrought on by their eyes, and were apt to be influenced by beauty: for theſe much repined and grieved to ſee ſo glorious a ſun reduced to ſet in her eaſt; they envied *Didymus*, for having ſo generouſly ſerved and ſuffered for ſo rare a perſon, who, they thought, inſtead of the barbarous uſage ſhe received, deſerved to be as happy, as her ſmiles could make her adorers; and they allowed themſelves to think, that nothing could be a virtue, that deprived the world of ſo much beauty. In ſhort, moſt of the by-ſtanders grieved, to behold a perſon, whoſe youth would paſs for innocency, and whoſe charms would give her captives among ſavages, deſtroyed in *Greece*, by Romans. So that bating thoſe few barbarians, whoſe ſuperſtition and malice brought her to that condition, all the other ſpectators of her ſufferings were deplorers of them too; and many to that degree, that, to judge by their looks, and thoſe of our fair martyr, one would have believed, that the aſſiſtants were to be ſufferers in the approaching tragedy, and ſhe but the ſpectator of it.

AND now the matchleſs *Theodora* came to the place, where her aſpiring ſoul was to take its flight to heaven. In order to which, ſhe firſt looked about her, with a kind of pity, on thoſe, that either never, or later than ſhe, were to be admitted into the felicity ſhe was preſently to poſſeſs: and afterwards ſhe pauſed a while, to recover from ſome diſorder, that ſhe was put into; not ſo much to ſee herſelf invironed with guards, as ſurrounded with gazers. And then, though her baſhfulneſs made it more uneaſy to her to ſpeak to the aſſiſtants, becauſe her ſpeech muſt be a public one, than becauſe it muſt be her laſt; yet with a voice and geſtures, wherein the modeſty of a virgin, and the courage of a martyr, were happily tempered, ſhe addreſſed herſelf to thoſe, that were about her, in ſuch as the following terms:

SINCE cuſtom has made it a kind of duty, that thoſe, that come to this place, ſhould ſay ſomething to the ſpectators, and make a public confeſſion of their guilt, or proteſtation of their innocence; I ſhall, in part, do both the one and the other; for I will not deny, that I am, what the laws have condemned me for being. Yes, I own myſelf a Chriſtian, and in ſpight of all my paſt and approaching ſufferings, I declare, that I think it an honour and a happineſs to be ſo: but, on the other ſide, I can moſt truly proteſt, that I have tranſgreſſed no other Roman laws, than thoſe, that are repugnant to thoſe of God and reaſon. And ſince we Chriſtians are taught by our great Maſter's example, as well as precepts, not only to forgive, but to love our enemies, and pray for our perſecutors; I think myſelf obliged, and, by his aſſiſtance, find myſelf enabled, not only to forgive, as I heartily do, the procurers of my death, but ardently to implore for them the bleſſing, and the unmoleſted exerciſe of a religion, that they ſee I value more than I do my life. And I hope, thoſe in authority will, by the frequent executions, that daily ſucceed one another in this place, be at length convinced, how ineffectual, as well as inhuman, a way they take to extirpate Chriſtianity; which being an heavenly light, can be as little ruined by the violence employed againſt it on earth, as tempeſts can extinguiſh the ſun. And becauſe it is likely, that charity or curioſity has, among other ſpectators, brought hither ſome Chriſtians, I ſhall now addreſs myſelf to them; yet not to deſire their pity, but their prayers, that I may be enabled to overcome the laſt enemy, death, and finiſh my courſe in ſuch a way, as may neither blemiſh my paſt life, nor the glorious cauſe I gladly loſe it for. But the chief part of my requeſt regards yourſelves, not me: for I muſt beg you to remember, that, beſides an All-ſeeing-eye, there are many eyes upon you, that pry into your actions with ſtrong deſires to find them criminal; and that though the truth, nor the ſubſiſtence of Chriſtianity does not, yet the credit of it does much depend upon the nature of your actions. For as all your perſonal faults will be imputed to your religion; ſo your ſhining virtues will probably bring many infidels, firſt to admire, and then to embrace Chriſtianity; juſtly concluding that that religion muſt be excellent, that makes its profeſſors ſo, and enables, as well as enjoins them, to live blameleſs in the world, and go joyfully out of it. If you lead ſuch lives, you will not be much afraid of martyrdom, which will but ſend you ſooner to receive thoſe ineſtimable rewards of them, that God's goodneſs hath promiſed and provided. I wiſh you may never have cauſe, nor, upon occaſion, want courage, to enter into life at that ſtreight gate, that I am now going to paſs through. But if you be called to that way of glorifying God, let neither the ignominy, nor the painfulneſs of it deter you. It is not ſhameful, but glorious, to ſuffer for God, for truth, and for a crown; and my example may encourage the weakeſt of you to expect, that *God*'s *ſtrength will be made manifeſt in your infirmity*; and that there is no temptation but may be reſiſted and vanquiſhed by the weakeſt hand, that is ſupported and ſtrengthened by an almighty arm. And though the diſtance between heaven and earth, our mortal and immortal ſtate, be very great, yet the paſſage between them may be very ſhort; and a few moments may bring us to exchange our agonies for extaſies, and paſs from the lamentations of our friends, and the reproaches of our perſecutors, to the congratulations of angels, and the ſolemn welcomes of him, whom even thoſe heavenly ſpirits adore.

As ſoon as ſhe had ended this diſcourſe, though her ſoul, abandoning ſuch a body as her's, could ſcarce any where, but in heaven, find an advantage by a change of manſion, yet it cheerfully diſpoſed itſelf to a ſeparation, that would give it a cloſer

and more immediate union with the divine object of its cœleſtial love. And after ſhe had decently and calmly made all the preparation, that on her part was requiſite for what ſhe was to ſuffer, ſhe thought fit to make her life's laſt actions, as moſt of the reſt had been, acts of piety and charity. And therefore elevating her eyes and hands towards heaven, where her heart, as well as her treaſure, had been placed long before, ſhe firſt paid her God moſt humble thanks, for the grace and opportunity he had vouchſafed her, *not only to believe in his divine Son, but to ſuffer for him*; and then made a ſhort, but very fervent prayer, for the church, for her enemies, and for herſelf. Which done, with a countenance, wherein ſerenity was mingled with joy, ſhe gave a ſign to the executioner to do his office, who thereupon did all that was neceſſary to complete her martyrdom. And the glad ſoul was by the angels, (whom ſhe had aſpired to reſemble in purity and devotion) carried to that happy place, whoſe glories are neither to be conceived by thoſe, that have not ſeen them, nor deſcribed by thoſe, that have; ſuch ſupernatural felicities as much tranſcending man's ideas and his expreſſions, as they ſurpaſs his merit.

1 Cor. xii. 9.

2 Cor. xii. 4.

MEDICINAL EXPERIMENTS:

OR, A

COLLECTION

Of CHOICE and SAFE

REMEDIES,

For the moſt Part SIMPLE, and eaſily Prepared:

Very uſeful in FAMILIES, and fitted for the Service of COUNTRY PEOPLE.

The PREFACE to his RECEIPTS ſent to a FRIEND in *America*, in the Edition printed at *London* in 1688, and omitted in the ſubſequent ones.

The INTRODUCTION.

THE following preſcriptions being but part of a collection of receipts and proceſſes, that had from time to time been recommended to me, either by the experience of the imparters, or by my own; I did not think it ſo expedient to promiſe, to ſo ſmall a number of ſlight receipts, the ſeveral medicinal cautions and other conſiderations, wherewith it might be fit to uſher in a larger writing of this nature, as to reſerve thoſe prolegomena for the whole collection, whereof that, which now appears, makes but a part, and that not the greateſt. Which intimation will, I hope, excuſe my leaving unmentioned the names of the imparters of ſeveral of theſe receipts; ſince all of them are tranſcribed from the collection; and the reaſon of the omiſſion is given in the preamble, together with divers advertiſements about the work itſelf, which diſpenſe me from giving any others at preſent, than thoſe very few, which ſeemed requiſite to be ſent about the following paper, to the inquiſitive D. *W. A.* practiſing phyſic in *New England*; who earneſtly deſired of me ſome receipts, that, being parable or cheap, might eaſily be made ſerviceable, eſpecially to the poor, in that country; where European books of phyſic are too great rarities, and ſeveral remedies, here known, are not in uſe.

THE beginning of my letter to Dr. *A.* conſiſting mainly of things, that regarded his peculiar circumſtances, it is needleſs, if not improper, to tranſcribe it hither, and conſequently it ought not to keep me from proceeding, without delay, to the next part of my letter, which gives him the three following

ADVERTISEMENTS.

I. IT would be a great miſtake of my deſign, in ſending you the following receipts, if you ſhould think, that I at all pretend them to be infallible ones, or at leaſt

leaſt of very extraordinary efficacy; ſince all, that I told you of them, was, that, for medicines ſo ſimple, and for the moſt part ſo cheap, I have found ſeveral of them, and take all of them, to be good in their kind. And though I think moſt of them ſafer than many other medicines, that are in great requeſt, yet I do not pretend, that theſe ſhould play the part both of medicines and phyſicians too; but only that they may be uſefully employed by one, that, like you, knows how to adminiſter them diſcreetly. In ſhort, I ſay not, that theſe medicines are the beſt I have, but only ſome of the moſt parable, or ſimple; both which I here mention together, as if the latter were referrible to the former; not only becauſe medicines, that are ſimple, or but very little compounded, are, *cæteris paribus*, more eaſy to be procured, but becauſe I am willing, that this ſhort collection ſhould furniſh you with divers inſtances to confirm the paper, to which I deſire you would ſubjoin it, of the uſefulneſs of ſimple medicines.

II. It may ſomewhat aſſiſt you to make a comparative eſtimate of the following receipts, if I diſtinguiſh them into three claſſes or orders, and annex to the title, or deſcription, of almoſt each particular medicine, one of the three firſt letters of the alphabet. Whereof *A* ſignifies, that the remedy it belongs to hath been, either by the affirmation of the phyſician, or other credible perſons, that imparted it to me, or by trials, that I cauſed to be made of it, recommended as very conſiderable and efficacious in its kind. *A* therefore is the mark of a remedy of the higheſt claſſis of theſe. *B* denotes, that that, which it refers to, is of a ſecond or inferior ſort, but yet conſiderable for its good operations. And the letter *C* belongs to thoſe remedies, that are of the loweſt order, though good enough not to be deſpiſed.

And becauſe I preſume it may be expected, that I ſhould give you ſome ſhort character, of thoſe, whereof I have had ſome kind of experience, whether by the relation of ſuch as have been cured or much relieved by them, or by my own exhibiting or preſcribing them; or by reports received from thoſe, that engaged to try them, or that employed them upon my account: for this reaſon, I ſay, and for brevity's ſake, and avoiding repetitions, I thought fit to accompany almoſt each of the three forementioned alphabetical letters, that refers to a receipt, of which I can ſay any thing upon ſome kind of knowledge of my own, with one of the three following marks: whereof the firſt, which is the ſmall figure of (1) denotes, that I have known but a ſingle trial of it; the other, which is a ſimple croſs (+) imports, that the trials have been made two, or ſome few more times; and the third, which is an aſteriſk (conſiſting of ſeveral lines croſſing each other in one point) (*) ſignifies, that the trials, wherein it hath been found uſeful, were many, if not very many.

III. There will be eaſily obſerved a diſparity of ſtyle in the following papers; for thoſe receipts, that were my own, were expreſſed in my own terms; and ſo uſually were thoſe, that I received from others but by word of mouth; and theſe, I hope, will be found clearly enough delivered: but as to thoſe others, that were imparted to me by empiricks, or unlearned perſons, in writing; though I would not, in divers places, have worded them as they did, that I had them from, yet I oftentimes made a ſcruple to correct or alter their expreſſions, though not ſuitable to the current ſtyle of the formularies of receipts; being more concerned, that the meanings ſhould be cloſe kept to, than the ſtyle rectified. And ſometimes too, when I received things by word of mouth, and committed them to paper in the author's preſence, haſte obliged me to make uſe of expreſſions, (and made me afterwards forget to mend them) that were rather the ſhorteſt than the beſt; and ſometimes forced me to em-

ploy words of the Latin, French, or ſome other language, eſpecially if I wrote after the inſtructions of foreigners: being leſs careful to expreſs things in the fitteſt way I could, than in the moſt compendious.

You will receive, by this ſhip, but five decades of receipts of parable medicines, becauſe I think that number ſufficient to be ſent at once. But if, when you have tried them, the ſucceſs, that God ſhall vouchſafe to give them, ſhall invite you to preſs for a recruit, I ſhall thereby be encouraged to draw ſome other decades of receipts (ſome of which will perhaps be preferable to moſt of theſe) out of a collection, wherein they have long lain mingled with receipts and proceſſes of remedies of a leſs ſimple nature, or more difficult to be procured.

The PUBLISHER to the READER.

THESE receipts, taken out of a large collection, as conſiſting of a few ſafe ingredients, commonly to be found at eaſy rates in moſt places, were ſent to a learned phyſician beyond ſea; to whom they were a welcome preſent, and anſwered, without doubt, the ends he had in deſiring them.

THAT excellent perſon, to whom theſe choice preſcriptions are owing, did permit a few copies of them to be printed, and was pleaſed to put them in the hands of ſome of his friends, provided, as there was occaſion, they would make trial of them, and faithfully report the ſucceſs.

DIVERS of thoſe, who, on theſe conditions, had received ſo great a favour, held themſelves obliged to inquire for perſons affected with any of the maladies againſt which the ſaid medicines were preſcribed; and, upon many experiments carefully made, having found, that frequently they have relieved thoſe, who uſed them, and ſometimes ſtrangely outdone expectation; they addreſſed themſelves with much importunity to the noble author, to ſuffer things, which were of ſuch general benefit, and ſo eaſily to be procured by the poor, to be made more public.

AND at length he hath been prevailed with, not only to allow the former receipts, which but few had ſeen, to be reprinted; but hath, out of his rich treaſury, ſtored us with a freſh collection, which, as in number it exceeds what we had before, ſo in quality and virtue it falls not ſhort of it.

AND if what here with ſuch an honeſt and kind deſign is offered to the public, be but candidly and favourably received, we may ſtill hope for more bleſſings of this ſort from him, who has not only a conſtant will and great abilities to do good, but hath, perhaps, obliged the age as much as any private perſon in it.

The AUTHOR's PREFACE.

THOUGH phyſic be not my profeſſion, yet I hope this ſmall collection of receipts will not incur the cenſure of equitable and charitable perſons, though divers of them are profeſſed phyſicians; ſince, as I was induced to what I had done by the dictates of Philanthropy and Chriſtianity, ſo I was warranted by great examples, both in antient times and in ours. Of the former ſort, I take notice of ſeveral of the old philoſophers, ſuch as *Democritus*, *Pythagoras*, to which ſome add *Ariſtotle*; and even divers monarchs and great men of thoſe times, ſuch as *Jubat* king of *Mauritania*; another king, *Nechepſos*, cited by *Galen* *, *Pliny*, &c. And of the ſecond ſort,

* *De ſimpl. medic. facultatibus*, lib ix. *titulus* Jaſpis Viridis. *Ac nonnulli quoque annulis inſerunt, ſcalpuntque in eo draconem radios habentem: velut rex* Nechepſos *memoriæ prodidit in ſexto et decimo libro.*

not

not only by the laſt age, and the firſt part of our own, but by very late times, and in a neighbouring nation, whoſe cuſtoms we are wont ſufficiently to eſteem and imitate, we may be furniſhed with examples to our preſent purpoſe. For the French king himſelf, who has raiſed the majeſty of a crowned head ſo high, did not think it beneath the grandeur of ſo great a monarch to order the publication of the Engliſh remedy, as the French called the Peruvian bark, which, at a great rate, he purchaſed from *Talbot*, an Engliſh empirick, famous for his many and ſpeedy cures of quartans, and other agues. By the authority of the ſame prince, who has been a great encourager of divers parts of learning, there has been ſome years ſince ſettled at Paris a ſociety or aſſembly of phyſicians, chirurgions, and others, whoſe main buſineſs is to keep correſpondency in ſeveral parts, and receive informations of the novelties that occur about diſeaſes, and impart to the public ſuch, as they ſhall think worthy and ſeaſonable; which communications conſiſt not only of new diſcoveries, odd caſes, ſpeculations and obſervations, but of receipts and proceſſes of remedies, printed for the moſt part in French, the common language of the people; divers of which remedies have, upon trial, been found uſeful, as well in *England* as in *France*. There has been alſo lately in that kingdom a book printed more than once, that makes yet for my purpoſe. For there has been publiſhed in the French tongue a large collection of receipts, for almoſt all diſeaſes, placed in alphabetical order; and though theſe receipts are circumſtantially delivered in the mother-tongue of the people, yet they came not forth without the licence or authority of the faculty of phyſic; and were (at leaſt the firſt tome) ſo well received and approved, that in divers places the reſpective biſhops authoriſed them by their public approbation, and recommended them upon the account received, or the good effects they had produced, both to the other charitable perſons, and to the curates (or pariſh-prieſts) in their dioceſes.

In complying with the deſires of many, and with the dictates of philanthropy, I hope, I may procure my medicinal receipts and proceſſes the more favourable reception, if I ſhew, that I might juſtly have a peculiar and perſonal repugnancy to this work. For many may think it ſtrange, as I myſelf have been prone to do, that I ſhould preſume to recommend medicines to others, who, for divers years, have been ſo infirm and ſickly myſelf; and ſome it is like will upbraid me with *Medice, cura teipſum*. But on this occaſion, I may repreſent, that being the thirteenth or fourteenth child of a mother, that was not above 42 or 43 years old when ſhe died of a conſumption, it is no wonder I have not inherited a robuſt, or healthy conſtitution. Many alſo have ſaid, in my excuſe, as they think, that I brought myſelf to ſo much ſicklineſs by over much ſtudy. But, I muſt add, that though both the forementioned cauſes concurred, yet I impute my infirm condition more to a third than to both together; for the grand original of the miſchiefs, that have for many years afflicted me, was a fall from an unruly horſe into a deep place, by which I was ſo bruiſed, that I feel the bad effects of it to this day. For this miſchance happening in *Ireland*, and I being forced to take a long journey before I was well recovered, the bad weather I met with, and the as bad accommodation in Iriſh inns, and the miſtake of an unſkilful or drunken guide, who made me wander almoſt all night upon ſome wild mountains, put me into a fever and a dropſy, (*viz.* an anaſarca;) for a compleat cure of which, I paſt into *England* and came to *London*; but in ſo unlucky a time, that an ill-conditioned fever raged there, and ſeized on me among many others: and though, through God's goodneſs, I at length recovered, yet left me exceeding weak for a great while after; and then, for a farewel, it caſt me into a violent quotidian or double tertian ague, with a ſenſe of decay in my eyes,

which during my long ſickneſs, I had exerciſed too much upon critical books ſtuft with Hebrew, and other eaſtern characters. I will not urge, that divers have wondered, that a perſon in ſuch bad circumſtances, by the help of care and medicines, (for they forget what ought to be aſcribed to God) ſhould be able to hold out ſo long againſt them. But this, after the foregoing relation, may well be ſaid, that it need be no great wonder, if after ſuch a train of miſchiefs, which was ſucceeded by a ſcorbutick cholick, that ſtruck into my limbs, and deprived me of the uſe of my hands and feet for many months, I have not enjoyed much health, notwithſtanding my being acquainted with ſeveral choice medicines; eſpecially ſince divers of theſe I dare not uſe, becauſe by long ſitting, when I had the palſy, I got the ſtone, voiding ſome large ones (as well as making bloody water) and by that diſeaſe ſo great a tenderneſs in my kidneys, that I can bear no diureticks, though of the milder ſort; and that I am forced to forbear ſeveral remedies for my other diſtempers, that I know to be good ones, and amongſt them divers, that, by God's bleſſing, I have ſucceſsfully tried on others. This ſhort narrative may, I hope, ſuffice to ſhew, that my perſonal maladies and ſicklineſs cannot rightly infer the inefficacy of the medicines I impart or recommended; and if it ſhew that, it will do all that was aimed at by this repreſentation.

If ſome receipts or proceſſes (for I hope they will not be many) ſhould happen to be met with in the following collection, that may be alſo found either in ſome printed book or other, it is hoped an indulgent reader will either excuſe or pardon that venial fault; eſpecially if we conſider, firſt, that neither phyſick nor chymiſtry being my profeſſion, I did not think myſelf obliged to peruſe any ſtore of medicinal books, and therefore may well be ſuppoſed to be unacquainted with a great many of them, much more with many of their receipts and proceſſes. And indeed I find by ſome of the latter printed catalogues of books written about the phyſicians art, that there is a multitude of them, which, when I wrote, I had never ſeen, or perhaps ſo much as heard of. Secondly, that it is ſo uſual for authors, eſpecially that write either ſyſtems or collections, to ſet down ſtore of preſcriptions dictated by their conjectures, not their trials, and yet without giving a diſtinct character of almoſt any of them in particular; that if I had met there with ſome of the ſame, that I am ſpeaking of, I ſhould not have ſelected them from a great number of other undiſtinguiſhed ones: and it is eaſy to obſerve, that there is a great deal of difference betwixt being told by an author, that many things, and among the reſt, but not before them, this or that drug, or receipt, is good for ſuch a diſeaſe, and to have particular notice given of it; and not only to be confirmed, that it is good, but to be told how good it is, and poſſible alſo, that it may be uſefully employed in other diſtempers beſides thoſe, for which it is preſcribed in the printed book.

The moſt of theſe receipts are intended chiefly for the uſe of thoſe, that live in the country, in places where phyſicians are ſcarce, if at all, to be had, eſpecially by poor people. And becauſe very frequently a labouring-man, or a handicraftsman, or ſome tradeſman, has a whole family depending upon him, being maintained by his pains and induſtry, and yet is diſabled to help himſelf and them, not by any internal, but oftentimes accidental maladies; ſuch as bruiſes, ſtrains, cuts, tumours, aches, burns, and the like; I have been careful to furniſh this final collection with a pretty number of good receipts, obtained moſt of them from able ſurgeons and practitioners for thoſe external accidents, that thoſe poor upholders of families, who cannot find or fee a ſurgeon, or a doctor, may be cheaply relieved without either of them.

The AUTHOR's Introduction to the FIRST VOLUME.

THE following preſcriptions are a part of a collection of receipts and proceſſes, that from time to time have been recommended to me by the experience of others, or approved by my own; receipts, that being parable or cheap, may eaſily be made ſerviceable to poor country people.

For medicines ſo ſimple, and for the moſt part ſo cheap, I have found all of them to be good in their kind; and though I think moſt of them ſafer than many other medicines, that are in great requeſt, yet I do not pretend, that theſe ſhould play the part of medicines and phyſicians too; but that they may be uſefully employed by one who knows how to adminiſter them diſcreetly.

I diſtinguiſh them into three claſſes or orders, annexing to the title of each particular medicine one of the three firſt letters of the alphabet; whereof *A* is the mark of a remedy of the higheſt claſſis of theſe, recommended as very conſiderable and efficacious in its kind. *B* denotes a ſecond or inferior ſort, but yet to be valuable for their good operation. *C* belongs to thoſe remedies that are of the loweſt order, though good enough not to be deſpiſed.

THOSE receipts, which were my own, are expreſſed in my own terms; ſo alſo thoſe, which I received from others by word of mouth: but them, which were imparted to me in writing, though I myſelf would not have worded them as they did that I had them from, yet I oftentimes made a ſcruple to correct or alter their expreſſions, though not ſuitable to the current ſtyle of the formularies of receipts; being more concerned, that the meaning ſhould be cloſe kept to, than the ſtyle rectified.

Mr. BOYLE's RECEIPTS.

DECAD I.

I. *For Coughs, eſpecially ſuch as proceed from thin rheums.*

B TAKE of choice *olibanum* finely powdered, from one ſcruple to half a dram, and mix carefully with it an equal weight of ſugar-candy, (white or brown) or, in want of that, of fine ſugar; and let the patient take it at bed-time in the pap of an apple, or ſome other proper additament, for ſeveral nights together: if it be found needful, it may be taken at any other time, when the ſtomach is empty.

II. *To give eaſe in the pains of the Stone, even that of the bladder.*

A TAKE the tranſparent ſparr, that grows upon veins of lead-ore, and having reduced it to fine powder, give from half a dram to a whole dram of it at a time, in a moderate draught of ſome convenient vehicle. *N. B.* Though there be (at leaſt in moſt of our *Engliſh* mines) two teguments, as it were, of the veins of lead, that grow cloſe together; yet that, which the diggers name cawk, which is white and opacous, is not the medicine I mean; but the tranſparent, or at leaſt ſemi-diaphanous, which eaſily breaks into ſmooth fragments, and in the fire cleaves into ſeveral pieces, that are wont to be ſmooth and prettily ſhaped.

III.

III. *For Sharpneſs of Urine.*

B TAKE of the dry ſtuff, that divides the lobes of the kernels of walnuts, beat them to powder, and of this give about half a dram at a time, in a draught of white-wine or poſſet-drink made with it, or in any other convenient liquor.

IV. *To appeaſe the violent pains of the Tooth-ach.*

B MAKE up a ſcruple of *pilulæ maſtichinæ*, and half a grain of *laudanum*, into two or three pills, for the patient to take at bed-time.

V. *For Agues.*

A TAKE ſalt of *card. benedict.* and ſalt of wormwood *anà* 15 grains; tartar vitriolate half a ſcruple; mix them, and give them in a few ſpoonfuls of Rheniſh wine, or of ſome other convenient vehicle, either before the fit, or at ſome other time, when the ſtomach is empty.

VI. *For the Yellow-Jaundice.*

B TAKE an ounce of Caſtile ſoap (the elder the better) ſlice it thin, put it into a pint of ſmall-beer cold, ſet it on the fire, let it boil gently half away; after boiling ſome time, ſcum it once; then ſtrain it through a ſmall ſieve, warm it, and drink it all in a morning faſting; take a ſmall lump of ſugar after it, and faſt two or three hours: the party may walk about his buſineſs, and eat his accuſtomed meals. If at any time he drinks wine, let it be white-wine. *N. B.* If he be far gone in the diſtemper, two or three days after he may take it once or twice more, and no oftener. Refrain all other medicines; it will keep a week or longer.

VII. *For the Jaundice.*

B TAKE two or three ounces of *ſemen canabis*, (hemp-ſeed) and boil them till the ſeeds (ſome of them) begin to burſt, and a little longer, in a ſufficient quantity of new milk, to make one good draught; which the patient is to take warm, renewing it, if need be, for ſome days together.

VIII. *For the Dyſentery.*

B TAKE pig's-dung, dry it, and burn it to grey (not white) aſhes; of theſe give about half a dram for a doſe, drinking after them about three ſpoonfuls of white-wine vinegar.

IX. *For the King's-Evil.*

B TAKE cuttle-bone uncalcined, and having ſcraped off the outſide or coloured part, dry the white part; and of this finely powdered give half a dram for a doſe in *aqua malvæ*.

X. *A ſafe and eaſy medicine in the fits of the Stone.*

B TAKE ſack, or in want of that, claret-wine; and by ſhaking, or otherwiſe, mix with it, as well as you can, an equal quantity of oil of walnuts; and of this mixture give from four or ſix, to eight or ten ounces at a time, as a clyſter.

DECAD II.

I. *For Convulſions, eſpecially in Children.*

B TAKE earth-worms; waſh them well in white-wine to cleanſe them, but ſo, as that they may not die in the wine: then upon hollow tiles, or between them, dry the worms with a moderate heat, and no further, than that they may be conveniently reduced to powder; to one ounce of which add a pretty number of grains of ambergreaſe, both to perfume the powder (whoſe ſcent of itſelf is rank) and to make the medicine the more efficacious. The doſe is, from one dram to a dram and a half in any convenient vehicle.

II. *For the Piles.*

B TAKE the powder of earth-worms prepared as in the former receipt (but leaving out the ambergreaſe;) and incorporate it exactly with as much hen's-greaſe, as will ſerve to make it up into an ointment. Apply this to the part affected, whoſe pains it uſually much and ſafely mitigates.

III. *To make Lime-water uſeful in divers diſtempers.*

C TAKE one pound of good quick-lime, and ſlack it in a gallon of warm water, and let it ſtand, till all that will ſubſide be ſettled at the bottom, and (ſeparation being made) the water ſwim clear at the top; (at which time it will often happen, that a kind of thin and brittle ſubſtance, almoſt like ice, will cover the ſurface of the liquor;) as ſoon as the water is thus ſufficiently impregnated, delay not to pour it off warily, and keep it well ſtopped for uſe.

IV. *A Lime-Water for Obſtructions and Conſumptions.*

B TAKE a gallon of lime-water made as above, and infuſe in it cold ſaſſafras, liquorice, and anniſeeds, of each four ounces, adding thereto half a pound of choice currants, or the like quantity of ſliced raiſins of the ſun: the doſe of this compound lime-water is four or five ounces, to be taken twice a day.

V. *An Amulet againſt Agues, eſpecially Tertian.*

TAKE a handful of groundſel, ſhred and cut it ſmall, put it into a ſquare paper bag of about four inches every way, pricking that ſide, that is to be next the ſkin, full of large holes; and cover it with ſome ſarcenet or fine linnen, that nothing may fall out. Let the patient wear this upon the pit of his ſtomach, renewing it two hours before every fit.

VI. *For Women in Labour to bring away the Child.*

B TAKE about one dram of choice myrrh, and having reduced it to fine powder, let the patient take it in a draught of Rheniſh wine or ſack; or if you would have the liquor leſs active, white-wine, poſſet-drink, or ſome other temperate vehicle.

VII. *For ſtrengthening the Bowels.*

B TAKE cloves or chives (not bulbs) of garlick, and let the patient from time to time ſwallow one or two, without chewing. VIII.

VIII. *An amulet againſt the Cramp.*

A TAKE the root of mechoacan, and having reduced it to powder, fill with this powder a little ſquare bag or ſacket of ſarcenet, or ſome ſuch ſlight ſtuff; which bag is to be about three inches ſquare, and to be hung by a ſtring about the patient's neck, ſo that it may reach to the pit of the ſtomach, and immediately touch the ſkin.

IX. *For ſtanching of Blood, eſpecially in Wounds.*

A TAKE thoſe round muſhrooms, that botaniſts call *crepitus lupi* (in Engliſh puff-balls) when they are full ripe (which is in autumn) and breaking them warily, ſave carefully this powder, that will fly up, and the reſt, that remains in their cavities; and ſtrew the powder all over the part affected, binding it on, or proceeding further, if need be, according to art.

X. *For Tumours and pains of the Hemorrhoids, not too much inflamed.*

B LET the patient dip his finger in balſam of ſulphur made with oil of turpentine, and with his finger ſo beſmeared, anoint the tumours, whether external or internal, once or twice a day.

DECAD III.

I. *For the Dyſentery, and other ſharp Fluxes.*

B TAKE the ſtalks and leaves of the herb called in Latin *coniza medina*, (in Engliſh flea-bane) dry it gently, till it be reducible to powder; of this powder give about one drachm at a time, twice or thrice a day, in any convenient vehicle; or elſe incorporate it in conſerve of red roſes.

II. *To ſweeten the Blood, and cure divers Diſeaſes cauſed by its Acidity.*

B TAKE coral, the cleareſt and reddeſt you can get; reduce it (by exactly grinding it on a porphyry or marble ſtone) to an impalpable powder. Of this magiſtery made without acids, give the patient once or twice a day, (as need ſhall require) a large doſe, ordinarily about one drachm at a time, or from two ſcruples to five. *N. B.* Let him long continue the uſe of it.

III. *To clear the Eyes, even from films.*

A TAKE *Paracelſus's zebethum occidentale*, (*viz.* human dung) of a good colour and conſiſtence; dry it ſlowly, till it be pulverable: then reduce it into an impalpable powder; which is to be blown once, twice, or thrice a day, as occaſion ſhall require, into the patient's eyes.

IV. *For Convulſions in children.*

A GIVE the patient from two, three, or four, to five, ſix, or ſeven grains, according to the child's age, of the true volatile ſalt of amber, in any proper vehicle. *N. B.* It is not ſo efficacious in full grown perſons.

V. *To*

V. *To bring away the After-birth.*

B GIVE about thirty drops, or any number between twenty-five and thirty-five of good eſſential (as chymiſts call it) oil of juniper, in a good draught of any convenient vehicle.

VI. *To ſtrengthen the Stomach, and help the want of Appetite.*

B MAKE the roots of gentian (ſound and not ſuperannuated) pulverable, with no more waſte of the moiſture than is neceſſary. Reduce theſe to powder, of which let the patient take from twelve or fifteen grains, to double that quantity (or more if need be) twice or thrice a day. *N. B.* It may be taken on an empty ſtomach, or, if that cannot conveniently be done, at meal-times. To correct the bitterneſs, one may add to it powdered ſugar, or make it up with ſome fit conſerve, or mix it with a ſyrup. It is very good, not only for want of appetite, but for obſtructions. And I (*R. B.*) have uſually given it in vertiginous affections of the brain, and to leſſen, if not quite take away, the fits of agues, and even quartans. But, in this laſt caſe, the doſe muſt be conſiderably augmented. One may alſo, if one pleaſes, inſtead of the powder, give the extract drawn with fair water, and for thoſe that like that form, made up into pills with a ſufficient quantity of powdered turmerick, or the like proper additament; to which I have ſometimes added ſome grains of ſalt of wormwood with good ſucceſs, in fluxes, that proceeded from crudities and indigeſtion. Where the winter ſeaſon, or the patient's cold conſtitution invite, or the medicine is to be long kept, I chuſe rather to make the extract with wine moderately ſtrong, than with water.

VII. *For Ulcers in the Breaſt, and elſewhere.*

A TAKE millepides (in Engliſh by ſome called wood-lice, by others ſows) and having waſhed them clean with a little white wine, and dried them with a linen cloth, beat them very well in a glaſs or marble mortar, (for they ought not to be touched with any thing of metal) and give the firſt time as much juice as you can by ſtrong expreſſion obtain from five or ſix of them. This juice may be given in ſmall ale or white wine, in which the next time you may give as much, as can be ſqueezed out of eight or nine millepides; and ſo you may continue increaſing the number, that you employ of them, by two or three at a time, till it amount to twenty-five or thirty; and if need be, to forty or more, for one taking. And note, that if, upon pounding of theſe inſects, you find the maſs they afford too dry, as it now and then happens; you may dilute it with a little white wine or ale, to be well agitated with it, that being penetrated and ſo ſoftened with the liquor, the maſs may the better part with its juice.

VIII. *For taking off the Fits of Agues.*

TAKE good common brimſtone (not *flores ſulphuris*) and having reduced them, by paſſing them through a very fine ſieve, to the ſubtileſt powder you can, give of this powder one drachm and half, or two drachms, either made up into a bolus with a little good honey, or elſe in any appropriated vehicle; let it be given at the uſual times, and reiterated once or twice, if need be, eſpecially if the fits ſhould return.

IX. *For Fluxes, eſpecially accompanied with Gripings.*

TAKE of *crude lapis calaminaris* finely powdered two ſcruples, of white chalk one ſcruple; mix them exactly, and give them in a ſpoonful or two of new milk twice, or, if the caſe be urgent, thrice a day. X. *For*

X. *For the Pains of the Piles.*

B TAKE of myrrh, olibanum, and common frankincenſe, of each a like quantity; having powdered them, mix them very well, and let the patient receive the fume of this mixture, caſt upon a chaffing-diſh with embers, in a cloſe-ſtool, for about a quarter of an hour (leſs or more, as he needs it, and is able to bear it).

DECAD IV.

I. *For an outward Contuſion.*

APPLY to the part affected ſkim'd or purified honey, ſpread upon cap-paper; to be kept on with ſome convenient plaiſter, or the like bandage, and ſhifted once or twice a day.

II. *Another of the ſame.*

A BEAT aloes ſuccotrina (or elſe hepatica) to fine powder; then pour on it as much roſe-water, as you gueſs may diſſolve a great part of it: this done, ſtir them well for a while, and, when the mixture is ſettled, pour off the liquor, and in it dip linen rags, which being applied to the part affected will ſoon ſtick to it, and ſeldom need be removed till the patient be relieved; and then to get them off, the rags muſt be well wetted with warm water, which will ſoften and looſen the adhering aloes.

III. *For a ſlighter Excoriation.*

B MELT mutton ſuet taken from about the kidneys, and freed from its ſuperfluous fibres or ſtrings; and to about two ounces of this add, little by little, about ſixteen or eighteen drops (ſometimes eight or ten may ſerve) of oil (not æthereal ſpirit) of turpentine; ſpread this mixture on a linen cloth, and, by binding or otherwiſe, keep it upon the part affected.

IV. *For an Excoriation, when the true Cutis is affected.*

B TAKE prunella (in Engliſh ſelf-heal) and having pounded it very well in a marble or glaſs mortar (not one of metal) apply it to the part affected, renewing it but ſeldom, and not without need.

V. *To take off the Pain and Inflammation of Ulcers in the Legs and elſewhere.*

B IN a quart of water boil about ſo much white bread, as in ordinary years may be found in a halfpenny loaf; then add to it two ounces of good ſheep ſuet cut very ſmall; and when that is boiled a little, add to it one ounce of finely powdered roſin, and a little well ſearſed brimſtone: of theſe make a cataplaſm, which is to be kept conſtantly on the part affected, and ſhifted once or twice a day, as need ſhall require.

VI. *For a Cough, eſpecially accompanied with a tickling Rheum.*

B TAKE equal parts of finely powdered olibanum and venice-treacle, incorporate them exactly, and of this maſs form pills of what bigneſs you pleaſe: of theſe let the patient take about half a drachm at bed-time, or, if need be, one ſcruple (or more) twice a day.

VII. *To*

VII. *To prevent the Tooth-ach, and keep the Teeth ſound.*

B Let the patient frequently rub his teeth moderately with the aſhes that remain in tobacco-pipes, after the reſt of the body hath been conſumed in ſmoak; ſome time after, waſhing (if need be) his mouth with fair water not too cold.

VIII. *For a Rupture, eſpecially in a Child or young Perſon.*

A TAKE of that geranium or crane's bill, that is commonly called columbinum, reduce the root and leaves to fine powder, and of this let the patient take about half a ſpoonful at night and morning for three or four weeks together, waſhing it down each time with ſome ſpoonfuls of red wine.

IX. *For the Heart-Burning, as they call it.*

B TAKE from fifteen or twenty, to thirty or forty grains of crabs-eyes (known commonly in the ſhops by the name of lapides cancrorum) reduced to very fine powder, and either take it alone, or in any convenient conſerve or ſyrup. It is for the moſt part beſt to take this medicine when the ſtomach is empty.

X. *For a Strain.*

B TAKE the ſtrongeſt vinegar you can get, and boil in it a convenient quantity of wheat-bran, till you have brought it to the conſiſtence of a poultice. Apply this as early as may be to the part affected, and renew it when it begins to grow dry.

DECAD V.

I. *For a recent Strain.*

B TAKE wormwood, and pound it very well in a mortar of ſtone or glaſs; then put into it as much of the whites of eggs beaten to water, as may ſerve to make it up into ſuch a conſiſtence, as may be applied like a poultice to the part affected.

II. *A ſtrengthening Plaiſter after a Strain, or when there is any Weakneſs in the Joint.*

B MELT down together, and incorporate very well, two parts of *diapalma*, and one part of *emplaſtrum ad herniam*; ſpread this mixture (but not very thick) upon leather, and lay it to the joint to be ſtrengthened.

III. *For Looſeneſſes.*

C BOIL a convenient quantity of cork in ſpring-water, till the liquor taſte ſtrong thereof; of this decoction let the patient drink a moderate draught from time to time, till he finds himſelf relieved by it.

IV. *For Obſtructions, and divers Diſeaſes proceeding thence.*

B LET the patient drink every morning a moderate draught of his own urine newly made, and (if it can conveniently be) whilſt it is yet warm, forbearing food for an hour or two after it.

V. *For Difficulty of Hearing, from a cold cauſe.*

B OUT of a bulbe, or root of garlick, chuſe a chive of a convenient bigneſs; then having paſſed a fine piece of thread or ſilk through one end of it, that thereby it may be pulled out at pleaſure, cruſh it a little between your fingers, and having anointed it all over with oil of bitter, (or, for want of that, ſweet) almonds, put it into the cavity of the patient's ear at bed-time, and draw it out the next morning, ſtopping the ear afterwards with black wool; but if need require, this operation is to be reiterated with freſh garlick for ſome days ſucceſſively.

VI. *For Ruptures in the Belly, eſpecially in Children.*

A HAVING well cleanſed the roots of ſigillum Salamonis, ſcrape one ounce of them into a quart of broth, and let the patient take a meſs, or a porringer full of it for his breakfaſt; or elſe give half a drachm, or two ſcruples, of the powder of it at a time in any convenient vehicle.

VII. *To give check to Fits of the Gout, and in ſome meaſure to prevent them.*

B TAKE three ounces of ſarſaparilla ſliced and cut thin; to theſe add an equal weight of raiſins of the ſun, rubbed very clean, but not broken; put both theſe ingredients into three quarts of ſpring water, and let the veſſel ſtand in a moderate heat, that the liquor may ſimmer for many hours, yet without burſting moſt part of the raiſins; keep this decoction well ſtopt, and let the patient uſe it for his only drink, till he need it no longer.

VIII. *A Water for Ulcers and Sores.*

B TAKE a ſolution of Venetian ſublimate, and having made with very good quick lime as ſtrong a lime-water as you can, (ſo that, if it be poſſible, it may bear an egg) drop this upon the diſſolved ſublimate, till it will precipitate no more reddiſh ſtuff at all; (which will not ſo ſoon be done, as one, that hath not tried, will imagine:) as ſoon as you perceive, that the liquors act no longer viſibly upon one another, pour the mixture into a filter of cap-paper, which, retaining the orange-coloured precipitate, will tranſmit an indifferently clear liquor, which is to be in a glaſs vial kept ſtopt for its proper uſe; namely, that the part affected may be therewith waſhed from time to time, and, if need be, kept covered with double linen cloths wetted in the ſame liquor.

IX. *A Plaiſter to diſcuſs Tumours, and ripen them, if it cannot diſcuſs them.*

B TAKE of yellow wax, frankincenſe, and roſin, of each four ounces, or a ſufficient quantity; melt them together gently, and being ſtrained, make up the maſs into a roll for uſe.

X. *For the Black Jaundice itſelf.*

B TAKE a ſpoonful of honey, boil it gently, and ſcum it, till it come to a good conſiſtence: then add of wheat-flour and ſaffron (reduced to a powder) as much of each, as you may take upon the point of a knife; and having mixed all well, put it over the coals again, until it loſe its ſmell; afterwards you may put it into a little ſtone or earthen pot, and keep it for uſe; which is, that the patient take the quantity of a pea, and anoint the navel, and fill the cavity thereof with it; repeating the application for ſome days together, when the ſtomach is empty, and abſtaining from meat and drink about two hours after the medicine is uſed.

DECAD VI.

I. *A parable Medicine for the Stone.*

B TAKE of the ſeed of ſlixwood, and give of it about as much, as will lie upon a ſhilling, either whole or groſly bruiſed, in any convenient vehicle.

II. *For Fits of the Mother.*

B DISSOLVE ſtore of ſea-ſalt in the beſt wine-vinegar, and in this dip a ſoft linen cloth, which being folded ſo as to make three or four doubles, is to be applied ſomewhat warm to the ſole of the patient's feet, and kept on till the fit be over.

III. *A choice Plaiſter to ſtrengthen the Joints after the Gout, and haſten the going off of the Pain.*

A TAKE of Paracelſus and diapalmaana, melt them and incorporate them exactly together, and ſpread the mixture very thin upon fine leather, to be uſed as a plaiſter to the part affected.

IV. *A very good Drink in continual Fevers.*

A MAKE a decoction of the leaves of rue in fair water, till the liquor taſte pretty ſtrong of the plant; this being ſtrained, is to be made ſomewhat palatable with liquorice, or a little ſugar, or aromatic body; to half a pint of this add about ten drops of ſpirit (not oil) of vitriol: let the patient uſe this for his ordinary drink.

V. *A good Drink, to be frequently uſed in Fevers, eſpecially continual ones.*

A GIVE in half a pint of ſome ſmall convenient drink, half an ounce of hartſhorn, burnt to great whiteneſs, which is to be a little boiled in the liquor; and this, thus altered, is to be given from time to time.

VI. *An eaſy Medicine for a freſh Strain.*

B MAKE up the clay, with which the bungs of barrels are wont to be ſtopt, with as much vinegar, as will bring it to the conſiſtence of an indifferently ſtiff cataplaſm: then warm it a little, and apply it to the part affected.

VII. *A Remedy much uſed for Chilblains.*

C TAKE a turnip, roaſt it well under the embers, and beat it to a poultice; then apply it very hot to the part affected, and keep it on (if need be) for three or four days; in that time ſhifting it twice or thrice, if occaſion require.

VIII. *A ſimple antimonial Remedy, that has often done much good even in the Leproſy, and all continual Fevers.*

A TAKE crude antimony, well choſen and powdered; of this give about one, two, or three ſcruples morning and evening, according to the age of the patient, in a little ſyrup of clove-gilly-flowers, or any ſuch vehicle, or elſe mixed with fine ſugar, enough to make it ſomewhat palatable. This may be continued for four or

five months, if need require; and if the firſt doſe prove beneficial to the patient, in caſes not urgent, a ſcruple or half a drachm may ſerve the turn, nor need the exhibition be continued for ſo long a time.

IX. *For the Cholic and divers other Diſtempers.*

B TAKE four or five balls of freſh ſtone-horſe dung, and let them ſteep for about a quarter of an hour (or leſs) in a pint of white-wine, in a veſſel well ſtopt, that the liquor may be richly impregnated with the more volatile and ſubtile parts of the dung; ſtrain this, and give of it from a quarter to half a pint, or ſome ounces more at a time, the patient having a care not to take cold after it.

X. *An often experienced antimonial Infuſion.*

B TAKE one ounce of powdered antimony tied up in a little bag of clean linen, and hang it in a gallon of beer or ale, that is brought from the brewhouſe, and is yet ſcarce fit to be drawn out, much leſs to be drank. Of this liquor, when it is ripe, let the patient make uſe for his ordinary drink; only having a care, that if by age or accident it be perceived to grow ſour, that veſſel then be left off, for fear leſt the acidity of the liquor corroding the antimony might make it vomitive.

DECAD VII.

I. *An eaſy Medicine to cleanſe the Womb, eſpecially after Child-bearing.*

B TAKE a large white onion, of about four ounces in weight, (if you can get ſo big a one, and boil it in about a pint of water, with any thing fit to make a very thin broth, till a third part or more of the liquor be conſumed: of this broth, which may be made a little palatable with nutmeg, *&c.* the patient is to take ſix or eight ounces twice or thrice a day.

II. *An experienced Waſh, that quickly Cures the Itch.*

A TAKE ſtrong quick-lime, one pound, and put to it a gallon of ſpring-water; let them lie together for ſome hours, and then warily pour off the clearer; filter the reſt, and take two ounces of quickſilver, tied up in a linen bag, and hang it in the liquor, and boil it for half an hour or more; then pour off the clear liquor once more, and waſh the hands only with it twice, or at moſt thrice a day.

III. *A Remedy often uſed with Succeſs in Fluxes, and even Dyſenteries.*

B. TAKE freſh roots of biſtort, cut them into thin ſlices, and moiſten them well with fair water and wine, to make them more ſoft and ſucculent; then preſs out the juice as ſtrongly as you can; and of this give about three or four ſpoonfuls mingled with half a dozen ſpoonfuls, or ſomewhat more, of red wine, or ſome other convenient liquor.

IV. *A good Medicine for a Sore Throat.*

B TAKE the white of a new-laid egg, and, by beating it, reduce it into water; and with this water mix diligently ſo much conſerve of red roſes, as will reduce it to a ſoft maſs; whereof the patient is to let a little bit at a time melt leiſurely in his mouth.

V. *A choice Medicine for a Sore Throat.*

A TAKE a piece of greaſy linen cloth, of ſuch a bigneſs, as, that being doubled, may make a bag in form of a ſtay, to reach from one ſide of the throat to the other, and contain as much matter, as may make it of the thickneſs of an inch or more: this bag being filled with common ſalt, is to be heated thoroughly, and applied to the part affected as warm as the patient can conveniently endure; and within two hours after, or when it begins to grow too cold, another like it, and well heated, is to be ſubſtituted in its room; and whilſt this is cooling, the other may be heated, and made ready for uſe: ſo that the part affected may be always kept in a conſiderable degree of warmth, for about 48 hours, if the remedy be ſo long needed.

VI. *An often experienced Medicine for the Cholic, eſpecially produced by ſharp Humours.*

A TAKE a quart of claret, and put into the veſſel about two ounces of nettle-ſeeds, ſtop the bottle, and keep it in boiling water, till the water has made three or four warms, to aſſiſt the wine's impregnation with the finer part of the ſeeds: of this liquor let the patient take a ſmall draught once or twice a day.

VII. *To appeaſe the Pain of the Hæmorrhoids, whether internal or external.*

B TAKE two parts of flower of ſulphur, and one part of ſugar very finely powdered, mix them exactly together, and make them up with a ſufficient quantity of mucilage or gum trajacanth into lozenges of about a drachm a-piece: of which you may give one at a time thrice a day, or, if need be, four or five times.

VIII. *To make an excellent Drink for the Scurvy.*

A TAKE two handfuls of water-trefoil, and let it work in about eight gallons of wort inſtead of hops, or of ſmall-ale or wort, made for it; and let the patient uſe it for all, or for a great part of his ordinary drink.

IX. *To make an eaſy Diuretic.*

C PEEL off the inner ſkin of an egg-ſhell, then beat the ſhell to a very fine powder: give about a ſcruple of it at a time in any convenient vehicle.

X. *A powerful Application to prevent and check the Apoplexy.*

A MAKE an iſſue at the meeting of the ſutures, and keep it open for a good while: but if the caſe will not admit a delay, clap on a good cupping-glaſs, without ſcarification, or with it, as need ſhall require, upon the ſame concourſe of the ſutures.

DECAD VIII.

I. *A choice Medicine for a Sore Throat.*

A TAKE houſleek, and having lightly beaten it in a glaſs or ſtone mortar, preſs out the juice hard between two plates; to this juice put almoſt an equal quantity of virgin-honey, mix them well, and add to the mixture a little burnt allum, as much as is requiſite to give it a diſcernible aluminous taſte: let the patient take this from time to time, with a liquorith ſtick, or ſome ſuch thing.

II. *An*

II. *An approved Medicine for a Cancer not broken.*

B TAKE dulcified colcothar, and, with cream of whites of eggs beaten to a water, bring it to the conſiſtence of a cataplaſm; which ought to be made large, and ſpread about the thickneſs of half a crown, and applied warm to the part affected, ſhifting it at leaſt once a day.

III. *To make a very good Syrup for thin Rheums.*

A TAKE ſyrup of jujubes, ſyrup of dried roſes, and ſyrup of corn poppy-flowers, of each a like quantity, mix and uſe them as the neceſſity of the ſick requires.

IV. *For the Dyſentery and Pluriſy.*

B GRATE to fine powder the dried pizzle of a ſtag, and give of it as much as will lie upon a ſhilling or thereabouts, once or twice a day, in any convenient vehicle.

V. *To ſtrengthen the Gums, and make the Teeth grow fine.*

B TAKE catechu, terra Japonica, or Japonian earth, and diſſolve as much as you can of it in a pint of claret, or red wine; then decant the liquor warily from the ſubſiding fæces, and let the patient now and then waſh his mouth with it, eſpecially at bed-time.

VI. *For a Hoarſeneſs upon a Cold.*

B TAKE three ounces of hyſſop-water, ſweeten it with ſugar-candy; then beat well into it the yolk of an egg, and drink it at a draught.

VII. *A choice Medicine for the Jaundice in Children.*

A TAKE half an ounce of choice rhubarb made into powder; incorporate with it exactly, by long beating, two handfuls of well choſen and cleanſed currants. Of this electuary let the patient take every morning about the quantity of a nutmeg, for ſeveral days together.

VIII. *A rare Medicine to take away gouty, or other arthritick Pains.*

A TAKE highly rectified ſpirit of man's urine, and anoint the part with it, the cold being juſt taken off, once or twice the firſt day, and no longer, unleſs the pain continue.

IX. *For a Prolapſus Uteri.*

B APPLY to the patient's navel a pretty large cupping-glaſs; but let it not ſtay on too long, nor above a quarter of an hour, for fear of injuring the part it covers, eſpecially the navel-ſtring.

X. *To allay Heat in the Eyes proceeding from ſharp Humours.*

B BEAT the white of an egg into a water, in which diſſolve a pretty quantity of refined loaf-ſugar, and then drop ſome of it into the patient's eye.

DECAD IX.

I. *An experienced Medicine for ſtrengthning a weak Sight.*

B TAKE of eye-bright, ſweet fennel-ſeeds, and fine ſugar, all reduced to powder, of each an ounce, nutmeg alſo pulveriſed, one drachm (at moſt;) mix theſe very well together, and take of the compoſition from one drachm, to two or more, from time to time.

II. *An often tried Medicine for tertian Agues.*

B TAKE crude allum and nutmeg finely ſcraped, of each about half a drachm, mix the powders well together, and with about ſix grains of ſaffron: give this in two or three ſpoonfuls of white-wine vinegar, at the uſual time.

III. *For ſtuffing of the Lungs, and the Chincough.*

B MAKE ſyrup of penny-royal, or of ground-ivy, moderately tart with oil of vitriol; and of this let the patient take very leiſurely about a quarter of a ſpoonful from time to time.

IV. *For the Falling-ſickneſs in Children.*

B TAKE half a drachm of choice amber, finely powdered, and give it for ſix or ſeven weeks together, once a day, when the ſtomach is empty, in about four ounces of good white-wine.

V. *An approved Medicine to drive the Stone, and cure Suppreſſion of Urine proceeding from it.*

A TAKE the roots of wild garlick (by ſome country people called crow garlick) wipe them very clean, ſtamp them very well in a mortar of ſtone or glaſs, and ſtrain out the juice; with which make a moderate draught of good white-wine conſiderably ſtrong, and let the patient take it once or twice a day.

VI. *An experienced Medicine for Sore Throats.*

A. TAKE of ſcabius water ſix ounces, of wine-vinegar a ſmall ſpoonful, of muſtard-ſeed beaten, and of honey, of each a ſpoonful; and ſtir and ſhake them very well together; and then filter the mixture, and keep it for uſe.

VII. *An often experienced external Remedy in Apopleƈtic Fits.*

A FIX a cupping-glaſs (without ſcarification) to the nape of the neck, and another to each of the ſhoulders, and let them ſtick on a competent time.

VIII. *An eaſy, but approved Medicine for the Cholick.*

B TAKE about half a drachm of maſtick, and mix it with the yolk of a new-laid egg, and give it to the patient once or twice a day.

IX. *To appeaſe the Heat of Fevers by an external Remedy.*

C APPLY to the ſoles of the feet a mixture or thin cataplaſm made of the leaves of tobacco, fit to be cut to fill a pipe with, beaten up with as much of the freſheſt currants you can get, as will bring the tobacco to the conſiſtence of a poultice.

X. *The Medicine, that is in ſuch requeſt in* Italy, *againſt the Worms in Children.*

B INFUSE one drachm of clean quick-ſilver all night, in about two ounces of the water of goats rue, diſtilled the common way in a cold ſtill: and afterwards ſtrain and filter it, to ſever it from all dregs that may happen in the making it. This quantity is given for one doſe.

DECAD X.

I. *A choice Medicine for a Whitloe.*

A TAKE ſnail-ſhells, and beat the pulpy part of them very well, with a convenient quantity of fine chopped parſley, which is to be applied warm to the affected part, and ſhifted two or three times a day.

II. *A ſimple but uſeful Lime-water good for the King's-evil, and divers other Cauſes.*

B TAKE half a pound of good quick-lime, and put it into one gallon of ſpring-water, and infuſe it for twenty-four hours; then decant the liquor, and let the patient drink a good draught of it two or three times a day, or he may uſe it for his ordinary drink; this infuſion may be coloured with ſaffron or red-ſanders; and, if need be, to make it ſtronger, add more lime, and warm the water and keep it well ſtopped.

III. *An excellent Medicine for a freſh Strain.*

A TAKE four ounces of bean-flower, two ounces of wine-vinegar; of theſe make a cataplaſm to be applied a little warm to the part affected; but if this ſhould prove ſomething too ſharp (as in ſome caſes it may) then take two drachms of litharge, and boil it a little in the vinegar before you put in the bean-flower.

IV. *For the Piles.*

A TAKE balſam of ſulphur made with oil of turpentine, ointment of tobacco, equal parts, incorporate them well, and anoint the grieved place therewith.

V. *For a Burn.*

B MINGLE lime-water with linſeed-oil, by beating them together with a ſpoon, and with a feather dreſs the burn ſeveral times a day.

VI. *For a freſh Strain.*

A BOIL bran in wine-vinegar to the conſiſtency of a poultice, apply it warm, and renew the poultice once in twelve hours for two or three times.

VII. *An*

VII. *An experienced Medicine for the Cholic.*

A TAKE good nitre, one ounce, and rub it well in a clean mortar of glaſs or ſtone; then grind it with half a ſcruple or more of fine ſaffron; and of this mixture give about half a drachm for a doſe, in three or four ounces of cold ſpring-water.

VIII. *To make an Iſſue raw, that begins to heal up.*

B TAKE of *lapis infernalis* one ounce, of crown-ſoap an ounce and an half, chalk finely powdered ſix drachms, mix them all together carefully, and keep them cloſe ſtopped, except when you mean to uſe them.

IX. *For a Sore Throat.*

A MAKE a plaiſter of *Paracelſus*, three or four fingers broad, and length enough to reach almoſt from one ear to the other, and apply it to the part affected, ſo that it may touch the throat, as much as may be.

X. *For Heat about the Orifice of the Stomach.*

B MAKE a ſyrup with the juice of houſeleek and ſugar, and give about one ſpoonful of it from time to time.

XI. *A Stomachical Tincture.*

A TAKE agrimony, two drachms, ſmall centuary-tops, one drachm, coriander-ſeeds bruiſed, one ſcruple, ſaſſafras-ſhavings and bark, one drachm, gentian-root, half a drachm, zedoary-root, ten grains; pour upon theſe three quarters of a pint of boiling ſpring-water, cover it, and let it ſteep twelve hours, then ſtrain it, and put it in a bottle; then drop a drop of oil of cinnamon upon a lump of ſugar, and put it into the liquor. The doſe is three ſpoonfuls twice a day, an hour or two before meals.

The End of the Firſt Volume.

MEDICINAL EXPERIMENTS:

OR, A

COLLECTION

OF

CHOICE and SAFE REMEDIES

Very Uſeful in all FAMILIES.

THE SECOND VOLUME.

I. *A powerful Remedy in Apoplectic Fits.*

A TAKE the herb maſtick, and diſtill, by an alembic, with a copper body, an eſſential oil, of which, with ſuch a pipe or quill, that one end may be opened and ſtopped at pleaſure, (the other ſtill remaining open) blow up ſome drops firſt into one of the patient's noſtrils, and a while after into the other too.

II. *A good Plaiſter for Achs, eſpecially ſcorbutical.*

SPREAD thinly upon ſlink, or very fine kids leather, the *emplaſtrum de mucilaginibus*, and let it lie upon the aching part as long as there is need.

III. *For an old Ach or Strain..*

TAKE of *Lucatella's* balſam one ounce, of oil of turpentine one dram, incorporate them very well with a gentle heat, and anoint the part affected therewith, wearing on it a piece of unwaſhed flannel beſmeared with the ſame ointment.

IV. *For Scorbutic Achs, eſpecially about the ſhare-bone.*

TAKE two parts of palm-oil, and one of oil of camomile (to which, if you pleaſe, you may add a little ointment of elder) mix theſe exactly, and anoint the part affected.

V. *A powerful Remedy for Scorbutic Achs.*

TAKE to one ounce of oil of turpentine, one dram or two of the volatile ſalt of harts-horn, or as much as being well ground with it in a mortar of glaſs or marble, will bring it to the conſiſtence of a kind of ointment, with which, the cold being taken off, the part affected is to be lightly anointed.

VI. *A very eaſy Medicine for light ſcorbutic Achs or Pains.*

ANOINT the pained part from time to time with faſting-ſpittle; and if you will have the medicine a little ſtronger, the patient may put roch-allum to the bigneſs of a ſmall pea into his mouth before he employs his ſpittle..

VII. *For Achs and pricking Pains in the ſides or elſewhere.*

WITH a ſufficient quantity of clean ſulphur finely powdered mix diligently as much Venice treacle as will bring it to the conſiſtence of pills. Of this mixture you may give the quantity of a piſtol-bullet twice, or, at moſt, thrice a day, drinking any convenient liquor after it.

VIII. *An experienced Remedy for an Anaſàrca, or general diſeaſe of the whole body.*

FRY freſhly gathered rue with oil of walnuts, till it become fit to be applied hot as a cataplaſm or poultice to the navel; and keep it on that part ſome hours, renewing it once or twice a day, if need require.

IX. *An external Medicine often ſucceſsfully tried for Agues.*

TAKE five, ſeven or nine (for it is pretended it muſt be an odd number) of the roots of rib-wort, and having made them clean, put them into a little bag of ſarſenet or fine linnen, and let the patient wear it upon the nape of his neck, renewing it within two, three, or four days, if need require.

X. *A tried Remedy for Agues.*

TAKE of the bark of ſaſſafras-root, and of Virginian ſnake-weed, both in powder, of each ten grains; and with half a dram, or two ſcruples of mithridate or Venice-treacle, or as much as will give it a due conſiſtence, make a bolus to be taken the uſual hours.

XI. *A choice Medicine for Aguiſh Diſtempers.*

TAKE of ſalt of wormwood fifteen grains, crabs-eyes, or powder of crabs-claws ſimple, eight or ten grains; mix theſe well, and give them in two or three ſpoonfuls of ſome cordial water.

XII. *An excellent Wriſt-Plaiſter for Agues.*

TAKE wax, and ſpread it to about the thickneſs of a crown-piece of ſilver, and of a convenient breadth and length to make an entire wriſt plaiſter; upon this ſpread and diſplay as well as you can the leaves of the tops of rue not yet fully opened by time, ſo that they may cover the whole plaiſter as well as you can make them do it. Then apply this emplaiſter, and let it lie on ſeveral days conſecutively.

XIII. *An often tried Medicine for Agues.*

TAKE ribwort, gather the leaves as near the root as you can in a dry morning, wipe them clean, but do not waſh them; then dry them carefully, till you may reduce them to powder. Of this powder give from one dram or two at moſt, mixed with one dram of conſerve of roſes, or the crumbs of white bread, or the yolk of an egg or two. [*N. B.*] You may, before you dry the leaves, diſtill a water out of ſome of them, and make an extract out of others with ſpirit of wine, or, which is better, with ſpirit of dew. They are both good for the ſame diſeaſe that the powder is. The doſe of the water is one ounce, or an ounce and an half, at the uſual times; and that of the extract about one dram in ſome ounces of white wine.

XIV. *An excellent Medicine for Agues, eſpecially Tertians.*

GIVE as much of well-conditioned Virginian ſnake-root reduced to fine powder, as will lie upon a ſhilling, in a cup of ſherry, juſt before the beginning of the cold fit, repeating it once or twice, if it need to be uſed oftner.

XV. *For a Tertian Ague.*

TAKE of the root of angelica grated, or otherwiſe made into powder, and give of it from half a dram to a dram, in any convenient vehicle at the uſual times (*viz.* about two hours before the cold fit.)

XVI. *A Medicine, with which a Quartan was cured, that could not be cured with Jeſuits-Bark.*

TAKE one dram of the black tips of crabs-claws, and having reduced them to exceeding fine powder, let the patient take it in any convenient vehicle or conſerve, twice or thrice, as he would take the cortex, without intermitting any day.

XVII. *An eaſy Remedy, which, long continued, does much deſtroy Acidities or Heart-burnings in the Stomach.*

TAKE half a dram at leaſt of finely powdered red coral, and give it from time to time in any convenient vehicle, till the patient be relieved.

XVIII. *A very often tried Remedy for the Aſthma.*

Take ſoap-boilers lees (made with potaſhes and quick lime) one part, ſpirit of wine rectified two parts; ſet them in digeſtion (to unite them well) and then add ſome drops (at diſcretion) of chymical oil of carraways, and if you pleaſe, of anniſeeds too. The doſe in younger perſons is about ten drops, in elder ones, from half a dram to one dram, in ſome convenient vehicle.

XIX. *An excellent Medicine for a Dry or Convulſive Aſthma.*

TAKE choice ſaffron, reduce it (by rubbing it in a ſtone or glaſs mortar) to a kind of powder, and, with any convenient mixture, give eight or ten grains of it in the form of pills at bed-time.

XX. *An experienced Remedy for Difficulty of Breathing.*

TAKE of choice *Caſtoreum* dried enough to be powdered, two or three, or at moſt four grains, mix this with ten or eleven grains of *Gaſcoign*'s powder reduced to very fine powder; mix up theſe with ſome little ſyrup or conſerve; and when the patient has taken it, let him waſh it down with the mixture, conſiſting of five drams of penny-royal-water, and half a dram, or at moſt two drams of briny-water compound.

XXI. *An approved Medicine for inveterate Scorbutic Cholics, and Pains of the Bowels.*

TAKE Engliſh barley, and having well waſhed it, boil it in a ſufficient quantity of freſh ſpring-water, till it be juſt ready to burſt: then pour off the clear upon the yellow part of the rinds of lemons, freſhly cut off from the white part, and put them into a bottle, which being carefully ſtopped, the liquor is to be kept ſo for uſe, which is, that the patient make it his conſtant drink.

XXII. *To reduce flaggy Breasts to a good shape and consistence.*

TAKE green hemlock, well bruised and reduced to a kind of cataplasm or poultice, which is to be applied (the cold being first taken off) to the parts it is to work upon, and to be kept on, till it hath performed what was intended, shifting it once a day.

XXIII. *An easy, but useful Remedy for a fresh Bruise or Contusion.*

TAKE fresh butter and parsley, of each a sufficient quantity, and having chopped the herb, mix it very well with the butter to the consistence of a cataplasm, which is to be applied warm, to the newly bruised part.

XXIV. *For Coagulated Blood, or a Bruise.*

TAKE black soft soap, and, with a sufficient quantity of soft crums of white-bread very well mixed with it, make a paste, which is to be laid on the part with a linnen rag, and kept bound upon it for some hours, that it may have time to resolve the congealed blood, and bring the contused part from a livid to a red colour, which will much hasten and facilitate the restoring it to its former state.

XXV. *To stanch Blood falling from the Nose, by a Simple held in one's Hand.*

LET the patient hold knot-grass and Solomon's-seal in his hand, till it grow warm there, or longer, if need be.

XXVI. *An excellent Remedy to stanch Blood in any part of the Body.*

TAKE plantain-water two ounces, barley-cinnamon-water, six drams, spirit of vinegar one ounce, dragons-blood half a dram, syrup of myrtles five drams; mix and make a julep, of which let the patient take three spoonfuls every hour.

XXVII. *The Styptick Water for stopping of Blood in any part of the Body.*

TAKE one pound of excellent quick-lime, and put it into a clear earthen-pot, pour upon it five or six pounds of fountain water, cover the pot close, and let it lie to infuse about an hour without touching it, then after stir it with a stick for a little time; then let it lie as before for twenty-four hours, sometimes stirring it; in the end you shall let it settle to a sediment; the water being very clear above, pour it off by inclination without stirring: take of this water one pound, which being put into a vial, you shall add to it a dram and a half of sublimate finely powdered; then shake very well all together, so that the powder may dissolve, and be of an orange colour, as more reddish than yellow, and in the end clear and limpid, because the red powder will precipitate to the bottom. Your water being clarified, you must separate the water from the grounds into another vessel, without troubling the sediments; and to the water you shall add one dram of oil of vitriol, and an ounce of *saccarum Saturni*. Shake all together, that they may mix the better; afterwards let all settle, and pour off the clear water, and keep it for your use.

XXVIII. *A choice Medicine to resolve Extravasated Blood.*

GRATE or rasp the root of burdock, and spreading the powder upon a linnen cloth, bind it round the part affected, renewing it twice a day.

XXIX. *To make an excellent Styptick for Stopping of Blood.*

TAKE Hungarian vitriol, allom, of each half a pound, phlegm of vitriol ten pounds: boil to a diſſolution of the vitriol and allom; being cold, filter it through brown paper, and, if any cryſtals ſhoot, ſeparate the liquor from them, adding to each pound one ounce of oil of vitriol. Dip cloths into this liquor, and apply them to the part affected.

XXX. *An often tried Styptick to ſtanch Blood, eſpecially in Wounds.*

TAKE colcothar, as it comes out of the retort, and having powdered it, roll tents of lint in it, and apply them to the orifices of the greater veſſels, and employ other uſual means to impreſs the veſſel upon the tent, and to fill the cavity of the wound, partly with colcothar too.

XXXI. *A very often experienced Remedy for Burns.*

TAKE two parts of oil of walnuts, and one of honey, mix them well together over a gentle fire, and, when they are thoroughly incorporated, dip a feather in the mixture, and anoint therewith the part affected ſo, as the ointment may touch it immediately, and then ſtrew on it ſome powder of ceterach, or ſpleen-wort, and keep the part quiet, and defend it from the air.

XXXII. *An eaſy Medicine, and common enough, but uſeful againſt Burns.*

TAKE onions, and beat them into a ſoft maſs, and apply them as ſpeedily as you can to the part affected, and keep them on it, till they begin to grow dryiſh, and then, if need be, ſhift them, and apply freſh ones.

XXXIII. *For a recent Burn.*

TAKE onions a ſufficient quantity, and beat them very well with common ſalt finely powdered into a maſh, that may be applied as a cataplaſm (the cold being firſt taken off) to the part affected; and renewing it, if need be, till the impreſſion of the fire be taken out.

XXXIV. *An excellent Ointment for Burns and Scaldings.*

TAKE of the inner rhind of elder-tree, and of freſh ſheep's-dung, without any adhering ſtraws or foulneſs, of each one handful, and with freſh butter or oil, make thereof an ointment, to be applied as is uſual in ſuch diſtempers.

XXXV. *An eaſy and approved Remedy for Burns, eſpecially recent ones.*

TAKE a ſufficient quantity of adder's-tongue, and boil it ſoftly in linſeed oil, till the liquor be ſtrongly impregnated with the herb; then ſtrain it, and keep it ſtopt for uſe.

XXXVI. *An excellent Ointment for Burns and Scaldings.*

TAKE of *ſaccarum Saturni* half a dram, of the ſharpeſt vinegar four ounces; make a ſolution of the former in the latter, and add to this ſolution drop by drop, (often ſtirring or ſhaking them together) as much oil of elder, as will ſerve to reduce the mixture into the form of a nutritum or ointment.

XXXVII. *A*

XXXVII. *A ſlow but innocent way of making Bliſters without Cantharides.*

TAKE crow's-foot, and putting to a handful of it about half a ſpoonful of muſtard, beat them very well together to the conſiſtence of a poultice; put this to the thickneſs of one's little finger into a cover of a box cut ſhallow, and of about the breadth of the palm of one's hand (though this cover be leſs neceſſary than convenient,) and cutting a hole of the wideneſs of the box in a plaiſter of diapalma, or the like, to make it ſtick, you muſt apply it to the part, and let it lie on twelve or twenty-four hours, becauſe it works as well more ſlowly, than cantharides, as more ſafely and innocently.

XXXVIII. *A good Medicine to raiſe Bliſters.*

TAKE cantharides reduced into powder, and upon half an ounce of this put two or three ounces of good ſpirit of wine; let them lie together four or five days, that the ſpirit may acquire a good tincture; then filter it, and dip into it a piece of linnen cloth 6, 7, or 8 times double, and of the figure and largeneſs, that you deſire. This cloth being throughly wetted and covered with a melilot plaiſter, or one of diachylum, or ſome other, that will ſtick, to keep it on, muſt be applied to the part. At the end of five or ſix hours you may take off your plaiſter and the linnen cloth, and find your work done.

XXXIX. *To raiſe a Bliſter without Cantharides.*

THE ſeed of *clemmatis peregrina* being bound hard upon any part, will in an hour, or at moſt two, have an operation like that of another veſicatory, as far as its contact reaches.

XL. *An uſeful Medicine for Coſtiveneſs.*

TAKE virgin-honey a ſufficient quantity, and mix exactly with it as much finely powdered *cremor tartari*, as will ſuffice to bring it to the conſiſtence of a ſomewhat ſoft electuary, of which the patient may take upon the point of a knife the bigneſs of an almond (more or leſs) as upon trial you ſhall ſee cauſe.

XLI. *For a Cancer in the Breaſt.*

TAKE of the warts, that grow on the hinder legs of a (ſtone) horſe, dry them gently till you can reduce them to a powder, of which you may give half a dram for a doſe in any convenient vehicle.

XLII. *A potent Medicine for Contuſions and divers other Affections.*

Take alcohol of wine, and diſſolve in it as much pure camphire, as you eaſily can, and keep it very cloſe ſtopt, till you have occaſion to uſe it. Then moiſten throughly with it ſome thin pieces of linnen or flannel, and apply them lukewarm: and likewiſe you may, with a rag dipt in it, apply it to the eye-lids, having a care, that none of it get into the eye itſelf, ſince there it would cauſe great ſmart. It may alſo be very uſefully applied to burns, and yet more to contuſions.

XLIII. *A tried Medicine for Chilblains.*

TAKE pretty thick parings freſhly cut off from turnips, and hold them to the fire, till they be very criſp; then apply them to the unbroken tumours or bliſters, as hot as the patient can endure it, and keep them on a competent time, and put on

new if need require. They will cauſe the peccant matter to tranſpire, or otherwiſe waſte, without breaking the bliſters.

XLIV. *To make a very nouriſhing Aliment, that hath recovered divers in Conſumptions.*

TAKE eight or ten craw fiſhes, (or, if they be not of the largeſt ſize, a dozen) boil them (after the blackeſt gut or ſtring is taken out) in barley-water, till they become very red; then take them out, and beat them long, ſhells and all, in a marble or glaſs-morrar, to a ſoft maſh, and in a preſs ſtrongly ſqueeze out the juice; which may be given either alone, or mixt with about an equal part of chicken-broth, or ſome ſuch convenient alimental liquor.

XLV. *A vulgar, but often approved remedy for a Cold, eſpecially that affects the Breaſt.*

TAKE a ſheet, or half a ſheet *pro re nata*, of brown paper, of as even a texture as you can get, and anoint it over evenly and very well with the eldeſt tallow, or candle-greaſe you can procure, ſo that the paper may be thoroughly penetrated by it: then cover it thinly with nutmeg, as you were to rub the ſpice upon a toaſt, and clap it warm to the pit of the ſtomach, that it may reach a good way, both above it and beneath it.

XLVI. *An experienced Medicine for Coughs.*

BOIL good turnips in water, and having expreſſed the juice, mix it with as much finely powdered ſugar-candy as will bring it into a kind of ſyrup, of which let the patient ſwallow a little as ſlowly as he can from time to time.

XLVII. *A good Medicine for Aſthmatic Coughs.*

TAKE two ounces of oil of ſweet almonds freſhly drawn, and put them upon one drachm of flour of brimſtone, keep them for a fortnight in digeſtion in a moderate heat, and then decant off the oil, or paſs it through a clean linen rag to keep back the brimſtone: of this liquor give a ſpoonful or two at a time.

XLVIII. *An eaſy Medicine, which cured not long ſince a Gentlewoman, that had taken much Phyſic for a Conſumptive Cough.*

TAKE eight, ten, or twelve choſen raiſins of the ſun, and having ſlit them open, take out the little kernels, and ſtuff the raiſins with the tops or ſmall tender leaves, of rue; and let the patient take them, either as they are, or in the form of a bolus, or the like, pretty early in the morning, faſting after them two or three hours at leaſt, if he cannot conveniently faſt until noon.

XLIX. *A potent Medicine (for thoſe, that can bear it) to ripen Coughs, and haſten the Expectoration of Phlegm.*

TAKE onions, cut them into ſlices, and fry them with freſh butter, as if you were to eat them; then take them out of the frying-pan, and boil them with new milk until it be well impregnated with them, and they be made tender: of this mixture let the patient take a moderate quantity from time to time.

L. *An excellent Remedy for a Cough.*

TAKE of virgin-honey two ounces, of red-roſes warily dried and finely powdered half an ounce, of choice ſulphur very well ſifted two drams, of good benjamin reduced to fine powder one drachm; beat and mix all theſe very well; of this let the patient take the mixture from time to time.

LI. *A Plaiſter to prevent Corns.*

TAKE yellow bees-wax four ounces, verdigreaſe exactly powdered and ſifted one ounce, the caput mortuum of the ſkull of a man one dram. Incorporate them well with boiling a little, and make thereof a plaiſter according to art.

LII. *An effectual Plaiſter for ſoftening and looſening Corns.*

SPREAD a plaiſter of gum ammoniacum, (not too thick) without being diſſolved in vinegar, and applying it to the part affected, let it lie on, until it have ſufficiently done the deſigned work of emolition.

LIII. *A powerful (but ſmart) Remedy for Corns.*

EVAPORATE the ſtrongly expreſſed juice of radiſhes to the conſiſtence of a ſoft plaiſter, to be applied to the part affected, and ſhifted as often as it grows dry. *N. B.* It will ſometimes ſmart for a while at firſt, but afterwards it will do its work.

LIV. *A good Remedy for Corns of the Feet.*

TAKE the yeaſt of beer (not ale) and ſpreading it upon a linen rag, or other cloth, apply it to the part affected, renewing it once a day.

LV. *An excellent Remedy, that has cured many Children of Convulſive Fits.*

TAKE two or three drops of (chymical) oil of roſemary, and put it into half an ounce of ſack in an ounce bottle; ſtop the vial, and let it be well ſhaked to make a whitiſh mixture of the liquors juſt before you give it. Or elſe in a half-pint bottle or vial, put four ounces of ſack, or ſome appropriated liquor, and drop into it forty drops of the forementioned oil; and whenever you are to give the medicine, ſhake the vial well ſtopt, and preſently give of the whitiſh mixture a child's little ſpoonful.

LVI. *A ſucceſsful Medicine for Convulſive Fits and Hyſterical Vapours (as they call them) or Fits of the Mother.*

TAKE the liver of a hare (if it hath been hunted, it may be the better) and hang it up in a dry place, till it be ſomewhat friable, having a care that it putrify not; of this reduced to powder, let the patient take two or three ſcruples at a time in any convenient vehicle.

LVII. *An excellent Medicine for dry or convulſive Aſthmas, and alſo for Coſtiveneſs.*

GIVE at bed-time eight or ten grains of choice ſaffron, pulverized groſly in a little ſyrup or conſerve, as of violets, *&c.* to embody it with.

LVIII. *An excellent Mixture for Fits of the Cholic, and ſome kinds of Convulſions.*

TAKE one ounce of flowers of ſulphur, and as much ſugar-candy; grind them very well together in a glaſs or ſtone mortar, and upon this quantity drop thirty drops of oil of carraway-ſeeds, as much of orange, and as much of the oil of anniſeeds: incorporate theſe well, and of the mixture give about twenty or thirty grains for a doſe.

LIX. *An incomparable Medicine for the Cholic.*

THE yellow peel of oranges being reduced to powder, give from half a drachm to two ſcruples of it in any convenient vehicle.

LX. *To make good Purging Drink for the Cholic.*

TAKE two ounces of rhubarb, four ounces of gentian, and a quart of good anniſeed-water; let the roots infuſe a long time in it, and give the patient about two ſpoonfuls at a time, as often as need requires.

LXI. *An almoſt ſpecific Remedy for a fit of the Cholic.*

TAKE about half a drachm of expreſſed oil of nutmegs, (uſually ſold in the ſhops for Eaſt-indian oil of mace) diſſolve this in ſome ſpoonfuls of good wine, which the patient is to take as hot as conveniently he can.

LXII. *An uncommon, but tried Remedy for Cholics (without much Matter) and good in Fits of the Mother.*

TAKE good ginger dry, and inſtead of powdering it, cut it into as thin ſlices as you eaſily can: with theſe fill a tobacco-pipe, and take the ſmoak as you would that of tobacco. Do this twice, thrice, or four times a day, but eſpecially at bed-time, and in the morning.

LXIII. *An excellent Medicine for Convulſive Cholics.*

TAKE of the volatile ſalt of pidgeon's-dung two or three grains, or ſomewhat more, (not exceeding five or ſix in all) mix theſe with a ſcruple or half a drachm of the ſame dung crude, but well and ſlowly dried, and finely powdered. Give this mixture for one doſe in ſome ſpoonfuls of any convenient vehicle.

LXIV. *For the Cholic, or Pains in the Sides.*

TAKE two balls of freſh horſe-dung, and infuſe them for twelve hours (if haſte require, three or four may ſerve the turn) in good white-wine, in a cloſe veſſel; then ſtrain the liquor, and let the patient take five or ſix ounces of it at a time.

LXV. *For the Cholic.*

BOIL about one ounce of the ſeeds of the black ſtinging nettles in about a quart or more of good claret-wine; then ſtrain the decoction, and give of it a wine-glaſs full at a time, two or three times a day, or as often as need requires.

LXVI. *An excellent Medicine for the Cholic.*

TAKE of Dr. *Stephens*'s water half a pint, plague-water half a pint, juniper-berry-water half a pint, powder of rhubarb two ounces; mingle theſe together,

ſhake the bottle when you take any of it, and take about four ſpoonfuls at a time.

LXVII. *For the Cramp.*

TAKE the leaves of roſemary, chop them very ſmall, and ſew them ſo in fine linen or ſarſenet, as to make a kind of garter of them to be tied about the patient's bare leg.

LXVIII. *To take off the Pain of the Cramp.*

TAKE of the ointment of populeon two parts, oil of ſpikes one part; mix them, and with the mixture anoint well or chafe the part affected.

D.

LXIX. *A Remedy, by which an Hydropical Merchant was cured.*

GIVE about half a drachm or two ſcruples for a doſe of yellow tranſparent amber, twice or thrice a day in any convenient vehicle.

LXX. *An experienced Medicine for a Dyſentery, or Bloody-Flux.*

GIVE about three ounces of the juice of ground-ivy, mixt with one ounce of the juice of plantane, once or twice a day.

LXXI. *For to ſtop a Dyſentery, or Bloody-Flux.*

USE the powder of *crepitus lupi*, or fuſs-balls, made up with ſome conſerve of roſes, or other convenient additament, into pills. Of this mixture give *in dyſenteria*, as much at a time, as contains from about a ſcruple, to about half a drachm of the powder.

LXXII. *An eaſy, but very often tried Digeſtive, to be uſed inſtead of Baſilicum.*

TAKE two ounces of good Venice-turpentine, and incorporate very well with it the yolks of two freſh eggs, and then add to it (at diſcretion) a little ſpirit of wine; with this dreſs the part morning and evening, laying it on thicker, if the part be near ſome nerve or other drier part, and leſs thick, if it be fleſhy or moiſt.

LXXIII. *A good Medicine for Incontinency of Urine, and the Beginning a Diabetes.*

CUT off the necks of well-blown ſheep's-bladders; of the remaining membranes put up pretty ſtore one over another into a covered pot, where being dried gently, and yet ſufficiently, in a baker's oven, take them out and pulverize them well. The doſe is as much as will lie upon a large groat, or ſmall ſix-pence.

LXXIV. *For a Diarrhœa, Looſeneſs, or Flux of the Belly.*

MIX up fifteen grains, or if the diſtemper be but ſlight, ten grains, of powdered rhubarb, with half a drachm of diaſcordium, and let the patient take it either going to bed, or early in the morning after his firſt ſleep.

E.

LXXV. *For a Contuſion in the Eye.*

TAKE the crumb of white-bread, and diligently incorporate with black ſoft ſoap as much of it, as will make a ſomewhat ſoft paſte; and then with your thumbs make a little cake (as it were) of it, and apply to the bruiſed part, the eye being firſt ſhut, and blind it ſo, that it may lie on for ſome hours, or a day, if need be. But this ought to be uſed with caution.

LXXVI. *An excellent Medicine for clammy Humours of the Eyes.*

TAKE new milk, and let it ſtand, until it hath got a little cream upon it: then let the patient, when he is in bed, take up with his finger a little of the cream (and not of milk) and ſhutting his eye-lids, beſmear his eyes with it, having a care, that very little or none get into his eyes, becauſe it would make them ſmart; let the cream lie on, until the next morning, and in caſe the patient chance to wake in the night, he may, if he finds cauſe, lay on a little more, and waſh all off in the morning.

LXXVII. *A ſomewhat ſharp, but often tried Medicine, to take off the Pearl on the Eye.*

TAKE of the juice of celandine, and mix with it about an equal part of pure honey; and of this mixture employ a drop, or at moſt two, at a time, letting it fall upon the part affected morning and evening.

LXXVIII. *An eaſy Remedy for a recently Blood-Shot Eye.*

TAKE a rotten apple, and as many tops of wormwood, as being well beaten together with it, will make a maſs of the conſiſtence of a cataplaſm; warm this a little, and put a ſufficient quantity of it into a thin and clean linen rag, and let the patient keep it upon the part affected all night, the next morning waſh it off with ſome red roſe-water, or the like liquor.

LXXIX. *To make a choice Ophthalmic Water to preſerve the Eyes and Sight.*

TAKE of the diſtilled water of rue, celandine and vervain, of each one ounce; mix them, and infuſe in them two drams of *crocus metallorum* exquiſitely ground, for a week or ten days; then very carefully filter the infuſion, that none of the atoms of powder paſs thorough the liquor. Of this let fall into the eye a drop or two, morning and evening, having a care not to ſhake the glaſs, when you employ the liquor, leſt ſome unheeded duſt may have eſcaped the filter, and be raiſed.

LXXX. *For a ſlight Ophthalmia, or Blood-Shot Eye.*

SHAKE half a drachm of diligently prepared tutty into an ounce of red roſe-water, and drop it often into the eye.

LXXXI. *An experienced Eye Water for an Inflammation and Tumour of the Eye.*

TAKE of prepared tutty half an ounce, the water of white roſes and of frog's ſpawn, and alſo of the beſt canary wine (not diſtilled) of each two ounces, of aqua mirabilis half an ounce. Mix theſe well, and drop a very little at a time into the patient's eyes.

LXXXII. *An odd and often tried Medicine for an Eryſipelas.*

TAKE the blood of a hunted hare whilſt it is yet warm, and drench thoroughly in it clean linen rags, which are to be dried in the wind or free air, and then kept in a dry place for uſe: lay a good piece of linen thus ſtained upon the part affected, and either by binding it on, or covering it with ſome ſilken or other cloth, whoſe edges have ſome ſticking plaiſter, keep it from falling off, and renew it from day to day, if there be need. *N. B.* If it be grown too ſtiff with long keeping, you may ſoften it with a little ſprinkling of fair water.

LXXXIII. *An experienced Water for ſharp and ſlimy humours in the Eyes and Eye lids.*

TAKE of prepared tutty half an ounce, prepared coral and pearl of each half a ſcruple, *trochiſci-albi raſ.* five or ſix grains, red roſe-water, and ſuccory-water, of each an ounce and a half; mix them well, and if you will have the medicine ſtronger, you muſt put three or four grains of aloes into it.

LXXXIV. *A choice Remedy for an Ophthalmia, or Blood-Shot Eyes.*

TAKE of the juice of houſleek two parts, daiſies and ground-ivy, of each one part; mix theſe juices together, and to about two ſpoonfuls of the mixture, put five or ſix drops of clarified honey: let the juices depurate themſelves by reſidence, and then in ſome ſmall ſilver veſſel clarify them, and of this mixture let fall a drop or two into the eye three or four times a day. *N. B.* But if the inflammation be not ſo great, but there is more need of abſterſion, uſe more of the juice of ground-ivy, and leſs of that of houſleek.

LXXXV. *For a light Stroke or Contuſion of the Eye.*

TAKE two ounces of betony-water, and three drops of clarified honey, mix them well together, and drop them into the eye three or four times a day; the compoſition muſt be made freſh every ſecond and third day.

LXXXVI. *A potent, but ſmarting Medicine for things growing on the Eye.*

TAKE white paper, and let it flame away upon a clean pewter platter, till there remain ſo much oil behind, as you think you ſhall need; blow off the cinders of the papers, and with a little of your ſpittle mixt by your finger with the oil, make up a kind of ointment; which, being taken up with a feather, is to be applied once or twice a day, as need ſhall require (and as the patient can well bear) to the affected eye; which courſe is to be continued, till the cure be compleated.

LXXXVII. *For Hurts, that make the Solution of Continuity in the Eye.*

TAKE two ounces of celandine-water, and put to it two, three or four drops of good clarified honey, enough to give the water a faint taſte: with this dreſs the eye at leaſt twice (if not thrice) a day. But the mixture muſt be made freſh once in two or three days, or elſe it will grow ſouriſh.

LXXXVIII. *An excellent and very often tried Eye-Water, eſpecially for outward Affections of the Eye.*

TAKE of plantane-leaves 4 ounces, and of ſtrawberry-leaves as much; digeſt theſe for 24 hours in a pound of good white-wine; then diſtill them to dryneſs in a glaſs

glaſs head and body in a *balneo Mariæ*. The liquor that is thus obtained, put into a very clean braſs (not copper) veſſel, and let it ſtand there ſome hours, till it have acquired a manifeſt, but not a very deep blue tincture; and then put to it (when poured on) an equal weight of white-roſe-water diſtilled after the common way: ſhake theſe together, and let fall one drop into the internal corner of the eye, the patient ſtooping backward, and ſhutting his eye-lids for a minute or two, that the water may diſperſe on the eye, and that the quickneſs of the liquor, which may make him weep, may the leſs prejudice him.

LXXXIX. *To make a uſeful Medicine for Pain or Itching in the Eye-lids, or on that Account in the Eyes.*

TAKE half a ſpoonful of French barley (after the firſt water it was put into over the fire is caſt away) and boil it ſoftly for a little while in a pint of ſpring-water, ſeaſonably putting to it a good pugil of dried damaſk roſe-leaves. (*N. B.*) Sometimes you may add, if you pleaſe, a few red roſe-leaves, or melliot-flowers, or both.) With this liquor foment the part with a ſoft ſponge for a pretty while, in the morning, and at night, having a care, that it be applied pretty hot, or at leaſt warm.

XC. *To make an excellent Eye-water, for Redneſs and Light Films,* &c. *in the Eye.*

MAKE ſome lime-water, by pouring a gallon of ſcalding hot water upon a pound or ſomewhat more of quick lime; ſtir them together, and after ſome hours, decant warily that, which is clear. And to a pound of this water put half an ounce (and no more) of choice verdigreaſe pulverized; and in a very moderate heat extract a tincture of a fine, but ſomewhat dilute, ſapphirine colour (but it ought not to be too deep.) Decant this very warily, and let a drop or two of it at a time fall into the eye, as often as need requires.

XCI. *An excellent Remedy to ſtop a violent Defluxion on the Eye.*

TAKE red ſage and rue, of each one handful, a ſpoonful of fine wheat-flower, and the white of a new-laid-egg beaten to water; mix theſe very well, and ſpread them upon very thin leather or black ſilk, and apply it to the temples: it is to be about the bigneſs of a ſilver crown at leaſt.

XCII. *An excellent Remedy for red Eyes, made ſuch by a Defluxion of a hot or ſharp Humour.*

TAKE the tops of roſemary about one drachm, and beat them up with one or two ounces of rotten pearmains or pippins, or, if thoſe cannot be had, with the like weight of the ſoft part of the ſame apples, that are ſound: and when by exquiſite beating, you have reduced theſe things to a cataplaſm, apply them (the cold being firſt taken off) to the part affected, binding it thereupon, and letting it lie all night.

XCIII. *An Eye-water.*

TAKE houſe-ſnails, and beat them in their ſhells, and gratify them with about an equal quantity of juice of celandine; and draw off the water in a cold or pewter ſtill (ſuch as is uſed for roſe-water) and keep the liquor, that will come over, cloſe ſtopt for your uſe.

XCIV. *The Lady* Fitz-Harding's *Eye-water, which lately cured an almoſt blind Perſon, whoſe Eyes looked like Glaſs.*

TAKE three ſpoonfuls of white roſe-water, as much eye-bright-water, and as much ſifted white ſugar-candy, as will lie on a three-pence, and the ſame quantity of fine aloes ſifted and put to the water, and ſhaked together, and drop a few drops every night going to bed.

XCV. *A Pericarpium, or Wriſt-plaiſter, that oftentimes frees the Patients from flying Clouds in the Eyes, and ſometimes leſſer Specks, eſpecially if recent.*

TAKE of rue, camomile, hemlock, each half a handful, of bay-ſalt two ſpoonfuls, one or two ounces of leaven; incorporate theſe well together, and make thereof *pericarpia*, to be applied to the patient's wriſts, and kept on, till growing dry, they become troubleſome.

XCVI. *An excellent Medicine for hot Defluxions on the Eyes.*

TAKE of prepared tutty half an ounce, white roſe-water, and frogs ſpawn-water, carefully drawn in very good canary-wine, of each two ounces, of *aqua-mirabilis* half an ounce; mix theſe well together, and let fall two or three drops into the patient's eye, eſpecially at bed-time.

XCVII. *An eaſy but uſeful Eye-water to keep the Eye cool and moderately dry.*

TAKE two ounces of ſuccory-water, half a drachm of prepared tutty, ſhake them well, and keep them together for uſe.

XCVIII. *An often tried Pericarpium, or Wriſt-plaiſter for Defluctions and Fumes in the Eyes.*

TAKE rue, camomile, hemlock, wormwood, of each half a handful, bay-ſalt pulverized about two ſpoonfuls, ſour dough about an ounce; mix all theſe together very diligently, moiſtening them from time to time with elder vinegar to a conſiſtence fit for *pericarpia*, one of which is to be applied to the wriſt of that ſide, on which the part affected is, and to be renewed, if there be occaſion.

XCIX. *For a Phylectena, or little Tumour in the carneous Tunicles of the Eyes.*

TAKE the decoction of mucilages, that is proper for phylecteas, and dreſs the eye from time to time to ripen the tumor: then open it with a lancet, and ſqueeze out all the matter; and laſtly, cleanſe and heal the part with honey. *N. B.* But when the tumor is beginning, or not great, you may, in want of the decoction of mucilages, dreſs the eye with the mixture of equal parts of the water of melilot, camomile, and betony.

C. *A Plaiſter to ſtrengthen the Eyes, and ſtop Defluxions on them.*

TAKE of frankincenſe two ounces, *olibanum* and maſtick, each half a drachm; mix theſe well, and reduce them into fine powder, of which a convenient quantity is to be melted and ſpread upon black ribbon, or ſome ſuch thing, with a hot knife or ſpatula, and ſo preſently applied to the temples.

CI. *An often experienced Medicine for little Strokes or Contuſions in the Eye.*

TAKE betony-water three ounces, and five drops of clarified honey; mix them, and drop a little of the mixture from time to time into the patient's eye. *N. B.* Take ſuccory-water, crumbs of white-bread, a little ſaffron, and ſometimes a little honey, for ſharp humours in the eye-lids, and burns or ſmall ſpecks (of the eye;) four grains of roman vitriol to four ounces of water, of either roſe-water, ſuccory-water, or fennel-water, *&c.*

CII. *A good Electuary to ſtrengthen the Sight.*

TAKE conſerve of borage and betony, of each an ounce and a half, Venice-treacle two drachms, *ſpecies Dionyſi*, *dairrhodon abbatis*, *diatryon ſantalon*, of each half a drachm, tartar vitriolate a ſcruple, diacorallion a drachm and a half, oil of fennel ſeven drops, ſyrup of violets and coral, of each a ſufficient quantity; mix and make an electuary.

CIII. *A choice Medicine for an* Ophthalmia Sicca.

TAKE of the leaves of fennel, hyſop, celandine, betony, and carduus, of each half a handful, or a whole handful; of linſeeds, quince-ſeeds, fenugreek, and fleawort, of each half a drachm, of French barley one ounce: boil all theſe a little in two quarts of fair water, and half a pint of white-wine. Let the patient hold his head (well fitted with a napkin for the purpoſe) over the fumes for about a quarter of an hour.

CIV. *For a Film, or other ſuch Thing, growing in the Eye.*

TAKE of crude roch-allom two parts, turmerick one part, and refined ſugar three parts. Pulverize each of theſe ſeparately, then mix them exactly, and warily blow it into the patient's eye from time to time, as need ſhall require.

CV. *To make an excellent, as well as famous Eye-water.*

TAKE celandine (the whole plant except the root) and having ſhred it, or chopt it a little, put it into a retort, and diſtil it in balneo. When all the liquor is come over, empty the veſſel, and put in it as much as the freſh plant, and diſtil the liquor from it to make it more ſtrong of the plant. Put this liquor once more upon new or freſh celandine, and diſtil in balneo as before; and keep this well-impregnated water cloſe ſtopt. It is to be outwardly uſed in the doſe of two, or three, or four drops at a time.

CVI. *A Medicine for Hurts in the Eye.*

TAKE ſuccory-water and crumbs of white-bread, enough to bring it almoſt to a conſiſtence; then add a little ſaffron to tinge and quicken it, and ſometimes alſo you may put to it a little honey, to make it more cleanſing and healing. Apply it (if need be) with pledgets of flax to the part affected.

CVII. *A Remedy, that hath cured the Epilepſy.*

GIVE daily half a drachm at a time of choice and very finely powdered amber, in any convenient vehicle for about ſix weeks together.

CVIII. *Elixir Salutis.*

TAKE of the ſeeds of aniſe, ſweet fennel, coriander and parſley, of each two ounces; of liquoriſh ſcraped, waſhed and bruiſed, and choice leaves of ſenna, of each

each likewiſe two ounces; of raiſins of the ſun, rubbed clean and bruiſed, one pound; of elecampane-roots and guaiacum-wood, of each one ounce. Mix theſe ingredients, and pour on them two quarts of *aqua vitæ*, or Engliſh ſpirits (for brandy is too hot a liquor.) Let theſe infuſe together forty-eight hours. Then put them all in a hair-bag, and preſs them ſtrongly in an apothecary's preſs, and, if there be need, paſs what is ſtrained through an hippocras bag after the liquor is ſettled. Keep this in bottles well ſtopt in a cool place, and give of it two or three ſpoonfuls at a time, in the morning faſting, and, if need require, at bed-time.

CIX. *An experienced Remedy for Convulſions and Epilepſies in Children.*

TAKE about half a drachm, or from one ſcruple to two, or ſomewhat more, of well-choſen and very finely powdered amber, native cinnabar ten grains; mix them, and of this, ſweetened with ſome powdered ſugar, or other fit thing, that may give it a reliſh, let the patient take twice a day (at leaſt for moſt days) during ſix weeks, unleſs he fully recovers before that time: and, however, he is to take it for two or three days before each new and full moon, for ſome months ſucceſſively.

F.

CX. *An excellent Drink in Fevers, even malignant.*

TAKE a quart of ſpring-water, and having given it a walm or two, put to it one ounce of harts-horn calcined to perfect whiteneſs, and when the mixture is cold, put to it three ounces of ſyrup made of the juice of lemons; ſhake this mixture; when you will uſe it, ſhake it well, and let the patient take of it a moderate draught ſeveral times in the day and night.

CXI. *An uſeful Drink in feveriſh Diſtempers.*

IN a pint and a half of clear poſſet-drink boil about one ounce of cleanſed roots of dandelion, or piſs-a-bed, cut or ſliced very ſmall, till near half a pint be waſted, and then ſtrain it, and let the patient take half a pint, or the whole quantity, if he can, at a time.

CXII. *An excellent Remedy for dyſenterical Fluxes.*

TAKE good Venice-turpentine, and with a very gentle heat evaporate ſo much of it, that when it is cold it may be but little ſhort of coagulation. This yet ſoft, but not fluid ſubſtance, incorporate with fine ſugar, enough to make it up into pills, whereof give in the morning faſting as many, as will amount from a ſcruple to half a drachm, or two ſcruples, or a whole drachm of turpentine, beſides the ſugar.

CXIII. *An uncommon, but experienced Remedy for dyſenterical Fluxes.*

TAKE the bone of the thigh of a hanged man (perhaps another may ſerve, but this was ſtill made uſe of) calcine it to whiteneſs, and having purged the patient with an antimonial medicine, give him one drachm of this white powder for one doſe, in ſome good cordial, whether conſerve or liquor.

CXIV. *For the Dyſentery and Fluxes cauſed by ſharp Humours.*

TAKE from half a drachm to one drachm of *mercurius dulcis*, and as much either of fine ſugar or ſugar-candy, and with ſome purgative or other, let the patient take it once a day, with care, that none of it remain in his mouth, or ſtick in his throat.

CXV. *An often tried Medicine for Fluxes of the Belly, though bloody ones.*

GIVE for a doſe, in any convenient vehicle, as much powdered or grated pizzle of a hart or deer, as will lie upon an ordinary half-crown-piece.

CXVI. *An effectual Medicine for dyſenterical and other Fluxes.*

TAKE of a hare the ſkin, liver, gall, and all the parts, except the muſcles; and having dried them ſo far (and no further) as that they may be conveniently reduced to powder, give of this powder, from about two ſcruples to one drachm, in any convenient vehicle.

CXVII. *An experienced Remedy for ſharp Fluxes of the Belly.*

TAKE a pint of new milk, and diſſolve in it two ounces of loaf ſugar, and at length about the bigneſs of a walnut of good mithridate; give this mixture moderately warm for a clyſter, to be reiterated, if there be occaſion.

CXVIII. *To ſtop Fluxes and Whites.*

FOR fluxes you may, in divers caſes, give the patient from time to time a moderate quantity of a decoction of half an ounce of iſing-glaſs, in about a pint of new milk.

CXIX. *An eaſy Medicine for Fluxes, eſpecially thoſe cauſed by ſharp Humours.*

INSTEAD of butter take well-conditioned olive-oil, and thoroughly drench therewith a good toaſt, and let the patient eat it.

CXX. *For a Bloody-flux.*

TAKE half an ounce of London-treacle, an ounce, or an ounce and a half of conſerve of red-roſes; mix them together with ſome ſyrup of clove-gilly-flowers, or ſyrup of citrons, and keep them thus mixed in a pot covered for your uſe. Take of this about the quantity of a walnut at night, and in the morning, for two days, faſting two hours before and after; intermit then a day, and take it again in the like manner.

CXXI. *A tried Medicine for the falling down of the Fundament.*

TAKE ſome ginger, and having careleſly ſliced it, put it in a little pan, heat it by clear and well-kindled coals, and let the patient receive the fume of it, caſt on by little, in a kind of cloſe-ſtool, or ſome equivalent ſeat, where the lower part of the body may be well covered for about half a quarter of an hour at a time.

G.

CXXII. *A Medicine for a light incipient Gangrene.*

AFTER having lightly ſcarified the part affected, apply, as hot as the patient can well bear it, a cataplaſm made of ſtrong brandy, and the pith or crum of white-bread, ſhifting it three or four times a day, or ſomewhat oftener, if need be.

[*N. B.*] Some uſe turnips boiled, and made unctuous with a little freſh hogs-lard, to reſolve the hard tumors of women's breaſts.

CXXIII. *A*

CXXIII. *A choice Anodyne Clyſter.*

TAKE marſh-mallow-roots half an ounce, leaves of the ſame, mallows, mullein, of each one handful, camomile-flowers, two pugils: boil them in a ſufficient quantity of water till ten ounces, yolks of two eggs, and oil of camomile an ounce and a half: mix and make a clyſter for eaſing pain.

CXXIV. *A ſlight, but often tried Medicine for the Griping of the Guts.*

TAKE about a quarter of a pint of brandy, and having made a toaſt of bread (not too fine and white) throw it very hot into the liquor, and as ſoon as it is thoroughly drenched, let the patient take it out, and eat it hot; and this may be repeated, if there be need, two or three times a day.

CXXV. *An often tried Remedy for the Gripes in little Children.*

TAKE of oil of nutmegs, and of worm-wood, of each a little quantity, mingle them well, and with the mixture a little warmed, anoint the patient's navel, and the pit of the ſtomach.

CXXVI. *To make an excellent Gargle.*

TAKE ſix ounces of ſcabious-water, one ſpoonful of muſtard, one ſpoonful of honey, and one ſpoonful of vinegar; grind all theſe very well together in a marble or glaſs mortar, till you have reduced them to a liquid mixture, which is to be uſed as a gargle.

CXXVII. *A choice Gargle for a ſore Throat.*

TO four ounces of plantane-water add three or four ſpoonfuls of red roſe-water, and mix very well with theſe the white of an egg beaten to a glair or water: ſweeten this mixture with a ſpoonful of white ſugar-candy, or, in want of that, as much very fine loaf-ſugar. Let the patient gargle this as often as need requires.

CXXVIII. *An experienced Medicine for a Gonorrhœa.*

TAKE two ounces of ripe laurel-berries, and infuſe them for a day in a quart of good white-wine: of this let the patient drink about two or three ſpoonfuls twice a day for a pretty while together; only once in three days (or thereabouts) intermitting, that he may take ſome gentle purging medicine.

CXXIX. *For a Gonorrhœa.*

TAKE choice maſtic a ſufficient quantity, and having very finely beaten and ſearched it, take about half an ounce of it at a time in the yolk of a new-laid egg, waſhing it down, if it be thought needful, in any convenient liquor.

CXXX. *An excellent Remedy to take off the Pain of the Gout.*

TAKE minium or red-lead ground fine, half a pound, oil of earth-worms one pound, or a ſufficient quantity: boil them to the conſiſtency of a hard or ſolid emplaſter, without burning: afterwards add of camphire two ounces, diſſolved in oil of earth-worms, ſo much as may make an emplaſter of a juſt conſiſtency.

CXXXI. *An excellent Ointment in the Gout.*

TAKE Barbadoes tar and palm oil, of each a like quantity; melt them together in no more fire than is needful to make them incorporate well; with this mixture warm, the part is to be anointed, and warily chafed.

CXXXII. *A ſlight, but effectual Medicine to appeaſe gouty Pains.*

TAKE linſeed well conditioned, and, with a little water, beat them in a marble or glaſs mortar, rubbing them very well, that the medullary part may be ſeparated in ſome meaſure from the huſk, and may make the water conſiderably white. In this liquor dip clean rags, and when they are thoroughly wetted, apply them ſomewhat warm to the part affected, ſhifting them, if need be, once in an hour, or at moſt in two.

CXXXIII. *A ſpeedy Remedy to take off arthritic or gouty Pains.*

TAKE good ſpirit of *ſal armoniac*, and with a feather dipt in it moiſten gently all the part, or parts affected.

CXXXIV. *A Medicine that almoſt preſently appeaſes the Pains of the Gout.*

TAKE of black ſoap four ounces, choice wood-ſoot finely ſifted about a drachm and half, and add to theſe about half the yolk of an egg: incorporate them diligently together, and ſpreading the mixture ſomewhat thin, apply it (the cold being firſt taken off) by way of cataplaſm to the part affected.

CXXXV. *A homely, but often tried Medicine to appeaſe the Pains of ſcorbutical running Gouts.*

TAKE earth-worms cleanſed, and having filled an earthen pot with them, and luted on a cover very well, ſet it into an oven with a batch of bread, and let it ſtand there, till the oven be cold. Then take out the pot, and having removed the cover, you will find the matter turned into a groſs liquor ill-ſcented. Strain this with expreſſion, and keep it ſtopped for uſe, which is, to rub therewith the part affected with a warm hand once or twice a day. [*N. B.*] If the ſmell be offenſive, you may put to it a few drops of oil of *rhodium*, or ſome other odoriferous one, to correct it.

CXXXVI. *An excellent Remedy for the Gonorrhœa.*

TAKE of choice amber and of maſtich, both reduced to very fine powder, and very well mixed, equal parts, and of this mixture give half a dram at a time in a proper vehicle, or in a draught of chocolate; continue this for three weeks or a month, if need require, purging the day before you begin to take it, and once every week afterwards, eſpecially when you leave off the uſe of the powder.

CXXXVII. *To appeaſe the Pains of the Gout, and by degrees leſſen the Fits.*

TAKE one part of *ſal armoniac*, and three parts of ſpirit of wine, neither of them too well rectified: ſhake them together, (and, if you pleaſe, digeſt them a while) and having dipt old, but clean linen rags in the mixture, apply them to the part affected, ſhifting them now and then, as need ſhall require.

CXXXVIII. *To*

CXXXVIII. *To make an excellent Cephalic, or Head-powder, good alſo for the Eyes.*

TAKE the leaves of flowers of betony, marjoram and damaſk roſes; alſo the flowers of ſage and roſemary, all at diſcretion. To theſe add the powder of *lignum* aloes, and ſome ſeeds of *nigella Romana:* reduce all theſe to powder, to be uſed as a hair-powder, when the patient goes to bed.

CXXXIX. *An uſeful Drink to be frequently employed to correct ſharp Humours.*

TAKE two ounces of choice barley (Engliſh or French) well waſhed from its duſt and ſorders: boil this in a quart or more of ſpring-water till the grains begin to burſt; then ſtrain the decoction through a clean cloth, and let the patient uſe it at meals and other times for his ordinary drink.

CXL. *An experienced Medicine for Dulneſs of Hearing, and Hyſterical Affections.*

THE juice of red onions is excellent for diſeaſes of the ears, and for deafneſs in its beginning. [*N. B.*] Betony-roots alſo wonderfully prevail againſt all affections of the womb.

CXLI. *An experienced Medicine for the Pains of the Hæmorrhoids.*

TAKE the ſole of an old ſhoe, worn by ſome man that walks much; cut it in pieces, and burn it, not to white or grey aſhes, but to a fryable and tender coal; reduce this to impalpable powder, and then with a ſufficient quantity of unſalted lard, make it into an unguent, wherewith the part affected is to be anointed from time to time.

CXLII. *For the Hæmorrhoids.*

MAKE a ſuppoſitory of hogs-lard or bacon, or inſtead of that employ gooſe-greaſe made up in the ſame form.

CXLIII. *For the Hæmorrhoids.*

IN the yoke of an egg, or a little of ſome convenient ſyrup or conſerve, give from half a drachm, or two ſcruples, or one drachm, or ſomewhat more of flower of brimſtone, once, or if the caſe be urgent, twice a day. The powder may be alſo given in milk to thoſe, that like it better than ſweet vehicles.

CXLIV. *A choice internal Remedy for Painful Hæmorrhoids.*

TAKE about two ſcruples of choice ſulphur *vive*, and mix it with a little ſugar to make it reliſh, and give that doſe once, or at moſt twice a day.

CXLV. *A very choice Medicine for the Pain and Tumors of the Hæmorrhoids.*

TAKE freſh leeks (the whole plant) ſhred them ſmall, and fry them well with freſh butter, till they be fit to be brought to the conſiſtence of a cataplaſm or poultice, that is to be applied very warm to the part affected, and to be renewed from time to time, as need ſhall require.

CXLVI. *An uſeful Medicine for the Pain of the Hæmorrhoids.*

MAKE up flower of brimſtone, and an equal weight, or a double, of fine ſugar, with a ſolution of gum dragon, into tablets, that may weigh about a drachm apiece; of

of thoſe that contain the moſt ſulphur, you may give one twice a day, but of the other ſort much oftener, if need require.

CXLVII. *A choice Remedy for the Pain of the Hæmorrhoids.*

TAKE *album Græcum*, or white dogs-turd, reduced to an impalpable powder, mix it up with a ſufficient quantity of gooſe-greaſe, and by grinding it well in a leaden mortar, reduce it to a black ointment, to be applied moderately warm to the part affected.

CXLVIII. *An experienced Remedy for unbroken Hæmorrhoids.*

TAKE calcined oyſter-ſhells, and incorporate them with as much honey, as will make up the powder into an ointment, with which the part affected is to be tenderly anointed from time to time.

CXLIX. *For the Hæmorrhoids, a very ſucceſsful tried Medicine.*

TAKE maiden-leeks (as ſome call thoſe, that grow without having been tranſplanted) and caſting away the green part, make of the bulbous part and a ſufficient quantity of whole oatmeal a caudle, whereof let the patient eat plentifully.

CL. *A choice Drink for the Pain of the Hæmorrhoids.*

TAKE yarrow, and boil an handful of it in about a pint and a half of poſſet-drink, in a covered veſſel, till it be ſtrong of the plant; and of this decoction let the patient drink pretty plentifully from time to time.

CLI. *An excellent Remedy for the Pain of the Hæmorrhoids.*

TAKE of maſtic, *olibanum*, aloes and myrrh, of each a like quantity; powder and mix them very well; then lay, or ſtrew a ſufficient quantity of this upon a pledget of lint or cotten, moiſtened throughly with ſpirit of wine over a few well-kindled coals, that the powder may melt, and be clapt hot to the pit of the ſtomach, or navel.

CLII. *A Medicine for the Pain of the Hæmorrhoids.*

TAKE a quart, or at leaſt a pint, of new-milk, and boil it well for a while; and then taking it off the fire, preſently put it into a cloſe-ſtool in ſome open-mouthed veſſel, and let the patient ſit over the fume of it.

CLIII. *An excellent Medicine to appeaſe the Pains of the Hæmorrhoids.*

TAKE two freſh eggs, and roaſt them pretty hard, then peel off the ſhells and mince them: to theſe add two pippins, the core being firſt taken out, that muſt be roaſted to pap; mix theſe, and incorporate them very well with the eggs, reducing all to a kind of cataplaſm, which is to be applied very warm, if not very hot, to the part affected.

CLIV. *A choice Medicine for Pains of the Hæmorrhoids.*

TAKE half a drachm of good flower of brimſtone, and boil it a little in new-milk, and let the patient take faſting in the morning both the liquor and the powder, for many days ſucceſſively. And, if need be, the like doſe may be taken between four and five in the afternoon. Alſo one may make up the like quantity of flores, with

with a little fine ſugar and gum tragacanth, into tablets or lozenges, to be taken inſtead of the powder and milk.

I.

CLV. *An experienced Liquor to cure the Itch in the Hands or Face, without Mercury or Sulphur.*

TAKE a handful of the roots of elecampane, and as much of ſharp-pointed dock; ſhred them ſmall, and boil them in two quarts of ſpring-water, to the conſumption of a pint: then ſtrain the liquor, and with it let the patient waſh his hands, or other parts affected, once (or at moſt twice) a day.

CLVI. *An experienced magnetical Cure of the Yellow Jaundice.*

TAKE the gall-bladder of a ſheep, and near the top, without emptying the liquor, make a hole, at which put in two or three drops of the patient's warm urine; then tye up the upper part of the bladder, and hang it in the free air, till it dry up, *&c.*

CLVII. *A homely, but not ineffectual Medicine for the Yellow Jaundice.*

GIVE about half a drachm of the white part of hen's dung, dried and mixed with a little ſugar, in a few ſpoonfuls of white-wine.

CLVIII. *A Medicine almoſt ſpecific for the Yellow Jaundice.*

TAKE of clean filings of ſteel a ſufficient quantity, and, to make them grind the better, mix them with ſome loaf-ſugar; grind them long with great exactneſs, for in that conſiſts the chief ſecret of this medicine. Of this impalpable powder give about half a drachm for a doſe (beſides the ſugar) and, if need be, give it twice or thrice a day in any convenient vehicle.

CLIX. *A ſpecific Remedy for the Yellow Jaundice.*

TAKE one part of good ſaffron dried enough to be rubbed in a glaſs mortar into powder, and incorporate it well with four parts of choice turmerick. In the mean time take a handful of freſh ſheeps-dung, and let it ſteep in about a quart of ſtrong ale in a moderate heat, until the liquor be fully impregnated with the virtue of the dung. Then ſtrain it lightly through a linen cloth; and into a pint of it, or as large a draught within the limit, as the patient can well take, give about half a drachm of the fore-mentioned mixt powder. This do in the morning faſting, and in the evening about bed-time, giving alſo another doſe the morning after the firſt.

K.

CLX. *The great Medicine of a famous Empirick for the King's-Evil.*

GIVE, for a good while together, a pretty ſtrong decoction of devil's bit.

CLXI. *To mitigate Pains in the Kidneys.*

TAKE oil of ſcorpions, and oil of bees-wax, of each a like quantity; mix them well, and with this mixture, moderately warm, anoint the pained kidney.

CLXII. *An effectual Remedy for Stoppage in the Kidneys.*

GIVE in any convenient liquor about a dozen grains of ſalt of amber for a doſe.

L.

CLXIII. *A pleaſant Medicine to appeaſe Scorbutic Pains in the Limbs.*

TAKE liquid ſtyrax; ſpread it thin upon ſlink, or ſome very fine kids-leather; and keep it upon the part affected till it dry up of itſelf, or till the patient has no more need of it.

CLXIV. *An Experienced, though ſimple Medicine for a Contracture produced by keeping of Limbs too long in an undue Poſture.*

ANOINT well once or twice a day the part affected with dogs-greaſe, chaffing it in with a warm hand, and keeping the part warm afterwards.

M.

CLXV. *A good Medicine to increaſe Milk to thoſe that give Suck.*

MAKE pottage with lentils (which many diſtinguiſh not from vetches) and let the patient uſe freely of it.

CLXVI. *Another Medicine to increaſe Milk in Nurſes.*

TAKE earth-worms, waſh them well, freeing them carefully from their excrements, and from all adhering earth and filth: then dry them ſo as they may not ſtink, and yet be pulverable. Of theſe, reduced to powder, give half a dram or two ſcruples for a doſe, in wine, or any other proper vehicle.

CLXVII. *A Remedy, by which many Dogs bitten by a Mad-Dog, have been all of them preſerved from running mad.*

TAKE three plants (*i. e.* roots and leaves) of that herb, which is called roſe-plantane, or by ſome ſtar-plantane; and having chopt it ſmall with a convenient quantity of butter, let the bitten dog take it the firſt day; the ſecond day give him five plants ordered as before, and the next day ſeven. *Lychnis Salamantica cluſ.*

CLXVIII. *A good Remedy for divers Affections of the* Genus Nervoſum, *or nervous Syſtem.*

TAKE of the freſh roots of the male piony one ounce, of the ſeeds of the ſame plant two drams, and with a ſufficient quantity of the ſyrup of piony, or ſome conſerve of the like nature, beat them up into an electuary, (which is beſt done not long before you mean to make uſe of it) of which the patient may take the quantity of a ſmall nutmeg, or more, if need be, twice a day, and, if occaſion requires it, thrice.

P.

CLXIX. *Alcetic Pills, that do ſcarce at all occaſion the Piles.*

TAKE of the Frankfort angelical pills, and give of them one ſcruple or half a dram, or two ſcruples, or more for a doſe.

CLXX. *A Medicine for the Pain and Tumour of the Piles.*

TAKE the patient's own urine moderately warm, and with rags dipt in it foment for a while the parts affected, and then anoint them with *unguent populeum*. This

do, if need be, three or four times a day; and if the tumours be internal, you may then inject a little of the formentioned urine.

CLXXI. *An excellent Remedy for Scorbutic and other Pains in the Limbs.*

TAKE red and unſophiſtical oil of petre, and anoint therewith from time to time the part affected.

CLXXII. *An eaſy, but excellent Poultice to appeaſe Pains and Achs, even Arthritic or Gout Pains.*

TAKE onions, and boil or ſtew them in water, till they be ſoft enough to make a poultice; then drain away the water, and beat them; and having ſpread them to a good thickneſs upon a linnen cloth, apply them as hot as the patient can well bear; let them keep them on all night.

CLXXIII. *To ſtrengthen a Part weakened by Sublaxation.*

SPREAD *emplaſtrum divinum* upon ſoft leather, and apply it, keeping it on for ſome time.

CLXXIV. *A ſomewhat rough Emetick, by which the French-Pox has been often cured.*

TAKE good mercury ſublimate, and mithridate, or Venice-treacle, of each one ounce; mix them together, and put them into a quart of ſpring-water; ſet them in *balneo* to diſſolve in a cloſe veſſel; and of this liquor, well ſettled, let the patient take about half a ſpoonful, or, if need be, a ſpoonful, but never above a ſpoonful and a half, in four ounces of ſmall ale warm, faſting in the morning, and once in the afternoon or evening, the ſtomach being empty. Every ſecond day intermit, and give a gentle purge.

CLXXV. *A choice Medicine for the Palſy.*

TAKE *ſarſaparilla* a pound and a half, bark of *guaiacum*, China in chips, of each two ounces and a half: boil all in ſix pints of water to a conſumption of a third part: at the end add raiſins of the ſun ſtoned four ounces, liquoriſh bruiſed one dram, fat figs number twelve, boil and ſtrain it. Of this let the diſeaſed drink warm, as their ordinary drink.

CLXXVI. *For a Weakneſs in the Hands, ariſing from the Palſy, or an ill-cured Rheumatiſm.*

TAKE the tops of roſemary, and, bruiſing them a little, make them up into a ball of the bigneſs of a ſmall orange, or a large walnut with the green huſk on. Let the patient often roll one of theſe balls between his hands, and for divers hours in a day graſp one of them in the hand affected, that it may grow hot there, and tranſmit its effluvia into the part. Continue this courſe as long as the diſtemper requires.

CLXXVII. *A choice external Remedy for Paralytic Affections.*

MAKE a ſtrong decoction of roſemary-leaves (or flowers, if the ſeaſon afford them) and let the patient hold the part affected for a good while at a time in the liquor kept very warm. If after ſeveral trials this medicine prove not effectual enough, take ten drops of oil of worms, and mix with it well four or five drops of oil of turpentine;

turpentine; and with this mixture, well warmed, anoint the part from time to time, or elſe let the patient keep the part for a good while together, for more than once or twice, if need require, in warm rain water (to diſſolve the ſcorbutic ſalts.)

CLXXVIII. *To take off little Pimples, or grating Inequalities within the Eye-Lids.*

TAKE one ſpoonful of eye-bright water, one ſpoonful of plantane-water, and half a ſpoonful of good red-roſe-water; mix theſe, and put to them about 15 grains of choice tutty finely prepared; ſhake them together, and then let the powder fall to the bottom, and with the clear liquor moiſten the eye ſeveral times in a day, if it be found needful.

CLXXIX. *For the Pleuriſy.*

CUT green broom-tops ſhort, and fill therewith a ſkillet or pipkin of a pint and a half; then fill it up with ale; boil it ſoftly, till it be waſted to two or three ſpoonfuls; it will look black like treacle, and be thick. When it is enough, and cold, add as much mithridate as a nutmeg, and mingle it well, and give it the party warm in bed, and let him ſweat three hours or more after it, by adding ſome clothes. If it help not at firſt, repeat it next day, or the ſecond, not to fail.

CLXXX. *An experienced (and by ſome good Authors excellent) Medicine for the Pleuriſy.*

TAKE as many freſh balls of ſtone-horſe dung, as the horſe in good caſe may diſburthen himſelf of at one time; cover theſe, whilſt they are warm, with good white-wine; let them ſtand a little to act on one another, and then preſs out gently through a clean linnen cloth, as much liquor or juice, as the mixture will readily afford; and of this (ſomewhat warm) give a moderate draught from time to time, as need ſhall require.

CLXXXI. *A very often experienced Medicine for the Small-Pox (eſpecially in Children.)*

TAKE the little balls of freſh ſheep's-dung, and having freed them from ſtraw and duſt, and other things foreign to them, put an handful of them thus cleanſed into a quart of good white-wine, and in a veſſel well ſtopt let them infuſe in a moderate heat for a night, or till the liquor be well impregnated with the taſte and colour of them. Strain this infuſion, and give of it warm about a ſpoonful at a time, once in two or three hours, or oftener, if need require. *N. B.* In caſe of neceſſity, the infuſion may be much ſooner made, by putting into the wine a greater proportion of the ſheep's-dung.

R.

CLXXXII. *A ſucceſsful Remedy for a kind of Rheumatiſm, and a Contracture of the Limbs, that followed upon it.*

TAKE the inward bark (that which grows next the wood) of an elder-tree, cut or tear it into ſmall bits, and with them looſely placed fill about a third part of a bottle; then pour in as much ſmall ale or beer, as will fill up the remaining part of the veſſel; ſtop it well, till the liquor be ſtrong of the infuſion, and of this let the patient drink a good draught once or twice a day, or, if he can well bear it, let him take it as a diet-drink.

CLXXXIII.

CLXXXIII. *An approved Outward Medicine to cauſe Reſt without Opiates.*

TAKE of roſe-water eight ounces, good wine four ounces, ſtrong vinegar two ounces; mix theſe well, and having warmed ſtupes in them, foment therewith the part affected, laying them on but moderately warm, but taking them off, when they begin to grow cold: this fomenting may laſt between a quarter and half an hour, before the patient ſhould compoſe himſelf to reſt.

S.

CLXXXIV. *A choice and diverſified Medicine for the Scurvy.*

FROM the freſh gathered tops of fir, a little bruiſed, abſtract ſpirit of wine, or at leaſt good Nantes brandy, and with this liquor draw a deep tincture from other freſh tops, of which tincture reduce ſome part into an extract, whereof to form pills; keep theſe, the tincture and the impregnated liquor apart, to be employed ſeparately or conjointly, as occaſion may require.

CLXXXV. *For an Excoriation, and for preternatural Tenderneſs of any Part of the Skin.*

TAKE *unguentum diapompholigos*, and ſpread it thinly upon lint, which muſt be applied to the part affected, and kept on by a bandage or ſome ſticking plaiſter.

CLXXXVI. *To take off the Heat and Roughneſs of the Skin, eſpecially on the Lips.*

ANOINT the part affected with freſh (or at leaſt not too ſtale) cream.

CLXXXVII. *To take out the Marks of Gun-Powder Shot into the Skin or Face, or elſewhere.*

TAKE freſh cow-dung, and having warmed it a little, apply it as a thin poultice to the part affected, renewing it from time to time, as occaſion ſhall require.

CLXXXVIII. *An Excellent Medicine to Strengthen a weak Sight.*

TAKE eye-bright, penny-royal, rue, celandine, lovage, ſaxifrage, of each half a handful, blew-bottle-flowers, fennel-ſeeds, parſley-ſeeds, of each half a dram, grains of paradiſe one dram, hyſſop, organy, willow-leaves, each half an ounce, galingal three drams, ginger half a dram, cinnamon one dram, ſugar half an ounce. Let them be finely powdered, and very well mixt together. Take of this powder one ſcruple, or half a dram, every day with your dinner.

CLXXXIX. *A diſtilled Water for Strengthening the Sight.*

TAKE roſemary-flowers, ſage, betony, rue, and ſuccory, of each one handful; infuſe theſe in two quarts of good ſack, diſtill them in a copper alembick. The doſe is a moderate ſpoonful.

CXC. *A choice Medicine, which I have ſeveral times uſed for a light ſtroke or Contuſion of the Eye.*

PUT to two ounces of carduus-water, or that of betony, three or four drops of honey; uſe it every three hours. (But have a care not to keep it above a day or two, leſt it grow ſour.)

CXCI. *A much commended Powder to ſtrengthen the Sight.*

POWDER of eye-bright one ounce, ordinary fennel-ſeed in powder half an ounce, powder of nutmegs half a quarter of an ounce, double refined ſugar two ounces. All theſe being finely powdered and ſifted, are to be mixt together, and taken as much as will lye on a ſhilling at a time, as often as you pleaſe. The powder is to be taken dry, and kept in a box cloſe ſhut in ſome dry place. This has done great cures in dimneſs of ſight, and rheums in the eyes.

CXCII. *To make a Drink to be taken like Tea, for ſtrengthening the Sight.*

To a quart of water ready to boil, put in half a handful of eye-bright, and then let the liquor boil for one walm or two, before you take it off to drink inſtead of tea.

CXCIII. *A rare Water to Strengthen the Sight.*

TAKE clary, and diſtill it in a cold ſtill; and of the water let the patient take every morning, and, if need be, every night going to bed, from two or three ſpoonfuls to ſix, either alone, or ſweetened with a little ſugar; let him alſo, with the ſame water unſweetened, bathe or waſh the parts affected in the morning, and at bed-time; and, if need be, once or twice more every day.

CXCIV. *An excellent external Medicine to ſtrengthen the Stomach.*

TAKE wormwood, mint, and mugwort, and by beating them well in a ſtone or glaſs mortar, make a cataplaſm, to be applied ſomewhat warm to the ſtomach, and kept upon it for a pretty while.

CXCV. *An often tried Remedy to ſtrengthen the Stomach, and alſo to take off griping Pains in or near it. (It is good alſo for Cold.)*

TAKE *emplaſtrum ſtomachicum* of the London diſpenſatory, and drop upon it five or ſix drops of oil of cinnamon, rubbing it well over with your finger, and ſo apply it to the patient's ſtomach; and after three or four days, or as ſoon as it grows dry, remove it, and having ſcraped the plaiſter, and warmed it on the wrong ſide, let fall ſome drops of the oil of cinnamon upon it, or more drops of the cordial ſpirit, and apply it again.

CXCVI. *An excellent Plaiſter to ſtrengthen the Stomach, and Cheſt.*

TAKE of cinnamon, nutmegs, cloves, and mace, of each a ſufficient quantity; powder them well, and ſtrew ſome of the powder all over the bottom of a deal box of a convenient length and breadth, and fit it with a cover to ſhut cloſe; upon this powder lay a piece of clean flannel well dried, and ſtrew it over thinly with ſome of the ſame powder; then lay on another piece of the like flannel of the ſame dimenſions with the former, and upon that likewiſe, if need be, a little more powder. This done, ſhut the box, till the time of uſe, and then take out one of the pieces of flannel, and having lightly duſted off the powder, lay it on the patient's breaſt, ſtomach, and belly, and let it lie on there for ſome days. When you perceive its virtue begin to languiſh, you muſt ſubſtitute for it the other piece of flannel, and put the firſt in the box to receive new virtue, and ſo proceed alternatively as long as you need the medicine, adding now and then ſome freſh powder, if neceſſity require.

quire. *Note*, that each piece of flannel ought to be long and large enough to cover the breaſt, and to reach from about the paps to the navel, or lower.

CXCVII. *For a recent Strain.*

TAKE a pint or more of claret-wine, and boil in it for a little while, in a cloſe veſſel, about a handful of red roſe-leaves, till the liquor be ſtrong of the plant. In this, well heated, dip a piece of linnen or flannel, and wringing out the moiſture, double it, and apply it hot to the part affected, uſing a fillet, or ſome ſuch thing, to keep it on.

CXCVIII. *My Lord* Bacon's *experienced Medicine for a recent Strain or Bruiſe.*

TAKE a good handful of freſh wormwood, and boil it in a ſufficient quantity of ſtrong ale to the ſoftneſs of a poultice; then take it off the fire, and when you apply it, which you ſhould do whilſt it is very hot, put to it a ſpoonful of good common brandy.

CXCIX. *A choice Plaiſter for a recent Strain.*

TAKE equal parts of the plaiſters called *diapalma* and *oxycroceum*, and make of them a compounded plaiſter, to be ſpread upon thin leather, and applied to the part affected, and to be renewed, if need be, twice a day.

CC. *An approved Medicine for a recent Strain.*

APPLY ſeaſonably a cataplaſm made of bran boiled in good vinegar, till it be ſoft enough to make a poultice.

CCI. *A ſlight but choice Remedy for a recent Strain.*

TAKE two ſpoonfuls of vinegar, and beat into it very well the white of an egg, and ſpreading it upon flax or tow, apply it to, and keep it on the part affected.

CCII. *A parable but excellent Medicine in the Fits of the Stone.*

TAKE ſomewhat leſs than a handful of red chick-peaſe, or cicers, and boil them ſoftly in a quart of ſpring-water, till the liquor be red and well impregnated with the ſeeds; ſtrain this decoction, and ſweeten it with ſyrup of marſh-mallows, out of which all the ſtronger diureticks are left.

CCIII. *For the Stone.*

TAKE a quart or half a pint of ſimple arſmart-water; ſweeten it with a little ſugar, or ſome convenient ſyrup, and aromatize it with a little nutmeg ſcraped, and give this mixture for one doſe.

CCIV. *For the Stone and Gravel in the Reins and Bladder.*

TAKE equal weights of common daucus ſeeds, and of burdock-ſeed, and having mixt theſe together, put one ounce of the mixture to a gallon of ſmall ale, and let the patient uſe it as a conſtant drink.

CCV. *A good Liquor, to uſe as Drink in a long Fit of the Stone.*

MAKE poſſet-drink of three or four parts at moſt of milk, and one of white-wine. Into two quarts of poſſet drink ſcrape or thinly ſlice a nutmeg and a half, or two nutmegs; add a little juice of lemon to your palate, and, if you pleaſe, ſweeten it a little with ſyrup of marſh-mallows. Take of this drink a pretty quantity at a time, and uſe it often in a day.

CCVI. *A good Medicine for the Stone.*

TAKE a pint or a quart of ale, ſomewhat new, ſweeten it with pure honey, and boil it to the conſumption of about one half, ſkimming it well from time to time. Then diſſolve in it the yolk of a new-laid egg; and let the patient drink a good draught of this mixture once or twice a day, until he find relief thereby.

CCVII. *A choice Medicine in an actual Fit of the Stone.*

TAKE the decoction made according to the London diſpenſatory for the ſyrup of marſh-mallows, with this difference that to the ſame quantity of water you muſt take but half the quantities of each of the ingredients. Let this corrected decoction be well clarified, and let the patient take it warm, ſix, eight, or ten ounces at a draught, from time to time, as need ſhall require.

CCVIII. *The Stone, and the Cure. Taken out of the Hiſtory of* Barbadoes, *written by* Rich. Lygon, *Gent. p.* 118, 119.

AFTER the ſtoppage of urine more than fourteen days, the following medicine did not only break, but brought away all the ſtones and gravel: and about three weeks after, the like pains returning, the ſame medicine did the like effect within ten hours after the taking thereof.

TAKE the pizzle of a green turtle (or tortoiſe) which lives in the ſea; dry it with a moderate heat; pound it in a mortar to powder, and take of this as much as will lie upon a ſhilling, in beer, ale, white-wine, or the like; and in a very ſhort time it will do the cure. Theſe are to be had eaſily, both at the Caribbee and Lucaick iſlands, where theſe fiſhes abound.

CCIX. *A good Medicine in Pains of the Stone, or Cholic.*

TAKE half a pint of good ſallet-oil, and as much good ſack, (or, if that cannot be had, good claret-wine;) ſhake them very well together, and give them moderately warm for a clyſter.

CCX. *To expel the Stone in a Fit.*

TAKE crabs-eyes powdered, and diſſolve a large proportion of them in good white wine-vinegar, and of this drink let the patient take from two ſpoonfuls to five or ſix at a time.

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CCXI. *An almoſt ſpecific Remedy for the Tooth-Ach.*

INTO a quart of red-wine (or at leaſt of claret) put one drachm of allum and another of acorns, a drachm and a half of galls, and half a handful of good dried roſe-leaves.

leaves. Boil this to a conſumption of near half, and then take it from the fire and ſtrain it, and diſſolve in it a drachm of acacia cut into ſmall bits; and with this liquor, a little hot, you muſt waſh the parts ſeveral times in a day.

CCXII. *An uncommon, but not unuſeful Remedy for the Tooth-Ach.*

LET the patient lie on the ear, that is oppoſite to the part affected, and into the other ear drop two or three drops of the freſhly expreſſed juice of rue a little warm, and ſtop the ear lightly with fine black wooll or cotton.

CCXIII. *An odd, but very ſucceſsful external Remedy for the Tooth-Ach.*

IN the declining of the moon in *Auguſt*, take the fruit called hipps, *viz.* thoſe of the wild-brier, with all the furzy ſtuff, that grows upon it; and lapping it up in a piece of thin ſarcenet, tie it upon the arm, that is on the ſame ſide with the part affected, and keep it on as long as there is need.

CCXIV. *For the Tooth-Ach.*

TAKE a handful of red ſage, and a handful of clary; ſhred them ſmall, and beat them; ſprinkle them with May-dew; then ſtrain out the juice, put it in a glaſs bottle, and ſet it in the ſun in a window; and when you uſe it, put three drops into a ſpoon, and heat it over a candle blood-warm, and drop it into the ear, and let them eat a cruſt of bread wet either in broth or poſſet, and chew it upon the teeth, that ach.

CCXV. *An approved Medicine for an Aching Tooth, that is hollow.*

TAKE two parts of common pepper ground to fine powder, and mix exactly with it one part of ſugar moderately fine over a gentle heat; form theſe into a ſmall pill of a ſhape and bigneſs fit for your purpoſe; and when your ſtuff grows cold, it will harden, and may be applied, when you pleaſe, to the part affected.

CCXVI. *An excellent Remedy to faſten Teeth.*

TAKE of burnt allum, acorns, of each one drachm, galls a drachm and a half, red roſes half a handful. Beat all theſe together, and make them boil in about a quart of good red wine, to the conſumption of about a fourth part. Then ſtrain the decoction, and diſſolve in the tranſmitted liquor, of good acacia cut into very ſmall bits half a drachm. With this decoction the mouth is to be waſhed ſeveral times in a day.

CCXVII. *To faſten the Teeth.*

PUT maſtic finely powdered upon the end of an handkerchief, rub your teeth therewith twice or thrice in a day, and chew maſtic often. Alſo boil pomegranate-flowers with mint or maſtic, in red or claret wine; gargle or waſh your mouth often with it.

CCXVIII. *A Medicine preſcribed to a great Prince,* (Charles *the Firſt*) *to faſten the Teeth*

TAKE a pint of ſpring-water, and put to it four ounces of brandy; let the patient waſh his mouth with the mixture of theſe every morning, and twice or thrice a

day beſides; and let him in the morning rowl for a little while a bit of roch-allum to and fro in his mouth.

CCXIX. *A good Aſtringent Liquor to faſten the Teeth.*

To four ounces of Claret-wine, or ſome other convenient menſtruum, you may put to diſſolve about four drachms of terra Japanica.

CCXX. *An excellent Medicine to faſten the Teeth in Scorbutic Gums.*

TAKE of choice bole-armoniac two drachms, choice myrrh (not lucid) one drachm, roch-allum crude half a drachm, claret-wine one pint; boil theſe ſoftly a little while together, and let the patient uſe twice, thrice (or, if need be, oftner) in a day.

CCXXI. *To faſten Teeth made looſe by the Scurvy.*

ANOINT the parts affected with oleum myrrhæ made by deliquium, with whites of eggs, boiled hard.

CCXXII. *A Lotion to faſten the Teeth.*

IN a quart of ſpring-water decoct for a while one ounce of the beſt terra Japanica reduced to groſs powder; and then having filtered the decoction, keep it cloſe ſtopt for uſe.

CCXXIII. *A good Aſtringent Liquor to faſten looſe Teeth.*

IN a pint of red wine infuſe about half an ounce of terra Japanica, until as much as will be diſſolved be taken up by the liquor. Decant it from the fæces (if there be need) and keep it well ſtopt for uſe.

CCXXIV. *An uſeful Liquor to faſten the Teeth, and prevent the Tooth-Ach.*

To a pint of ſpring-water put half an ounce of clean ſal armoniac, and with the ſolution of this ſalt let the patient waſh his mouth from time to time.

CCXXV. *To make an excellent Poultice to ripen Tumours.*

TAKE eight ounces of (fat) figs, two ounces of white-lilly-roots, and two ounces of bean-flower (or meal:) boil theſe together in water, and reduce them to the conſiſtence of a poultice; which is to be ſpread to a good thickneſs, and laid warm enough upon the part, and ſhifted as often as it begins to grow dry.

CCXXVI. *An excellent Medicine to relieve thoſe, that are troubled with Tumours in the Throat, and ſome other Parts.*

To a quart of new-milk put a handful of mallow leaves, with as much of the leaves of ſolanum, or nightſhade; ſhred them ſmall, let them boil, till the herbs be tender, as if they were to be eaten. Then put into the milk as much crumbs of white-bread, as, being ſtirred well with the other ingredients, will bring all to the conſiſtence of a poultice. This is to be ſpread upon a ſtay for the throat, or ſome other thing fit to be applied to any other part affected, and is to be laid on as hot as the patient can well endure it; and when it begins to grow cold, it is to be ſucceeded by freſh made very hot, and ſo long as the caſe ſhall require.

CCXXVII. *A Medicine, that lately cured an obſtinate Tumour of the Knee, that had baffled ſome Chirurgeons.*

TAKE a green colewort-leaf with red veins or ſtreaks, and having cut the ribs flat and almoſt level to the reſt of the leaf, bruiſe it with the haft of a knife, or ſome ſuch thing; apply it to the part affected, renewing it once or twice a day.

CCXXVIII. *A powerful and experienced Topic for a ſore Throat.*

Take two new-laid eggs roaſted moderately hard, and the pap of two well roaſted pippins; beat them well together, and add to them as much curds of poſſet made with ale. Having incorporated them all very well, apply the mixture very warm to the part affected, ſhifting it, if need be, once in five or ſix hours.

CCXXIX. *An approved Remedy for a ſore Throat.*

TAKE verjuice of grapes one ounce, good honey half an ounce, crude allum about a drachm and a half, and ſea-ſalt half a drachm; powder the ſalts finely, and incorporate them very well with the liquors into the form of a kind of a liniment. In this dip a long feather, or a piece of rag tied about the end of a ſlender ſtick (as of liquoriſh,) and with it touch the part affected three, four, or five times; between each two times gargling with a mixture of plantane-water, and ſome red roſe-water.

CCXXX. *A choice external Remedy for a ſore Throat.*

TAKE millepedes, ſow's or hog's lice alive, and ſew them up between the foldings of a piece of linen, and apply them to the throat in the form of a ſtay, which is to be kept on all night.

CCXXXI. *An eaſy, but tried Remedy for a ſore Throat.*

TAKE bay-ſalt dried, and having pounded it, put it into the folds of a rag, in a ſufficient quantity to make a ſtay to be tied about the throat, and apply it over night, as hot as the patient can conveniently endure it.

CCXXXII. *A choice Remedy for a ſore Throat, eſpecially if inflamed.*

TAKE a little handful of the leaves of common mallows, and eight or ten good figs; boil theſe about a quarter of an hour in a pint of new milk, and let the patient uſe it very hot and often.

CCXXXIII. *A homely, but experienced Medicine for a ſore Throat.*

TAKE about one drachm of album Græcum, or white dog's-turd, burnt to a perfect whiteneſs, and with about one ounce of honey of roſes, or clarified honey, make thereof a linctus, to be very ſlowly let down the throat.

CCXXXIV. *A homely, but experienced Medicine for a ſore Throat.*

INTO the leg of a worſted ſtocking, that has been long worn next to the fleſh, put in a ſufficient quantity of good ſea-ſalt exactly dried, or elſe decripated; and this ſalt being put in warm, if not hot, the ſtocking is to be tied about the patient's neck, and kept on all night. And if by the next day the diſtemper be not removed, you may apply freſh ſalt (in the proportion) in the ſame ſtocking as before, the night following.

CCXXXV. *A tried Medicine for a ſore Throat, cauſed by acid Humours in the internal Parts of it.*

TAKE half a handful of the leaves of common mallows, and boil them in about a pint of new milk near half an hour; then let it run through a clean cloth, and let the patient uſe it a little warm three or four times a day as a gargle; or elſe let him uſe it by holding it in his mouth, letting ſome drops ſlowly ſlide down his throat.

CCXXXVI. *An often experienced Remedy for Tettars and the Itch.*

TAKE flowers of ſulphur finely powdered, ginger and burnt allum, each alike, ſave that of the allum there muſt be ſomewhat leſs. Incorporate theſe with as much freſh butter, (without any ſalt) as will bring them to the conſiſtence of an ointment: with this anoint the part affected at bed-time, as hot as the patient can well endure it, and let it lay on all night; waſh it off in the morning with celandine-water well heated; and whilſt you continue the uſe of this medicine, take daily ſome cordial, to keep the noxious humour from being driven inwards. This will not fail to do the work.

CCXXXVII. *A choice Medicine for a Thruſh in young Children, or a ſore Mouth.*

TAKE an egg, and put out the meat, then fill it with the juice of red ſage, and ſet it on hot embers untill it boil; then ſkim it, whilſt any ſkum doth ariſe. Then take as much allum beaten, as the bigneſs of a pea or bean, and half a ſpoonful of honey, and let this be put in the egg, and boil it a little, and ſo take it off; and when it is cold, rub the child's mouth as oft as you ſee cauſe.

CCXXXVIII. *An almoſt ſpecific Medicine for a Teneſmus.*

MIX balſam of ſulphur made with oil of turpentine, with linſeed-oil, or ſome other convenient oil, till the balſam be thereby ſo far allayed, that the patient may well endure it; and then let him dip his finger in it, and make uſe of it as a ſmall ſuppoſitory two or three times, or, if need be, oftner in a day.

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CCXXXIX. *An excellent Emulſion to be uſed in Sharpneſs of Urine, eſpecially cauſed by bliſtering Plaiſters.*

TAKE mallows two handfuls, gum Arabick two drams, brandy-water a ſufficient quantity; boil all to a quart, to which add ſweet almonds blanched one ounce, of the four great cold ſeeds, of each two drachms. Make an emulſion, ſtrain, and add two ounces of ſyrup of marſh-mallows, of which drink at pleaſure.

CCXL. *A powerful Medicine for Stoppage of Urine.*

FRY chervil with a ſufficient quantity of oil of walnuts, and apply a cataplaſm made of it very hot to the navel (and, if need be, to the *os pubis*, or ſhare-bone.)

CCXLI. *For a Retention of Urine.*

TAKE chervil, and with freſh hog's-lard fry it well, and lay it very hot upon the patient's navel, and all the adjacent parts, ſhifting it, if there be need, once or twice.

CCXLII. *An*

CCXLII. *An uſeful Powder for ſuch as cannot hold their Urine.*

TAKE root of the male piony, yellow amber, red coral, and choice gum Arabick, of each a ſufficient quantity: reduce them to fine powder, mix them well, and let the patient take of this mixture from ten to twenty grains twice a day.

CCXLIII. *An eaſy Medicine for ſharpneſs of Urine, and for obſtruction of the Menſes, and their flowing too much, if the Diſtemper be not obſtinate.*

GIVE about half an ounce at a time of the newly expreſſed juice of ground-ivy in any convenient vehicle.

CCXLIV. *An old Lithotomiſt's Medicine for Suppreſſion of Urine, (given me by himſelf.)*

GIVE from about fifty grains to one drachm for a doſe of the *pulvis Hollandi*, and if the neceſſity be very urgent, you may give from one drachm to four ſcruples, or a drachm and half, not neglecting in the mean while other proper remedies.

CCXLV. *For Suppreſſion of Urine.*

GIVE about a ſpoonful at a time of bruiſed muſtard ſeed in any convenient vehicle.

CCXLVI. *A tried Medicine for a Suppreſſion of Urine, that is not very obſtinate.*

DISSOLVE half an ounce of choice Caſtile ſoap in half a pint of white-wine, or ſome appropriated liquor; paſs the ſolution through a woollen filter, that the more greaſy parts may reſt behind, and the liquor paſs more clear; put to this five or ſix grains of ſaffron: divide it into two doſes, whereof one is to be given ſome few hours after the other, if the firſt do not operate well.

CCXLVII. *A ſpeedy Remedy for Fits of Vomiting.*

TAKE a large nutmeg, grate off one half of it, and toaſt the flat ſide of the other, until the oily part begin to ouze or ſweat out; then clap it to the pit of the patient's ſtomach as hot as he can well endure it, and let him keep it on whilſt it continues warm, and then, if need be, put on another.

CCXLVIII. *To make an aſtringent Liquor, of great uſe in Ulcers and (ſome) Wounds.*

BOIL two drachms of choice catechu, or Japan earth, in a quart of ſpring-water; pour off the clear, and with it, by injection or otherwiſe, dreſs the ulcers or wounds.

CCXLIX. *For outward Ulcers.*

TAKE the green bark of oak, and chop it all together, both inſide and outſide, into very ſmall pieces. Upon theſe pour good lime-water freſhly made, and let him infuſe in it, till the liquor has acquired a deep tincture. With this dreſs the ulcer once, and, if need require, twice a day.

CCL. *The famous Scotch empirical Medicine for a ſtubborn Ulcer.*

BURN to aſhes, but not too much, the groſs ſtalks, on which the red colewort (not cabbage) grows, and with any fit additament, make thereof a cataplaſm to be applied to the ulcer, and ſhift it at reaſonable diſtances of time.

CCLI. *A Remedy againſt the Bitings of Vipers, and other venomous Creatures.*

As ſoon as ever one is bitten (for if the poiſon be diffuſed through the maſs of blood, the experiment may not ſucceed) a hot iron may be held as near the wound, as the patient can poſſibly endure, till it has, as they ſpeak, drawn out all the poiſon, which will ſometimes adhere like a yellowiſh ſpot to the ſurface of the iron.

CCLII. *A Medicine againſt voiding of Blood out of ſeveral Parts.*

TAKE two drachms of henbane-ſeed, and the like weight of white poppy-ſeed; beat them up with an ounce of conſerve of red roſes, of which give to the quantity of a nutmeg or walnut.

Or, take the expreſſed juice of twelve handfuls of plantane-leaves, and ſix ounces of freſh comfrey-roots, well beaten together with a convenient quantity of fine ſugar. Theſe two medicines have wonderful effects to ſtop bleeding.

CCLIII. *A ſimple, but powerful Remedy for freſh Wounds.*

TAKE the juice of celandine, and dreſs with it recent wounds and cuts, inſtead of a balſam.

CCLIV. *To make a ſimple, but excellent Balſam to ſtanch the Blood of freſh Wounds newly made, and to heal them ſpeedily.*

TAKE good Venice-turpentine, and in a limbeck, or ſome other convenient veſſel, diſtill off a good part of it with a very moderate fire, till there remains a thick ſubſtance, yet not like colophony, but of a liquid and balſamic conſiſtence. What you have diſtilled off ſet aſide for other uſes, for the remaining ſubſtance is what we now ſeek for, and is to be applied as a balſam both *per ſe*, and with pledgets and other helps.

CCLV. *An excellent Wound-Drink.*

TAKE hart's-tongue, liverwort, wood-bugle, wood-ſage, wood-betony, ſouthernwood, wormwood, alehoof, bugloſs, ſcabious, ribwort, white-bottles, mugwort, comfrey, mint, agrimony, ſtrawberry and violet leaves, cinquefoil, daiſy-leaves, roots, and flowers, wild honeyſuckles, wild angelica, avens, plantane, clowns, wound-wort, hawthorn-buds, oak-buds, and bramble-buds.

Gather theſe herbs in *May*, or as many as can then be had; the buds in *March* as ſoon as ever they put forth, before they come to leaves; meaſure them, and take equal quantities of them, and dry them ſeverally in the ſhade, and, when throughly dried, put them up in bags, and ſo keep them for uſe.

How to make the Drink.

TAKE one gallon of ſpring-water, one pottle of the beſt white-wine, add to this two good handfuls of all the herbs, mingled well together being dried; but if green, then one good handful of each. Boil them in a pipkin or iron-pot to the conſumption of the half; then ſtrain it out, and put to the liquor a quart of honey, and let it boil again, and ſkim it, and when it is cold, put it up into bottles ſtopt very cloſe; then let the patient drink thereof morning and evening about a quarter of a pint at a time (ſome uſe only three ſpoonfuls at a time) faſting after taking of it one hour or two. Obſerve, the liverwort is ever beſt to be put in green. If you make uſe of this for any ſore or ulcer in the body, lay any ſearcloth or plaiſter to it, of

unguentum

unguentum apoſtol. or minium, or ſuch like, as they uſe for wounds in the body, or a plaiſter of honey and wax.

This drink is effectual for ſores old or new, women's breaſts, putrified bones, cauſing them to ſcale; it is good for any ach in the ſtomach, for the king's-evil it hath cured; alſo cauſed bullets in the fleſh to come out, having long continued there. Sir *Jo. Mince* was healed by drinking of this, being wounded through the loins.

CCLVI. *A quick Remedy for a ſmall and freſh Cut, or Wound.*

LET the patient ſpeedily plunge the hurt part into brandy, and keep it there for a while, until the pain, which will be excited, be extinguiſhed, or much abated: or, if the part be unfit for this operation, the liquor may be applied to it immediately with a ſoft ſponge, *&c.*

CCLVII. *A good Vehicle for divers Remedies, and that is itſelf uſeful againſt the Jaundice, and Worms in Children.*

THE diſtilled water of the huſks of walnuts is a very good vehicle in divers diſeaſes, particularly in jaundices; it is a cordial, and exceeding proper to be mixt with juleps in fevers. It is alſo an excellent antiverminary, or medicine againſt the worms, eſpecially for children.

CCLVIII. *A powerful Medicine for white Fluors (and the like Diſtempers.)*

TAKE a pottle of ale, and ſhred into it two ounces of white ichthyocolla (iſinglaſs,) and in a looſely ſtopt veſſel let the liquor ſimmer, till about half is waſted; ſtrain the reſt, and give of it two or three ounces at a time once or twice a day, as need ſhall require.

CCLIX. *A tried Medicine for an Ulcus Uteri.*

TAKE of true and choice bitumen Judaicum, or aſphaltum, and having reduced it to very fine powder, let the patient take of it about a drachm at a time in any proper vehicle, once or twice a day.

CCLX. *An excellent Water to preſerve the Sight.*

To half an ounce of celandine-water, and two drachms of ſuccory-water, mixt together, put two or three drops of clarified honey, and ſhake them all together, when you are to uſe them. Of this water let fall a drop or two into the eye once or twice a day. It will not keep above three or four days, eſpecially in ſummer, and therefore muſt be often renewed.

CCLXI. *A tried Medicine for a Whitlow.*

TAKE houſe-ſnails and beat them, ſhells and all, in a ſtone or wooden mortar, ſo long, till they be reduced to the conſiſtence of a cataplaſm; which apply ſomewhat warm to the part affected, and keep it on for ſixteen or twenty four hours, renewing it then, if need be.

CCLXII. *A powerful diſſolving Ointment for Warts and divers Tumours.*

TAKE May butter, and having melted it in a moderate heat, mix with it very diligently, but by little and little, as much oil of tartar *per deliq.* as will give it a ſenſible, but not a conſiderably ſtrong taſte.

CCLXIII. *To*

CCLXIII. *An experienced Remedy for Bloody Water.*

TAKE waters of the black alder, of mallows, of each three ounces, ſyrup of comfrey one ounce: mix them, and let the patient take four ſpoonfuls immediately; and four or five times a day.

CCLXIV. *To make a well experimented Lime-Water.*

TAKE freſh quick-lime two pounds, on which pour two gallons of water boiling hot; when they have ſtood together about twenty-four hours, pour off the clear, and into one gallon of this put of anniſeeds, liquoriſh, and ſaſſafras thinly ſliced, of each four ounces. Let them infuſe for twenty-four or forty-eight hours in a covered veſſel; then take a pound and a half of Smyrna raiſins (which ſome call great blue currans) waſhed and ſtamped. Let theſe infuſe for a few hours, and then paſs the whole mixture firſt through a ſieve, and then through a woollen bag. The doſe is about a quarter of a pint warm twice a day.

CCLXV. *An experienced Medicine to correct the peccant Humour in the King's-Evil.*

TAKE half an ounce of cuttle-bone dried, till it may be finely powdered. Give thisto the patient for one doſe.

CCLXVI. *An excellent and often tried Clyſter in Fluxes, eſpecially in ſharp Humours, and ſome other Diſtempers of the Bowels.*

IN a quart of new milk boil ſoftly two ſmall ſpoonfuls of groſly powdered rice, till it be brought to the conſiſtence of cream, then diſſolve it in two ounces of our ſuet of ſheeps kidneys, and having ſtrained it to keep back the fibres, give it at once for a lavement.

CCLXVII. *A cure for Schrophulas, and the King's Evil.*

TAKE a handful of *paronychia folio rutaceo*, called rue whitlow-graſs, and by ſome felonwort; boil it every morning in a quart of ſmall beer, ſtrain it, and drink it for your ordinary drink. It waſtes the peccant humour, appeaſes the pains, diſcuſſes the unbroken tumours, and heals the broken ones.

CCLXVIII. *Againſt Epilepſies, or the Falling-Sickneſs.*

TAKE of the powder of the true miſſeltoe of the oak, as much as will lie upon a ſixpence, early in the morning, in black-cherry-water, for ſome days near the full moon.

CCLXIX. *A ſimple Remedy for the Stone.*

TAKE *Perſicaria*, or arſeſmart, as much as you pleaſe: diſtill it in a common roſe-water-ſtill, and give ſome ſpoonfuls of it in or before the fits.

CCLXX. *An excellent Remedy againſt Fluxes.*

TAKE unſalted butter, boil it gently, till a pretty part be conſumed, ſkimming it diligently from time to time, whilſt it ſtands over the fire: of this butter melted give now and then a conſiderable quantity, as the patient is able to bear it. This medicine was very ſucceſsful in *Ireland*.

A

SUPPLEMENT

TO

Mr. BOYLE's COLLECTIONS

OF

SAFE and CHOICE REMEDIES

Taken from his own Manuſcripts, added to the Fourth Edition.

CCLXXI. *An excellent and often experienced Medicine for Convulſions, eſpecially in Children.*

TAKE a pound of the true ſingle piony-roots, ſcrape and ſlice them as thin as paper into three pints of white-wine; infuſe it all night on embers in a pipkin cloſe covered and paſted up: in the morning ſtrain it out hard, and put in a quarter of an ounce of caſtor in fine powder, an ounce of the beſt ſpirit of caſtor, thirty grains of the moſs of a dead man's ſkull, and thirty grains of the ſkull itſelf: put all theſe into a ſtrong glaſs, that is very dry, and ſhake them half an hour with all your might. It may be given in a fit: a ſpoonful to a young child; to a man, or a woman, a wine-glaſs. I uſually mix black-cherry-water with it.

CCLXXII. *The Pills for the Dropſy, that are much uſed by a Perſon eſteemed for the Cures he has done on that Diſeaſe.*

TAKE *gambogia*, gum *ammoniacum*, of each a dram and a half; *diagridium*, and tartar-vitriolate, a dram; with ſyrup of buckthorn: make a maſs for pills. Doſe from fifteen grains to half a dram.

CCLXXIII. *An eaſy but effectual Medicine for the Roughneſs of the Lips, and to heal Parts that have the Scarf-ſkin worn off.*

TAKE two parts of wax, and one of the freſheſt butter; melt and incorporate them over a gentle fire, and then let the mixture drop into ſmall cakes upon a glazed tile or a plate (whether pewter or ſilver) dipt in water, or elſe upon a piece of wetted white paper.

CCLXXIV. *A good and tried Way to make an artificial Wine, that is ſoon drinkable, and ſerves to keep the Body ſoluble.*

TAKE a gallon of boiling water, and pour it upon three pounds of raiſins of the ſun ſtoned and well bruiſed; by ſqueezing and preſſing get out the juice as thoroughly

as you can from the ſkins, *&c.* and, having ſtrained, put to it a pound of brown ſugar-candy.

CCLXXV. *A not unpleaſant Purge for Children and delicate Perſons.*

IN the yolk of an egg diſſolve, by rubbing them very well in a clean glaſs or ſtone mortar, about ſix grains of choice reſin of jalap finely powdered, and, when the ſolution is made, incorporate with it, little by little, two or three ounces of ſuccory or ſome other convenient water, which by this operation will be turned white, and make a kind of emulſion, which you muſt ſweeten at pleaſure, either with fine ſugar or ſome laxative ſyrup, and give it in a morning faſting. *Cum cuſtodia.*

CCLXXVI. *An ingenious Chymiſt's Arcana for the Stone.*

TAKE *borax*, finely powdered, and make it up with ſome choice turpentine into pills, whereof one doſe ought to contain from a ſcruple to two ſcruples; waſh theſe down with ſome few ſpoonfuls of the tincture of *lignum nephriticum* made in water, or of cochineal; or, if the caſe be urgent, you may give from twenty to thirty grains of the borax, and about a fifth part of myrrh; diſſolve in a couple of ſpoonfuls of the tincture of *lignum nephriticum*.

CCLXXVII. *An uncommon but tried Medicine to make a quick Exfoliation of a carious Bone.*

TAKE the thigh-bone of a hanged perſon, (if it can be had of ſuch a body, elſe another may be ſubſtituted) and having burnt it to blackneſs, but not calcined it, reduce it to fine powder, which is to be carefully ſtrewed all over the part to be exfoliated, after ſome drops of chymical *oleum ſabinæ* have been employed to wet and ſoften the part, and make the powder ſtick well; this done, dreſs it up S. A. and it will ſeldom require a third (if it do a ſecond) application.

CCLXXVIII. *An experienced Medicine for Madneſs* (Mania) *not very obſtinate.*

TAKE two ounces of the berries of box, and infuſe them warm in a cloſe veſſel in a quart of claret, or red-wine, for forty-eight hours; then decant the liquor, and put to it an equal quantity of the diſtilled water of vervain, and of this mixture let the patient take ſix or eight ounces at a time, and compoſe himſelf to ſweat and reſt after it. This muſt be daily done for a pretty while together, if need requires.

CCLXXIX. *To prevent a Gangrene upon a great Pain, and to ſtrengthen the Part.*

TAKE of melilot-plaiſter and diapalma equal parts, and having melted and well incorporated them together, make thereof a thin plaiſter; which, being prickt full of holes, is to be laid upon the inflamed or bruiſed part, firſt lightly ſcarified.

CCLXXX. *An excellent Plaiſter to diſcuſs Tumours, (even ſcrophulous) that may be reſolved, and ripening thoſe that it cannot diſſipate.*

Incorporate exactly with the *emplaſtrum de ſapone* about a fourth part of *balſamum ſulphuris terebinthinati*, and uſe it as a plaiſter for the above-mentioned purpoſes. *N. B.* In want of this, you may employ *diachylon cum gummis*, renewing it once in two or three days.

CCLXXXI.

CCLXXXI. *A parable Medicine to drive away Gravel and ſmall Stones.*

TAKE the thick ſkin, that is found in the gizzard of a cock or hen, (but not a capon) and having warily dried it, till it be grown pulverable, give from a ſcruple to two ſcruples of it in a draught of any convenient vehicle.

CCLXXXII. *An excellent Remedy for Whitloes on the Fingers.*

TAKE a reddiſh or at leaſt a blackiſh ſnail, of that ſort that has no houſe or ſhell, and having beaten it in a mortar, that is not metalline, to the conſiſtence of a poultice, apply it to the part affected, renewing it, if need be, once or twice, after it has been kept on for ſome hours.

CCLXXXIII. *To make one ſpit out Rheum, that ſwells the Gums, and therewith cauſeth the Tooth-Ach.*

DISSOLVE a ſpoonful of good muſtard in about a pint of French wine (claret or white), and having warmed it a little, let the patient from time to time waſh his mouth with it, and hold it therein for a pretty while together.

CCLXXXIV. *To give Eaſe in the Fit of the Gout.*

TAKE three parts of oil of turpentine, and one of chymical oil of ſpike; ſhake them well together; with this mixture anoint the parts lightly.

CCLXXXV. *An excellent Eye-water to preſerve from Rheums, eſpecially ſharp ones.*

TAKE two parts of celandine, and one of eye-bright, and diſtil thence (*N. B.*) in balneo, a water or liquor, which you muſt put upon exquiſitely pulverized *lapis calaminaris*, and let them digeſt together in an exactly cloſed veſſel for ſome weeks, adding, before you uſe it, a third part of brandy; afterwards continue upon the powder as long as you employ the liquor.

CCLXXXVI. *To make an excellent and often tried Medicine for the Stone, whether of the Kidneys or Bladder.*

TAKE of pure white-wine, or rheniſh-wine, and of fennel-water, each one pint: into this mixture put half an ounce of wood-lice, alive and well cleanſed, of a middling ſize, and one lemon ſliced; let them infuſe in a veſſel well ſtopt, for three, four, or five days, and then let the patient take about four ounces at a time twice a day.

CCLXXXVII. *An almoſt ſpecific Remedy for the Thruſh in Children.*

TAKE houſleek freſhly gathered, cruſh it well between two plates, or otherwiſe, till you have ſqueezed out the juice, mix this with live honey, enough to make it ſomewhat ſweet, and then put to it as much finely powdered roch-allom as will give it a little tartneſs; put ſome of this mixture with a quill, or a feather, down the patient's throat, as far as conveniently may be; if there be need, the part affected may be touched once more within an hour after.

CCLXXXVIII. *For the Yellow-Jaundice.*

TAKE rhubarb two drams, ſaffron, mace, of each a dram, hemp-ſeed one handful; bruiſe them, and put therein a quart of white-wine, and ſet it in a gentle heat

to extract; then take, mornings and evenings in an empty ſtomach, about a quarter of a pint; and when all is ſpent, pour on ſome more wine upon the ingredients, adding a little freſh rhubarb and ſaffron, and uſe it as before.

CCLXXXIX. *An almoſt ſpecific Medicine for Agues.*

TAKE reſin of ſcammony twelve grains, diaphoretic antimony, and cryſtals of tartar, of each eight grains; mix theſe carefully, and give them for one doſe, an hour before the fit comes.

CCXC. *To make a nephritic Tincture, often found to relieve in the Stone.*

TAKE oyſter-ſhells, and calcine them, till they be very white; of theſe take two parts, and one of rheniſh-wine-tartar; pulveriſe theſe apart very well, and then mix them diligently; pour on the mixture a little fair water, and let the ingredients work on each other, till the conflict be over; then ſtir the mixture with a ſtick, and pour on ſome more liquor; and when the effervеſcence ceaſes, put on a little more, and ſo proceed till no conflict be made. Evaporate to a kind of ſoft mucilage; digeſt this a while; decant the liquor and filter it, and you will have it, if it be not too flegmatic, of a fine red colour. Of this the doſe is from ten or fifteen to thirty drops, or more, in any convenient vehicle.

CCXCI. *An almoſt ſpecific Medicine for Exulceration in the Kidneys.*

TAKE jet, and, having reduced it to fine powder, give of it about half a dram for a doſe, in ſome good white-wine, in the morning faſting, and at bed-time, for ſome days together.

CCXCII. *An almoſt ſpecific Medicine for the Jaundice.*

WITH ſmall ale, or at leaſt not very ſtrong, draw a deep green tincture from freſh ſheep's-dung, and, in a ſmall draught of this, give from half a dram to a dram of a powdered mixture, conſiſting of four parts of turmeric, and one of Engliſh ſaffron. This doſe may be given twice, or, if need be, thrice a day, having a care that the patient, whom it will diſpoſe to ſweat, keep very warm, and ſo whilſt the operation laſts.

CCXCIII. *An uſeful medicinal Aliment for thoſe who are troubled with Pains of the Stone.*

LET the patient eat five or ſix onions roaſted, and ſparingly buttered, either in the morning faſting, or at meals, or at other times, if the caſe be urgent. [*N. B.*] The diſtilled water of onions is likewiſe of good uſe in the ſame diſtemper.

CCXCIV. *An experienced Ointment for the Worms in Children.*

TAKE rue, wormwood, and ſabine, of each a ſufficient quantity, and with May or other unſalted butter, or elſe with freſh hogs-lard, boil the herbs ſoftly, till you have brought the mixture to be very green; then ſtrain it, and pot it up for uſe: when you employ it, anoint with it firſt the pit of the ſtomach, and part of the cheſt a little above it, and then after a while rub it pretty well upon and all about the navel.

CCXCV. *An*

CCXCV. *An often tried Cataplaſm to break a ſore Breaſt.*

To the yolks of four eggs, take four ounces of live honey; mix them by grinding well together with about half a pint of red or claret wine, and apply this mixture as a kind of poultice to the part affected.

CCXCVI. *For an Ague.*

TAKE the ſoot that is in a baker's chimney, and muſtard, and rue, and white-wine vinegar, and ſallad-oil, and ſome white-pepper and ginger, and make a poultice of it, and lay it to the pulſe of his or her arms, and let it lie for a fortnight or three weeks, if you lay it on juſt before the fit come.

CCXCVII. *A very often experienced Medicine for Cankers in the Mouth, and elſewhere.*

TAKE flowers of ſulphur one ounce, roch-allum, crude and finely pulveriſed, half an ounce; mix theſe very well together, and incorporate them with as much good honey, as will ſerve to bring the mixture to the conſiſtence of a liniment, to be applied from time to time to the part affected.

CCXCVIII. *An eaſy but very effectual Medicine to ſtop bleeding in Wounds, and check ſome other Hæmorrhages.*

STREW upon the part the powder of clear roſin beaten very ſmall.

CCXCIX. *A very good Drink for Children, whoſe ſore Eyes are ſuſpected to be ſcrophulous.*

TAKE of ground-ivy and arch-angel, (leaves, flowers, and all) of each half an handful: pour on them a pint of boiling ſpring-water, and proceed as in making of coffee; let the patient drink a moderate cup of this two, three, or four times a day; but if you would have it ſtronger, you may put to a quarter of a handful of each of theſe, two or three drams of pile-wort-roots, which muſt be put to infuſe all night alone in the water, which, being thus impregnated, muſt then boil, and be uſed as before.

CCC. *For ſcrophulous Humours of Children's Eyes and other Parts.*

TAKE figwort, and put two handfuls of it to a pottle of ſmall ale; of this give a quarter or half a pint at a doſe. The operation will be promoted by quenching ſeven or eight times in this liquor a gad of ſteel about eight or ten inches long.

CCCI. *Againſt a Vertigo.*

TAKE of cyprus-roots two ounces, of aniſeed half an ounce; make of both a very fine powder, and take as much as you can lay on a ſixpence, in a ſpoonful of wine, beer, or ale, when you go to bed. This medicine continued for five nights (beſides other patients) cured a woman, who for divers years was troubled with a vertigo, and had uſed all ſorts of other remedies, preſcribed to her by London phyſicians, to little or no purpoſe.

MEDICINAL EXPERIMENTS:

OR, A

COLLECTION

Of CHOICE

REMEDIES,

Chiefly SIMPLE, and eaſily Prepared:

Uſeful in FAMILIES, and fitted for the Service of COUNTRY PEOPLE.

The PREFACE.

THE Hon. ROBERT BOYLE, Eſq; deceaſed, hath gratified the whole race of mankind by his public labours. The world may be divided into the learned and the unlearned part thereof. The former he much obliged by his elaborate diſcourſes on ſeveral ſubjects; the latter, which are far more numerous, he hath condeſcended alſo to oblige, by conſulting their health in the enſuing receipts. For, whereas the ordinary and inferior ſort of men either have not ability (by reaſon of the tenuity of their eſtates) to reward phyſicians, or, by reaſon of the remoteneſs of their habitations, have not opportunity to conſult them; here they have remedies provided to their hands, and almoſt at their own doors; ſome of which the learned collector had experience of himſelf; and others were recommended to him by credible perſons, who had experienced their benefit in themſelves or their friends.

AND though thoſe ways of probation might be ſufficient to juſtify their publication; yet ſuch was the ſcrupulous care and zeal of this author, that he would not ſuffer them to ſee the light, till they had been firſt peruſed by ſome eminent phyſicians of his acquaintance, to whom he was pleaſed to commit the ſuperviſal of his medicinal receipts, both galenical and chymical.

THIS century bears the name of parable receipts, becauſe they may be eaſily procured and prepared by country people, as their reſpective diſeaſes do require.

WHAT comes forth in the name of Mr. BOYLE, and is genuinely his, needs no farther recommendation.

HIS *ipſe dixit* is ſufficient, and ſuch are theſe preſcripts, as being found among his many other papers of like import, which in time may be publiſhed alſo.

I SHALL therefore only recommend them and their ſucceſs to the bleſſing of GOD, the alone Giver, Preſerver, and Reſtorer of health.

J. W.

A COL-

A

COLLECTION

Of CHOICE and SAFE

REMEDIES.

THE THIRD VOLUME.

I. *A good Medicine for a newly taken though violent Cold.*

TAKE about four ounces of ſpring-water, and, in a convenient veſſel, put to it three leaves of good tuſſilago (colts foot) and a pugil of maiden-hair, and a ſtick of liquoriſh for bigneſs and length like the furtheſt joint of the little finger: make the water warm, and, when it is ready to boil, put in the forementioned ingredients, the liquoriſh being firſt ſliced and minced; cover the pot well; let it boil for a few whalms; then take it off the fire, and, having preſently ſtrained it, let the patient drink it hot like tea, he being already in bed: do this three or four nights conſecutively, or till there be no more need of the medicine.

II. *A good Water for the Eyes, that are foul, and pained by ſharp Humours.*

TAKE prepared pearl and coral, *anà* one ſcruple, aloes cabalina, finely powdered three grains, red roſe-water and ſuccory-water *anà* one ounce; mix them well, and if you would have the mixture ſtronger, put in a very few grains of *trochiſchi albi raſis* in very fine powder.

III. *A good Medicine for Pain of the Teeth, that comes from Rheum.*

OF the powder of white hellebore, put into a clean linen rag, like a nodule, of about the bigneſs of the largeſt ſort of peaſe, or ſomewhat greater; and let the patient hold it between his teeth, with his head and face ſomewhat inclined, that the rheum may run freely out of his mouth.

IV. *An experienced Sternutatory to clear the Head.*

LET the patient ſnuff up, in the morning faſting, a ſmall ſpoonful, or leſs, of the clarified juice of *hedera terreſtris*, *i. e.* ground-ivy, or of beets, ſpitting out from time to time as much liquor as comes into his mouth.

V. *An often tried Remedy for the Dyſentery and ſharp Fluxes of the Belly.*

GIVE from fifteen to twenty grains of carefully made *mercurius dulcis*, incorporated with about two ounces of catholicon, or elſe with about one ſcruple of toaſted or ſomewhat leſs of untoaſted rhubarb. See Numb. (1.)

VI. *A good though uncommon Medicine for the Dropſy.*

TAKE Virginian ſnake-weed a ſufficient quantity, and, having cut and ſliced it very ſmall, infuſe it into a competent quantity of good ſack, till the liquor be very

ſtrongly impregnated with the plant. Of this infuſion let the patient take three, four, or five ſpoonfuls at a time (or more, if the caſe be urgent) when the ſtomach is empty. See Numb. (2.)

VII. *An often experienced Medicine for bloodſhot or inflamed Eyes.*

CUT a new-laid egg, boiled hard, into two halfs, without taking out the yolks, and apply one of theſe conſiderably warm, but not too hot, to the part affected, and keep it on for ſome hours (ſix or eight, if it need ſo long.) Note well; to the ſame purpoſe you may apply, with good effect, a poultice made of a rotten apple, the cold being firſt quite taken off. See Numb. (3.)

VIII. *An excellent Remedy for a Burn or Scald in the Eye.*

TAKE mucilages of quince-ſeed, flea-wort, linſeed and fenugreek-ſeed, of each one ſcruple; boil it very lightly in four ounces of betony-water, filter it, and apply it to the part.

IX. *A good and innocent Dentrifice.*

TAKE maſtic and dragons-blood, of each a ſufficient quantity; powder them, and mix them together, and let the patient uſe them as a dentrifice.
See Numb. (4.)

X. *To correct the Laxity of the Gums, and faſten the Teeth.*

To a pint of red or claret-wine take about two drams of Japan earth, and having diſſolved ſo much as you can, pour off the clear, and let the patient waſh his mouth therewith from time to time.

XI. *An uncommon but effectual Fomentation for Tumors accompanied with ſharp Humours.*

To a gallon of ſpring-water put as much dried ſage as you judge will afford a decoction ſtrong enough of the herb: into this, when it firſt grows hot, caſt about two ounces or ſome drams of Caſtile-ſoap, and let it diſſolve there till your decoction be completed: with this, and ſtupes, foment the part for a good while together.

XII. *A rare Medicine for hyſterical Affections, and ſeveral Diſtempers of the* genus nervoſum.

TAKE one ounce, or a ſufficient quantity of volatile ſalt of harts-horn, which need not be exactly pure, and drop on it as much ſpirit of tartar as will ſerve to ſatiate it, when the conflict is quite ceaſed. Digeſt the mixture for a while, that it may acquire a red colour, and keep it carefully ſtopt for uſe, and give four or five drops twice a day in any convenient vehicle.

XIII. *An often proved Remedy to bring away what is, or ſhould not be left, in the Womb of a Puerpera, though it were Part of a dead Child.*

WITH the juice of ſheep's-ſorrel, and ſome of the ſtrong infuſion of the ſame herb (unpreſſed) in water, and a ſufficient quantity of ſugar, make a ſyrup; of which let the patient take about a ſpoonful (a little more or leſs, as need may require) twice or thrice a day.

XIV. *A tried Medicine to take away Corns.*

THE parts being made ſoft with bathing, and ſcraped, apply to the corn a plaiſter of ſhoe-maker's wax; but, if the part be very tender, your plaiſter may conſiſt of equal parts of ſhoe-maker's wax and diapalma melted together, and ſpread ſomewhat thin.

XV. *To make an excellent ſtyptic Powder to ſtaunch Blood.*

TAKE of white ſugar-candy, roch allom burnt (but not too much calcined) and white vitriol, and pulverize them exceeding well, and mix them diligently, and having dipt pledgets of wax or lint, moiſtened with the white of an egg, into this powder, apply them to the orifices of the bleeding parts. Note well; it will do very well, after the dry ingredients are mixed, to grind them with as much whites of eggs, beaten to water, as will make a paſte, which is afterwards to be thoroughly dried in the air, and then again reduced to powder.

XVI. *For a Tooth-ach proceeding from Defluxions or Rheum from the Gums.*

DISSOLVE one ounce of choice Japan earth in a pint at leaſt of good red or claret wine, and let the patient hold it in his mouth often, and a good while together.

XVII. *To prevent the Fit of an Ague, or cure that Diſeaſe.*

TAKE of the ſcraping or gratings of the root of angelica half a dram, and of the flowers of antimony; mix them well, and let the patient take them at the uſual times.

Note here, that the flowers of antimony are not to be given inwardly in ſubſtance, but only in infuſion; for in ſubſtance they will hazard life, bringing firſt ſtrong convulſions, and then death. But you may make the medicine thus.

See Numb. (5.)

XVIII. *To make an often tried Pericarpium for Agues, eſpecially Tertians.*

TAKE a handful and a half of freſh rue, half a handful of freſh ſage, a ſpoonful of bay-ſalt, a ſpoonful of good vinegar: beat all theſe very well together into an uniform maſs; which divide into two parts, and make thereof two wriſt-plaiſters, to be applied at the uſual times before the fit; and to be renewed, if there be occaſion, to keep them on, till they grow dry and troubleſome.

XIX. *For the Cholic.*

R. Orange-peels dried, till one may grate them to powder; and when they are pulverized, take about a ſpoonful of the powder at a time, mixed with a little white ſugar to ſweeten it, in or before ſome ſpoonfuls of any convenient vehicle.

XX. *An approved Remedy for preſent Deafneſs.*

TAKE of the breaſt-milk of a woman, that has had her firſt male-child ſome time before, and drop three or four drops of it warm, as it comes from the nipple, into the part affected.

XXI. *A choice Medicine for Burns.*

TAKE gooſe-greaſe (which the country-people call the leaf of a gooſe) and having ſoftly melted and a little ſkimmed it, ſqueeze into it as much freſhly exprelt juice

of ground-ivy leaves, as, by continual ſtirring, will bring it to the conſiſtence of a green ointment. With this anoint the part itſelf affected, and afterwards lay on it fine rags well dipt in the ſame ointment.

XXII. *An external Remedy, almoſt ſpecific for the Leproſy.*

TAKE pomatum one ounce, flower of ſulphur one dram, *ſal prunellæ* half an ounce; and, having mixed them very well together, from time to time anoint the part affected therewith, as long as there is need.

XXIII. *For the Head-Ach.*

TAKE green hemlock, that is tender, and put it in your ſocks, ſo that it may lie thinly between them and the ſoles of your feet; ſhift the herbs once a day.

XXIV. *For the Hiccup (even in Fevers.)*

GIVE two or three preſerved damſons at a time.

XXV. *A ſimple Remedy for the Cholic.*

IN a draught of any convenient liquor, diſſolve about one dram of good ſalt of tartar, and let the patient take it for one doſe.

XXVI. *An experienced Medicine to cleanſe the Womb.*

TAKE a large white onion, cut it into ſmall pieces, and boil it in about a pint of water, or leſs, as if it were to be dreſſed for eating; and of this decoction give ſeven or eight ounces for a doſe, mixed with about half an ounce of freſh oil of walnuts.

XXVII. *To appeaſe the Fits of a* Furor uterinus.

TAKE the feathers of partridges (it matters not much from what part of the fowl) and burn them for a competent time under the patient's noſe.

XXVIII. *A very good Syrup to ſtrengthen the Sight.*

TAKE about a ſpoonful of a ſyrup made of betony-water and honey, twice, thrice, or four times a day.

XXIX. *An eaſy prepared but uſeful Drink for a beginning Scurvy.*

To a quart of ſmall-beer (of ſix ſhillings *per* barrel) or ſmall ale, put over-night about a handful of ſcurvy-graſs-leaves, and let the patient drink this liquor at dinner for his ordinary drink for ſix or eight weeks together.

XXX. *A parable Remedy for recent Burns.*

APPLY, as ſpeedily as you can, to the part affected, an onion, or more (if the burnt place be large) beaten to maſh.

XXXI. *For the Tooth-Ach.*

APPLY a plaiſter of *caranna* to that part that burns, between the bottom of the ear and the temples, on the ſame ſide where the pulſation of the artery is the moſt manifeſtly or ſtrongly felt.

XXXII. *An*

XXXII. *An excellent Medicine, though not curative, for thoſe that are tormented with the Stone in the Bladder.*

TAKE powder of comfrey-roots an ounce and half, marſh-mallow-roots three ounces, liquorice-powder two drams, ſeeds of daucus of Crete two drams, ſeeds of purſlane, of winter-cherries, of each half a dram, nutmegs two drams, ſaffron one dram, the ſpecies *diamargariton* frigid ſix drams, ſyrup of marſh-mallows four ounces; mix and make a ſoft electuary, of which let the ſick daily take the quantity of a walnut. It is profitable againſt the ſtone in the reins and bladder, but chiefly againſt the latter; as alſo againſt the ſtrangury, dyſuria, *&c.*

XXXIII. *To make a purging Electuary, eſpecially for Children.*

TAKE an ounce of choice rhubarb reduced to fine powder, and eight ounces of very good currans picked, waſhed, and rubbed dry; beat theſe together in a glaſs or marble mortar for near two hours. Of this electuary let the patient take about the bigneſs of a ſmall or large cheſnut in the morning faſting, and, if need be, at bed-time. If the caſe be very urgent, the medicine may be taken thrice in twenty-four hours.

XXXIV. *An excellent Remedy for an Inflammation in the Eyes.*

TAKE a pippin (or other apple) cut it into two halves, take out all the core of each of them, fill up the cavities with the tender tops of common wormwood, tye the halves together, and roaſt the apple well; then beat it and the herb together to a kind of poultice, and apply it warm (but not hot) to the part affected, and bind it thereon, letting it lye all night, or, if you uſe it in the day-time, for ſix or eight hours.

XXXV. *An uſeful Drink for the King's Evil, and ſome Affections that have the like Cauſe to it.*

TAKE a large handful (or two little phyſical handfuls) of the leaves of ground-ivy, green, or (if the ſeaſon denies you them) well dried; waſh off the duſt with beer, not water, and put the herb into a gallon of alewort; when it is ripe for drinking, draw it out into bottles, and let the patient take a draught of it twice or thrice a day, or, if it be thought fit, it may be uſed at meals. See Numb. (6.)

XXXVI. *An often experienced Remedy to expel Gravel, and provoke ſuppreſt Urine.*

KILL a black cock or hen (rather than one of any other colour) take out the thick membrane or ſkin that lines the gizzard or ſtomach; and, having wiped it clean, dry it cautiouſly, ſo as it may be beaten to powder. With this mix an equal part, or half ſo much of choice red coral calcined: of this mixture give from twenty or thirty to forty or fifty grains. See Numb. (7.)

XXXVII. *An approved Remedy for the King's Evil.*

SET a quart of new-milk on the fire, till it juſt boils up; then take it off, and put into it two ſpoonfuls of the beſt honey, and ſtir it till it be diſſolved; and then ſet it on the fire again, and let it boil two or three walms: then divide it into four parts, and drink one part warm, early in the morning, another about ten of the clock, another about four in the afternoon, and the laſt a little before bed-time. Do this daily for two or three months, except you purge, which muſt be once a week,

taking (if a grown man) three quarters of an ounce of *caryocoſtinum* diſſolved in poſſet-drink: dreſs the ſores, if they run, with any drawing ſear-cloth, or a plaiſter of Burgundy-pitch. The medicine, though not very promiſing, is very famous by the many cures done with it by a charitable lady, of whoſe ingenious chaplain I procured this.

XXXVIII. *A good Compoſition to ſtop a hollow Tooth, and appeaſe the Pain.*

TAKE two parts of fine ſugar (that of *Liſbon* does beſt) and one part of black round pepper, both finely powdered and mixed; put them into a ſilver ſpoon over two or three well-kindled coals; and, when the ſugar begins to melt, take off the ſpoon; and, whilſt the mixture is yet ſoft, form it into little grains for ſize and ſhape ſuited to the part affected.

XXXIX. *A Plaiſter preferred by an ancient Phyſician, that often tried it, to the common Soap-Plaiſter.*

MIX about a dram of Caſtile-ſoap with one ounce of diachylum, and make thereof a thin plaiſter to be worn upon the part affected.

XL. *An excellent Medicine to be uſed topically in Gleetings.*

TAKE four ounces of ſpring-water [or plantane-water] and diſſolve in it about one ſcruple of the ſympathetic powder, or ſo much as will give it a ſenſible yet but faint vitriol-like taſte: and of this mixture inject as much as is uſual of a ſmall ſyringe every morning and evening, as long as need require, directing the patient to retain the injected liquor as long as conveniently he can.

XLI. *An approved Medicine in the Biting of a Viper.*

TAKE of white hore-hound, and apply the plant well beaten into the form of a poultice to the part affected, and give the patient a ſpoonful or two of the juice of the ſame herb to drink: it is alſo very good for the jaundice.

XLII. *An almoſt ſpecific Medicine for the Suppreſſion of Urine.*

TAKE of *ſtœchas citrina* (in Engliſh, French lavender) and infuſe in a good heat two handfuls of the flowers in a pint of good brandy (not rectified ſpirit of wine) and of this infuſion give about a ſmall wine-glaſs full at a time (diluted, if there be great need, with a ſufficient quantity of ſome appropriated liquor.)

XLIII. *For an Ague, often tried.*

Boil yarrow *(millefolium)* in new-milk, till it be tender enough to have a cataplaſm made of it. Apply this to the patient's wriſts, juſt when the cold fit is coming on, and let it lie on the parts till the fit be gone; and if another fit comes, uſe freſh cataplaſms as before.

XLIV. *An uſeful Plaiſter for thoſe that are troubled with Vapours of the Spleen, and Shortneſs of Breath, when it is a nervous Affection.*

TAKE two parts of ſtrained galbanum, and one part of aſſa fœtida, and make thereof, according to art, a plaiſter of about the bigneſs of the palm of one's hand, taking

taking care to leave a broad edge quite round, to prevent its ſticking to one's linen, and putting a pretty large piece of cotton in the middle, that the gums may not touch the navel, to which the plaiſter is to be applied.

XLV. *A ſlight but excellent Medicine to take off Fits of the Head-Ach.*

TAKE about a handful of freſh roſemary, and boil it for a pretty while in a quart of common water; then almoſt fill with it a pint-pot (or rather a mug); let the patient cover his head and face with a napkin, ſo that he may receive the ſteam as hot as he can well bear, and keep the veſſel there as long as he finds the ſteam ſtrong enough.

XLVI. *An eaſy and dry Medicine for the Itch,* præmiſſis univerſalibus.

BOIL four ounces of clean quickſilver in about a gallon and a half of ſpring-water, and let the patient take of this between a quarter and half a pint at a time, aromatizing it, if he pleaſes, with a little lemon-peel.

XLVII. *An eaſy Medicine to purify and ſweeten the Blood.*

TAKE the minera of Hungaria, or other choice antimony, and, having ground it to very fine powder, without ſuffering it to touch any metal, give of this dry alcohole from ten grains to a dram, giving it once a day, and (unleſs ſome particular reaſon diſſuade that time) let it be at dinner, that it may mingle with the patient's meat in his ſtomach.

XLVIII. *A cheap but excellent Medicine for Ulcers.*

TAKE one drachm, at leaſt, of corroſive ſublimate finely powdered; diſſolve it in a quart of fair water, and let it lie there, if you have leiſure, four or five days (in a light digeſtion) that it may be thoroughly diſſolved. Then drop in it as much ſpirit of ſal armoniac, or as much oil of tartar *per deliquium*, as will precipitate it all: then filter it carefully, and keep it ſtopt for uſe, which is to imbibe doſſils or pledgets with it, and apply them to the ulcer twice or thrice a day.

XLIX. *An eaſy and innocent Medicine for Coſtiveneſs.*

BOIL, in as much broth as will ſerve to fill a large porringer, about half a handful of the leaves of common mallows chopped; and of this broth (being ſtrained) let the patient make the firſt part of his meal.

See Numb. 8.

L. *For the aching of a hollow Tooth.*

TAKE oil of wax, and with it moiſten well a little cotton, and thruſt it up into the hollow tooth, letting it lie there until the pain be ſufficiently aſſwaged.

LI. *An often tried Medicine for the bloody Flux, being good alſo for Pleuriſies.*

GIVE the weight of an eſcu d'or (or near one drachm) of the ſeed of *ſophia chirurgorum*, in Engliſh, flax-weed, in two or three ſpoonfuls of any convenient vehicle, once or twice a day.

LII. *The*

LII. *The Cinnamon-Drink, good in Gripes and Fluxes, &c.*

TAKE two ounces of calcined harts-horn, powder it, and boil it in three pints of ſpring-water till a pint be waſted; then take it off the fire, and infuſe in it an ounce and half of good cinnamon, ſetting it upon embers in a covered veſſel for about an hour. Then ſweeten it with ſugar to your palate, and drink about a quarter of a pint at a time. If taken for prevention only, a fourth part of the cinnamon will ſerve the turn. See Numb. (9.)

LIII. *An eaſy but uſeful Remedy for Redneſs of the Eyes.*

TAKE a blanched almond, and about three grains of camphire, and, in a glaſs or marble mortar, incorporate them by wary grinding; and then add to them, little by little, two or three ounces of red roſe-water, ſtill grinding them, till the whole be brought to a kind of emulſion. Drop a little of this into the part affected.
See Numb. (10.)

LIV. *A moſt excellent Balſam for any green Wound, of what Nature ſoever.*

OIL of St. *John*'s-wort, and Venice-turpentine, of each a like quantity; ſet them over the fire in a gentle heat, half an hour or leſs, that they may incorporate. Then put them up, and keep it for uſe, as one of the beſt of balſams.

LV. *A good Medicine for the Suppreſſion of the Menſes.*

GIVE for three mornings together, about the expected time of the monthly evacuation, a drachm, or drachm and half, or thereabouts, of the galls and livers of eels dried and made into powder.

LVI. *An experienced Remedy to prevent apoplectic Fits.*

MAKE, at the croſſing of the ſutures, an iſſue with diapalma and oil of vitriol, and keep it open the ordinary way.

LVII. *To dry up or correct the Humour that makes ſcrophulous Ulcers.*

TAKE of the bone of the cuttlefiſh, and, having reduced it to an impalpable powder, give about one dram of it at a time in any convenient vehicle.

LVIII. *An effectual Medicine for a recent Strain.*

TAKE a handful of wormwood-leaves, and boil them in ſtrong ale, till the conſumption of about a third, that you may reduce them to the form of a cataplaſm, which, when you take from the fire, you muſt ſtrengthen by putting into it two, or at moſt three, of brandy, and apply it warm, renewing it, if need be, in twenty-four hours at leaſt. See Numb. (11.)

LIX. *For a ſlight Inflammation of the Eyes, as alſo a Hordeum growing on the Eye-lid.*

TAKE freſh houſleek; and, having pounded it very well to a kind of cataplaſm, cover as much as is needful of it, for example-ſake, to the thickneſs of an half-crown, or a crown-piece, in the fold of a rag or linen cloth, which may be ſo applied, that the cataplaſm may reach the eye, and the reſt of the cloth be faſtened about the patient's head. Let the medicine lie on all night, and be taken off the next morning. Repeat this application two or three times, in caſe there be need.

LX. *For*

LX. *For moſt aſthmatic Diſtempers.*

TAKE of the roots of elecampane, thinly ſliced, one ounce, of the leaves of ground-ivy a good handful. Boil theſe in three pints of ſpring-water to a quart; then ſtrain the decoction, ſweeten it with a little live honey, and let the patient take it five, ſix, or ſeven ſpoonfuls at a time. (Note well, remember the efficacy of ſaffron in the ſame diſeaſe, as it is commended by Mr. *Ray*, in his catalogue of plants.)

See Numb. (12.)

LXI. *For an Ague.*

TAKE of the bone called platella, of the knee of a dead man, and, having reduced it to fine powder, give of it as much as will lie upon a groat or a ſix-pence, for one doſe, in any proper conſerve, or fit vehicle, at a convenient time (before the cold fit.)

LXII. *An experienced Medicine to kill Tetters.*

TAKE of flowers of brimſtone, ginger, and burnt allum, of each alike; mingle them well, and of this mixture incorporate as much with new unſalted butter as is requiſite to bring it to the conſiſtence of an unguent. With this anoint the part affected, as hot as the patient can well endure it, and let it ſtay on all night, and the next morning waſh it off with celandine-water. But, when the patient goes to bed, he is to take a doſe of ſome alexipharmical medicine, as *Gaſcoign*'s powder, treacle, *&c.* to keep the humour from being driven into the maſs of blood: he is alſo to bathe the part oftentimes in a day with the celandine-water.

LXIII. *To make a good Powder for a Gonorrhœa.*

TAKE of choice red coral, and of maſtic equal parts; reduce them ſeparately to fine powder; mingle them very well, and of this mixture give about thirty or forty grains for one doſe.

LXIV. *A choice Medicine for a ſlight Stroke or Bruiſe of the Eye.*

TAKE two ſpoonfuls of fennel-water, or of betony-water, and drop into it three or four drops (or five at moſt) of good clarified honey: ſhake them well together, and uſe them twice or thrice a day. But you muſt have a care to make this mixture freſh once in four (or at moſt in five) days, eſpecially in ſummer; for if it be longer kept, it will be apt to grow ſour.

LXV. *An often tried external Medicine for an Eryſipelas.*

TAKE the blood of a hare (it is beſt if killed by hunting in *March*) and, if you can have it freſh, anoint the part affected with it; otherwiſe apply on it a linen rag, that has (though a good while ago) thoroughly imbibed the freſh blood of that animal, and dried in the air. But, if the imbrued linen be too hard or ſtiff, it muſt be ſoftened with a little fair water, and then, the cold taken off, applied to and bound upon the part. See Numb. (13.)

LXVI. *An Empiric's much boaſted Remedy for the Fluor albus, or Whites in Women.*

MAKE a ſtrong decoction of the herb alchymilla (in Engliſh, ladies-mantle) and let the patient drink of it about half a pint every morning faſting; and if the caſe be urgent, make an injection of the ſame plant, boiled until it be very tender, and let the patient make uſe of it from time to time. See Numb. (14.)

LXVII. *An excellent Water for Ulcers and Sores. Tried with great Succeſs.*

To a quart of ſpring-water, take one dram of mercury ſublimate finely powdered; and, when it is quite diſſolved, drop into the ſolution either ſpirit of ſal armoniac (which is beſt) or oil of tartar *per deliquium*, until you ſee that no more will manifeſtly precipitate. This done, filter the mixture through cap-paper, and reſerve the precipitate for other uſes. The liquor, that paſſes, you muſt keep cloſe ſtopt in a glaſs vial; and when you will uſe it, you muſt dip linen rags in it, and being thoroughly wetted, apply them to the part affected, ſingle or double, more or leſs, as need requires. This application may be renewed twice, or (if the caſe be urgent) thrice a day.

LXVIII. *An experienced Medicine for Want of Sleep, proceeding from great Heats in the Head.*

TAKE the paleſt carrots you can get, and ſcrape a ſufficient quantity of them to afford ſcrapings enough to make a cataplaſm of about two fingers (or two inches) broad, and of the thickneſs of a half-crown-piece of ſilver, or thereabouts. Let the patient apply this in a piece of double linen to his throat, ſo that it may reach to the jugular veſſels on each ſide, when he goes to bed, and let it lie on all night (for it will not eaſily grow dry); if the firſt application do not prevail, it is to be applied the following night; and ſo a third and fourth time, if need require.

LXIX. *A parable Medicine, that has cured very many, eſpecially Children, and young Boys and Girls, of convulſive Fits.*

TAKE of the powder (whether made by filing, raſping, or otherwiſe) of the ſound ſkull of a dead man, and give of it about as much as will lie upon a groat, made up into a bolus, with conſerve of roſemary-flowers (or any other that is proper) to a young boy or girl: but, in perſons more aged and ſtrong, the doſe of the powder muſt be augmented to double the quantity. The medicine muſt be given often, if neceſſity requires it: if the patient be a child, it will be uſeful to apply to the throat a kind of necklace, made of the roots of vervain cut into beads.

LXX. *An eaſy and experienced Remedy for the Piles.*

IN four ounces of ſpring-water diſſolve about one drachm of ſalt of tartar, or as much as will give the liquor a manifeſt but not ſtrong alcaliſate taſte; and apply ſoft rags dipt in lukewarm, or ſomewhat more, to the part affected, ſhifting it from time to time.

LXXI. *A ſucceſsful Medicine for the Fluxes of the Belly.*

TAKE rice-meal, and mix with it about a fifth part of finely powdered and ſifted chalk; boil theſe in water, or (which is better, if it agrees with the patient) in milk, and make thereof a haſty-pudding, to be moderately ſeaſoned with ſugar and powdered cinnamon; and let the patient eat it at meals, and, if need be, at ſome other times.

LXXII. *An often tried Remedy for Corns.*

TAKE the juice of houſleek, and mix it up with about equal parts of the thick barm or yeaſt that ſticks to the barrel, or to the clay that ſtops it. Of theſe make a kind of plaiſter, which, being kept upon the toe for a while, and then, if need be, renewed, will make the corn very ſoft, and eaſy to be drawn out and extirpated.

See Numb. (15.)

LXXIII. *A*

LXXIII. *A good Medicine for Burns and ſtaunching of Blood.*

DISSOLVE in ſpring-water, or, which is better, rain-water, as much ſugar as will make it a ſtrong ſolution, and then with a ſufficient quantity of linſeed-oil, or oil of olives, beat up this liquor, until the oil on it be brought to the conſiſtence of an unguent, with which anoint the part affected, as timely as you can, renewing the application as often as need ſhall require.

See Numb. (16.)

LXXIV. *An approved Medicine for the bloody Flux, being good alſo for Pleuriſies.*

GIVE two or three ſcruples of hare's-blood beaten to powder for one doſe, to be taken in a ſpoonful or two (or three) of mint-water, or any other fit vehicle.

LXXV. *A very often (though homely) experienced Remedy for dyſenteric and other Fluxes.*

TAKE the freſh dung of a hog (and, if you can, whilſt it is yet warm) and boil, in a porringer full of new milk, as much of it as may amount to the bigneſs of a walnut; and alſo an equal quantity of fine mutton-ſuet ſliced very thin: when theſe are well incorporated with the milk, ſtrain them well through a clean linen; and, if there be need, ſweeten them a little with loaf-ſugar. Let the patient take this warm, once or twice a day.

LXXVI. *A powerful Styptic to ſtaunch Blood, where it can be applied.*

TAKE the fine powder of *lapis hæmatites*, made by grinding it exactly well with an equal or double weight of *ſal armoniac*: and of this high-coloured ſublimate put a little upon the orifices of the veſſel.

LXXVII. *For a ſlight Redneſs of the Eyes.*

TAKE of French barley half an ounce, and damaſk-roſes half a handful. Boil them but very little in a pint of ſpring-water, and with this moiſten the part affected.

See Numb. (17.)

LXXVIII. *For the Relaxation of the* Uvula.

TAKE bluiſh peaſe, or, in want of them, white ones, and chew them very well, ſo as to reduce them to the conſiſtence of a poultice. Lay this warm upon the crown of the head, to the breadth and thickneſs of a five-ſhilling-piece of ſilver, or ſomewhat larger, ſhifting it in the morning and at bed-time.

See Numb. (18.)

LXXIX. *A powerful Medicine to ſtop ſharp Rheums.*

TAKE a dram of catechu, or Japan earth, and make thereof a decoction in five or ſix ounces of good white-wine, or elſe of ſome diſtilled water, or other liquor appropriated to the diſeaſe. Of this give two or three ſpoonfuls at night, and in the morning as much alſo, if need require.

LXXX. *The Frenchman's famous Eye-water.*

TAKE two or three ounces of the water of ſimple pimpernel, diſtilled in balneo, and put this into a little pot or porringer of roſe-copper; then put into it about the

bigneſs of a hazel-nut, or a filbert, of ſtrong quicklime: cover the pot, and let the ingredients lie in it, till the liquor hath acquired a bluiſh colour. Then very warily pour off the clear, and add to it as much live honey as will give a little or but little taſte: uſe it after the wonted manner of ſuch waters; and, if you find it too ſtrong, dilute it a little with water of the ſame plant, or good ſpring-water, which, for need, may be uſed from firſt to laſt, inſtead of the water of pimpernel.

See Numb. (19.)

LXXXI. *Eye-Water.*

TAKE red roſe-water, plantane-water, of each an ounce; *tutia* prepared, half a ſcruple; *lapis lazuli* prepared, ſix grains; red coral prepared, five grains: mix, and make a *collyrium*, or eye-water.

This, dropped into the eyes, being firſt well ſhaken, cures inflammations of the eyes, provided there be no great foulneſs, nor ſcrophulous diſpoſition in the patient. It takes off the redneſs of the eye-lids; if, with a ſpunge dipt in it, the eye-lids be often wetted, it takes off films very well.

LXXXII. *A ſafe and uſeful Medicine to prevent Dryneſs, and ſome other Diſaffections of the Eyes.*

TAKE of choice virgin-honey two ſpoonfuls, of ſuccory-water, or the diſtilled water, four ſpoonfuls; mix them, and, in a very clean veſſel over a very gentle fire, let them evaporate (taking off from time to time any ſcum that may ariſe) till the mixture be brought to the conſiſtence of a ſyrup, or of honey; keep this in a glaſs cloſe ſtopped, and make uſe of it, by letting fall a drop or two (or at moſt three) of it, at a time, into the eye. See Numb. (20.)

LXXXIII. *The Medicine of a famous Empiric for the Stone.*

TAKE amber (clear or yellow), ſea-horſe pizzle, and nitre, of each a like quantity; (Note well, in caſe of ulcerated kidneys put half the quantity of amber, and an eighth part of the nitre of natural balſam). Pulverize each apart, and make them up into pills with Chios (or at leaſt clean Straſburg) turpentine. Take five, ſix, or ſeven pills (of about ten to an ounce) morning and evening. See Numb. (21.)

LXXXIV. *An excellent Medicine for Fits of the Mother.*

TAKE *ſagapenum* diſſolved in vinegar of ſquills, ſtrained through a ſieve, and again inſpiſſated or thickened, *ammoniacum* in like manner prepared, ſteel prepared, myrrh, *fæcula* of briony, of each half a dram, Engliſh ſaffron, *caſtoreum*, of each a ſcruple, *borax* two ſcruples, ſyrup of *ſtœchas* a ſufficient quantity; mix, and make pills of a convenient bigneſs to be ſwallowed; of which take three morning and night, with care.

LXXXV. *A choice Medicine for the Cholic.*

TAKE clean white chalk, and, having dried it with a gentle heat, reduce it to fine powder; wet this powder with the expreſſed juice of camomile, and let it dry in the air, without the heat either of the fire or of the ſun. This done, wet it again with new juice of camomile, and dry it the ſecond time as before. Wet and dry it again the third time, and, if you pleaſe, the fourth time; and then reduce the dry maſs to fine powder again. Of this powder let the patient take at a time as much as will lie upon a groat or ſix-pence, in ſome ſpoonfuls of wine, or other proper vehicle.

LXXXVI. *Troches of Vipers ſucceſsfully uſed to cleanſe the Blood, and to ſtrengthen weak Patients.*

TAKE of vipers reduced to fine powder one ounce, diaphoretic antimony half an ounce, clear yellow amber two drams, of ſtarch as much as of all the reſt, and of ſugar as much as of ſtarch; make them to a fine paſte with ſpirit of wine, and then make them into ſmall cakes, whereof one may ſerve for a doſe.

LXXXVII. *An approved Medicine for ſcorbutic Gums, and to faſten the Teeth.*

TAKE of white-wine a pint, of allum half an ounce, of juniper-berries, and of red ſage *anà* one ounce: boil theſe together, till a quarter of the liquor be waſted; then put into the remaining part four ounces of honey, and let it boil till the ſcum be all riſen; then filter it, and put into it one dram of *balſamum vitæ*.

See Numb. (22.)

LXXXVIII. *A Caution about the vitriolate Eye-Water.*

TAKE four grains of Roman vitriol, not more, to four ounces of diſtilled water, either of roſes, ſuccory, fennel, *&c.*

LXXXIX. *A good Medicine for a light Stroke or Contuſion of the Eye.*

TAKE half an ounce of celandine-water, and ſhake well into it three or four drops of clarified honey, and let fall of this into the eye a drop or two, twice or thrice a day.

XC. *An excellent Medicine for a Stroke or Bruiſe in the Eye.*

TAKE of betony-water and hyſop-water, of each one ounce, and in their mixture ſtir ſome blades of ſaffron, till the liquor be pretty well coloured, and no more. And laſtly, add to it four or five drops of clarified honey.

See Numb. (23.)

XCI. *An excellent Remedy to take off Films, and ſuch like Things, from the Eyes.*

TAKE choice bole-armoniac, and reduce it to very fine powder, blow this gently into the eye, once or (at moſt) twice a day. But, if the patient be ſubject to, or fearful of, any ſwelling, heat, or diſaffection in the eye-lids, incorporate the powder with a little clarified honey. See Numb. (24.)

XCII. *To ſtrengthen weak Eyes ſubject to Rheums.*

TAKE *lapis calaminaris* four ounces, roſe-water a pint; ſhake them well together two days. Then let it ſettle; pour off this water into a little vial, and drop of it in weak eyes, two or three times a day, *&c.*

XCIII. *A Plaiſter to ſtrengthen the Eyes, and ſtop Defluxions on them.*

TAKE of frankincenſe two drams, olibanum and maſtic, *anà* half a dram; mix theſe well, and reduce them into fine powder; of which a convenient quantity is to be melted and ſpread upon black ribbon, or ſome ſuch thing, with a hot knife or ſpatula, and ſo preſently applied to the temples.

XCIV. *An experienced Remedy for ſharp and hot Humours in the Eyes.*

INTO a quart of new milk, already boiling, put about two handfuls, or leſs, of green houſleek, freſhly gathered, and chopt ſmall, and let the milk boil on, till it will yield no more curd. Then ſtrain the green poſſet-drink, and let the patient take every day once or twice a pint (or as near that quantity as he can reach to) ſweetened a little, if need be, with fine ſugar. The drink may be beſt taken cold.

XCV. *An excellent Fumigation for Pains in the Eyes, and over-great Dryneſs of them, and when one fears the Beginning of a Cataract.*

TAKE of fennel, hyſop, betony, celandine, carduus, of each half a handful, or a handful; of the ſeeds of linſeed, quinces, fenugreek, flea-wort, of each half a dram, of French barley one ounce: boil theſe in two quarts of fair water, and half a pint of white-wine: let the patient hold his head over the fumes for about a quarter of an hour every morning.

XCVI. *For ſore Eyes.*

TAKE crumbs of white bread half an ounce, coral and pearl prepared, tutia, white ſugar-candy, of each half a dram; powder of red roſes a dram and a half, flower of St. *John*'s-wort one dram; and with a ſufficient quantity of milk make a cataplaſm or poultice, which ſpread upon linen cloth, and bind it over the eye.

XCVII. *For Heavineſs, and Pain in the Eyes.*

TAKE flowers of melilot, of elder, and of marigolds, of each a ſmall handful, linſeed, ſeeds of fenugreek, flea-wort, cummin, and quinces, of each half a ſcruple, French barley half an ounce, damaſk roſes half an ounce, ſpring-water a pint and a half; mix and make a decoction, with which foment the forehead, temples, and eye-brows, being ſufficiently warm.

XCVIII. *For a dry Inflammation.*

TAKE of betony, hyſop, rue, wormwood, vervain, as alſo of ſage-flowers, and roſemary-flowers, of each of all theſe half a handful; (to which may be uſefully added, cummin-ſeeds, fennel-ſeeds, and carduus-ſeeds, of each a quarter of an ounce); boil theſe a little in two or three quarts of fair water, and then let the patient hold his head for about a quarter of an hour over the ſteam of this decoction, making uſe of a napkin, to keep the ſmoak from diſſipating, and direct it to the eyes. A while after he may put into them, if it it be thought fit, a little clarified honey.

Several neceſſary NOTES, explicating, illuſtrating, or enlarging ſome of the HEADS in the PRECEEDING VOLUME.

Numb. (1.) *For the bloody Flux, or other Fluxes.* See Page 375.

TAKE Japan earth, powder of rhubarb, each equal parts; of which give half a dram at a time every morning faſting.

Numb. (2.) *A good Medicine for the Dropſy.* See p. 376.

NOTE, an infuſion of mechoacan in white-wine (an ounce and a half thin ſliced to a pint) being infuſed twenty-four hours, and drank of every morning for ſome days,

days, is a moſt admirable thing, and if a little muſtard-ſeed be infuſed in it, it will be ſo much the better.

Numb. (3.) *A Medicine for blood-ſhot or inflamed Eyes.* See p. 376.

THERE is no better remedy for inflamed eyes, than to waſh them every day ſeveral times with this: Take frogs-ſpawn-water a pint, ſalt of tartar a dram; mix and diſſolve, and waſh therewith.

Numb. (4.) *A good and innocent Dentrifice.* See p. 376.

BUT that, which exceeds all, is a fine powder of red coral, with which you may rub them two or three times a day, and then waſh them with water in which *ſal prunellæ* is diſſolved.

Numb. (5.) *To prevent or cure an Ague.* See p. 377.

TAKE gratings of angelica-root, flowers of antimony, of each half a dram, choice canary three ounces; infuſe in a cold place for one or two days, and pour off the clear for two doſes: it is a ſingular good vomit for the cure of agues of all ſorts, being given in the morning faſting, four or ſix hours before the coming of the fit; and if it be not a quotidian ague, then on the intermitting day.

Numb. (6.) *An uſeful Drink for the King's-Evil.* See p. 379.

THERE is no better thing in the world for the king's-evil, than to give daily ſome ſpoonfuls of this following liquor: Take white-wine a quart, juice of pellitory of the wall a pint, ſpirit of wine half a pint, *ſal prunellæ* an ounce; mix and diſſolve, then pour off the clear, and ſweeten with white ſugar. Doſe, ſix ſpoonfuls morning and night.

Numb. (7.) *An experienced Remedy to expel Gravel, and provoke Urine.* See p. 379.

TAKE the juice of onions two ſpoonfuls, white-wine half a pint or more; mix them for a draught. It gives preſent eaſe, and, if repeated for ſome time, in a ſhort ſeaſon cures.

Numb. (8.) *An eaſy Medicine for Coſtiveneſs.* See p. 381.

A turpentine clyſter thus made is admirable to cauſe ſtools in a very great coſtiveneſs: Take Straſburg-turpentine an ounce, yolk of one or two eggs; grind them well together, and put thereto a pint of fat mutton-broth, and exhibit it blood-warm.

Numb. (9.) *A Remedy for Gripes and Fluxes.* See p. 382.

A moſt excellent remedy for gripings is a tincture of corn poppy-flowers made with common ſpirit of wine: of this you may give from a ſpoonful to two ſpoonfuls, in ſpirit of opium half an ounce, mixt with black-cherry-water four ounces. This gives eaſe upon the ſpot.

Numb. (10.) *A Medicine for Redneſs of the Eyes.* See p. 382.

IF the redneſs be with a fierce hot rheum, it is from weakneſs of the eyes; and then the only remedy is to waſh them twice or thrice a day with brandy. There is no danger in it, nor will it ſmart much.

Numb. (11.) *An effectual Medicine for a Strain.* See p. 382.

TAKE comfrey-roots (beating them to a pulp) half a pound, powder of Japan earth four ounces, ſpirit of wine a ſufficient quantity; mix and apply it to the part.

Numb. (12.) *For moſt aſthmatic Diſtempers.* See p. 383.

TAKE juice of hyſop, choice honey, of each two pounds: mix, boil, ſcum, and make a ſyrup; of which let the ſick take four ſpoonfuls or more, morning, noon, and night.

Numb. (13.) *An experienced Medicine for an Eryſipelas.* See p. 383.

THE blood of almoſt any living creature is found by many experiments to be a ſpecific againſt an eryſipelas, being often anointed on the affect, or cloth dipt in the ſame being laid moiſt thereon.

Numb. (14.) *A Remedy for the Whites in Women.* See p. 383.

THE beſt of Remedies in this caſe (after due purging) is to give two, three, or four grains of laudanum, and to inject three, four, or ſix times a day this water:

TAKE ſpring-water two quarts, white vitriol, roch-allum, of each two ounces: being in powder, mix and diſſolve. Let it ſettle, and uſe only the clear.

Numb. (15.) *A tried Remedy for Corns.* See p. 384.

TAKE ammoniacum ſtrained, emplaſtrum diapalma, of each an ounce, arcanum corallinum half an ounce, white precipitate two drachms: mix them well together, and apply it only over the corn, being firſt cut as cloſe as it conveniently can be.

Numb. (16.) *A Medicine for Burns and ſtaunching of Blood.* See p. 385.

BUT, for ſtaunching of blood, there are but few medicines which exceed the colcothar of vitriol, whether waſhed and freed from its ſalt, or not waſhed: it is but a common thing, but will do more than a thouſand much more ennobled.

Numb. (17.) *For a ſlight Redneſs of the Eyes.* See p. 385.

ONE of the beſt of remedies againſt redneſs and inflammation of the eyes, is often to waſh them with this water: Take frog-ſpawn-water a pint, common ſpirit of wine four ounces; mix them; waſh herewith five or ſix times a day; and at bedtime apply over the ſore eyes a cataplaſm of a rotten aple.

Numb. (18.) *For the Relaxation of the Uvula.* See p. 385.

THIS common medicine is found very ſucceſsful: the throat being firſt gargled with claret-wine, in which a little roch-allum has been diſſolved, as hot as it can well be endured; then anoint it with this: Take honey one ounce, powder of elecampane two drachms, pepper in powder half a drachm: mix them, and apply it thrice a day with your finger.

Numb. (19.)

Numb. (19.) *A famous Eye-Water.* See p. 385.

TAKE red roſe-water a quart, aloes in fine powder, half an ounce; white vitriol, *vitrum antimonii*, *crocus metallorum*, of each ſix drachms; mix and digeſt warm a month; then uſe the clear water three or four times a day. It has ſcarcely an equal.

Numb. (20.) *A Medicine to prevent running of the Eyes.* See p. 386.

TAKE white-wine half a pint, diſſolve in it white vitriol two drachms; filter or ſtrain, and therein diſſolve choice honey two ounces; with this fill the eyes two or three times a day. It is good againſt moſt diſtempers of the eyes.

Numb. (21.) *A Medicine for the Stone.* See p. 386.

TAKE Straſburgh-turpentine two ounces; grind it well with the yolks of eggs, and then mix herewith this following ſyrup: Take water a pint and a half, ſal prunellæ an ounce and half; mix and diſſolve, and, with honey a pound, boil it into a ſyrup, which add to the former mixture. Doſe, two or three ſpoonfuls morning and night.

Numb. (22.) *A Medicine for ſcorbutic Gums, and to faſten the Teeth.* See p. 387.

THERE is nothing faſtens the teeth better, than to waſh them with this mixture. Take claret-wine a pint, roch-allum half an ounce; mix and diſſolve, and then add thereto ſix ounces of ſtrong tincture of Japan-earth, made with common brandy.

Numb. (23.) *For a Stroke or Bruiſe in the Eye.* See p. 387.

TAKE celandine-water three ounces, ſpirit of ſaffron one ounce; mix them; with which waſh the eyes ſeveral times a day; and (if the eyes be very ſore, red, or blood-ſhot) after waſhing anoint them every time with a little pure virgin-honey.

Numb. (24.) *An excellent Remedy to take off Films from the Eyes.* See p. 387.

TAKE powder of coral levigated one ounce, powder of pearls levigated three drams, crabs-eyes levigated one drachm, virgin-honey two ounces; mix them, and anoint four or five times a day, but chiefly morning and night.

Numb. (25.) *A remedy for the King's-Evil.*

TAKE roots of pile-wort a ſufficient quantity; bruiſe and boil them in hog's-lard, until they are criſp, after which preſs them hard out; and boil in the like manner as many more freſh roots, and preſs out again, doing it the third time; then keep the ointment for uſe, to anoint with morning and night.

Numb. (26). *A Remedy for the Stone.*

GIVE every morning faſting, and every night going to bed, half a drachm of the powder of winter-cherries in a draught of parſley or arſemart water, or in a glaſs of white-wine.

A

DISQUISITION

ABOUT THE

FINAL CAUSES

OF

NATURAL THINGS:

Wherein it is inquired,

Whether, and (if at all) with what Cautions, a Naturalist ſhould admit them?

To which are ſubjoined, by way of

APPENDIX,

SOME

UNCOMMON OBSERVATIONS

ABOUT

VITIATED SIGHT.

The PREFACE.

THERE are not many ſubjects, in the whole compaſs of natural philoſophy, that better deſerve to be inquired into by Chriſtian philoſophers, than that which is diſcourſed of in the following eſſay. For certainly it becomes ſuch men to have curioſity enough to try at leaſt, whether it can be diſcovered, that there are any knowable final cauſes to be conſidered in the works of nature; ſince, if we neglect this inquiry, we live in danger of being ungrateful, in overlooking thoſe uſes of things, that may give us juſt cauſe of admiring and thanking the Author of them, and of loſing the benefits, relating as well to philoſophy as piety, that the knowledge of them may affords us: and if there be no ſuch things, we are more than in danger to miſpend our labour and induſtry, in fruitleſs ſearching for ſuch things as are not to be found. And an inquiry of this kind is now the more ſeaſonable, becauſe two of the chief ſects of the modern philoſophizers do both of

them, though upon differing grounds, deny, that the naturaliſt ought at all to trouble or buſy himſelf about final cauſes. For *Epicurus*, * and moſt of his followers (for I except ſome few late ones, eſpecially the learned *Gaſſendus*) baniſh the conſideration of the ends of things; becauſe the world being, according to them, made by chance, no ends of any thing can be ſuppoſed to have been intended. And, on the contrary, † Monſieur *des Cartes*, and moſt of his followers, ſuppoſe all the ends of God in things corporeal to be ſo ſublime, that it were preſumption in man to think his reaſon can extend to diſcover them. So that, according to theſe oppoſite ſects, it is either impertinent for us to ſeek after final cauſes, or preſumptuous to think we may find them. Wherefore I hope I ſhall be excuſed, if, having been engaged by ſome ſolicitations, wherewith it is needleſs to trouble the reader, I did not decline to try, what the bare, but attentive, conſideration of the ſubject would ſuggeſt to my own thoughts. And though it was eaſy to foreſee, that by this means my friend might miſs of receiving, in my eſſay, divers things that occurred not to me; yet I conſidered on the other ſide, that ſuch things would, notwithſtanding my ſilence, be found in the authors that delivered them; and it was very poſſible, that, by the courſe I took, I might light upon ſome thoughts that I ſhould have miſſed, if I had prepoſſeſſed my mind with the opinions of others; which I was the leſs tempted to do, becauſe an eaſy proſpect of my theme ſufficed to let me ſee I was like to have the Epicureans and Carteſians for my adverſaries, not my aſſiſtants: and for the ſchool-philoſophers, the very ſlight account, that their maſter *Ariſtotle* gives of one of my four queſtions (for of the reſt, as far as I remember, he ſays little or nothing) gave me ſmall hopes of being aided by them; eſpecially ſince in this, as in many other queſtions, they proceed upon grounds that I cannot aſſent to. Anatomiſts indeed, and ſome phyſicians, have done very laudably upon the uſes of the parts of the human body; which I take this occaſion to declare, that it may not be ſuſpected, that I do in the leaſt undervalue their happy induſtry, becauſe I tranſcribe not paſſages out of their books: the reaſons of which omiſſion are, not only, that I had not any one book of anatomy at hand, when I was writing, but that the uſes of the parts of man's body related but to a ſmall part of my diſcourſe; to make which more comprehenſive, I took in the conſideration of more general queſtions, beſides that which was controverted between *Ariſtotle* and the ancienter philoſophers, who diſputed how bodies, that were devoid of knowledge, could act for ends.

THOSE, that reliſh no books in natural philoſophy but ſuch as abound in experiments, are ſeaſonably advertiſed, that I do not invite them to read this treatiſe; wherein I thought it much more ſuitable to the nature of my ſubject and deſign, to declare the works of God, than of men; and conſequently to deliver rather obſervations, than artificial experiments. And even of the former of theſe, though perhaps moſt readers may find, in the enſuing diſcourſe, ſeveral that they have not met with in claſſic authors, yet I ſhall freely acknowledge, that, upon the review I made of what I writ, I find, though too late to repair the omiſſion, that I have left ſeveral things unmentioned, that would have been very pertinent to my ſubject; which may, I hope, be more eaſily excuſed, becauſe, the body of the following diſquiſition having been written many years ago, and thrown by upon the death of the ‡ gentleman, that preſſed me for it, I could not then take notice of thoſe

* *Illud in his rebus vitium vehementer ineſto, Effugere illorumque errorem præmeditemus, Lumina qui faciunt oculorum clara creata proſpicere ut poſſimus*————*Lucr. de rer. nat. lib.* IV. *ſect.* 824.

† *Ita denique nullas unquam rationes circa res naturales, a fine, quem Deus aut natura in iis faciendis ſibi propoſuit, deſumemus; qui non tantum nobis debemus arrogare ut ejus conſiliorum participes eſſe putemus: Carteſius princip. philoſoph. parte prima, artic.* 28.

‡ Mr. *Henry Oldenburg*, Secretary to the Royal Society.

many diſcoveries in anatomy, and other parts of phyſiology, that have ſince been happily made. But perhaps ſome will think I may have more need to excuſe the largeneſs of ſome parts of the following treatiſe, compared with the others. And I ſhould rather grant than anſwer the objection, if I could not alledge, that the contagious boldneſs of ſome baptized Epicureans engaged me to dwell much longer on the third propoſition of the fourth ſection than I at firſt intended. And, on the other hand, the Carteſian opinion having of late made it requiſite to handle the formerly difficult queſtion, about the conſideration of final cauſes, after a new manner, I thought it unfit lightly to paſs over the paradox maintained by ſo great a man, and judged it expedient in ſome places (what I could not do without enlarging) to propoſe thoughts adjuſted to the preſent ſtate of things in this affair; in the management of which, I have had ſo much more regard to ſome other things, than to the ſymmetry of the parts whereof this tract conſiſts, that I will not ſay that I fear I have in it but thrown together materials for a juſt diſcourſe on my ſubject; ſince to do ſo was the main thing I intended. And if the materials be good and ſolid, they will eaſily, in ſo learned an age as this, find an architect, that will diſpoſe them in a more artful way than I was either at leiſure or ſolicitous to do.

A N

E S S A Y,

INQUIRING

Whether, and how, a NATURALIST ſhould conſider FINAL CAUSES.

To my very learned Friend Mr. *H. O.*

S I R,

THOUGH in a book or two of mine, that you have already been pleaſed to peruſe, there are ſome paſſages, whence you may eaſily enough gather what I thought about your queſtions; yet, becauſe the ſubject is of great moment, as well as difficulty, and you may ſuſpect I have altered my opinion, I ſhall, without referring you to writings, which perhaps neither you nor I have at hand, ſet down ſuccinctly, but yet as if I had ſaid nothing of any of them before, my preſent thoughts about theſe four queſtions:

I. WHETHER, generally or indefinitely ſpeaking, there be any final cauſes of things corporeal, knowable by naturaliſts?

II. WHETHER, if the firſt queſtion be reſolved in the affirmative, we may conſider final cauſes in all ſorts of bodies, or only in ſome peculiarly qualified ones?

III. WHE-

III. WHETHER, or in what ſenſe, the acting for ends may be aſcribed to an unintelligent (and even inanimate) body?

IV. AND laſtly, how far, and with what cautions, arguments may be framed upon the ſuppoſition of final cauſes?

SECT. I.

TO begin with the firſt queſtion. Thoſe, that would exclude final cauſes from the conſideration of the naturaliſt, are wont to do it (for aught I have obſerved) upon one of theſe two accounts: either that, with *Epicurus*, they think the world was the production of atoms and chance, without any intervention of a Deity; and that conſequently it is improper and vain to ſeek for final cauſes in the effects of chance: or that they judge, with *Des Cartes*, that, God being an omniſcient agent, it is raſh and preſumptuous for men to think, that they know, or can inveſtigate, what ends He propoſed to Himſelf in his actings about his creatures. The ground, on which the Epicureans have rejected final cauſes, has been diſallowed by the philoſophers of almoſt all other ſects; and ſome have written ſufficient confutations of it, which therefore I ſhall here forbear to inſiſt on; though ſome things I ſhall upon occaſion obſerve, that may help, if not ſuffice, to diſcredit ſo unreaſonable an opinion. But the Carteſian argument has been ſo prevalent among many learned and ingenious men, that it will be worth while (if it be but to excite better pens) to ſpend ſome time in the conſideration of it.

PERHAPS one thing, that alienated that excellent philoſopher from allowing the conſideration of final cauſes in phyſics, was, that the ſchool-philoſophers, and many other learned men, are wont to propoſe it too unwarily, as if there were no creature in the world that was not ſolely, or at leaſt chiefly, deſigned for the ſervice or benefit of man; inſomuch, that I remember I have ſeen a body of divinity, publiſhed by a famous writer, wherein, to prove the opinion he favours, of thoſe, that would have the world annihilated after the day of judgment, he urgeth this argument; that ſince the world was made for the ſake of man in his travelling condition (*hominis viatoris cauſa*) when once man is poſſeſſed of his everlaſting ſtate of happineſs or miſery, there will be no further uſe of the world. The opinion, that gives riſe to ſuch preſumptuous and unwarrantable expreſſions, did, as I gueſs by his objection, more ſhock *Des Cartes*, than I wonder, that it ſhould diſpleaſe him. But the indiſcretion of men ought not to prejudice truth; which muſt not be caſt away, with the unwarrantable conceits, that ſome men have pinned upon it.

WHEREFORE, ſince I cannot entirely cloſe, either with the opinion of the Epicureans, or of the Carteſians, I ſhall leave each party to maintain its own opinion, and proceed to propoſe mine; for the clearing of which, and indeed of the diſquiſition of final cauſes, I ſhall beg leave to premiſe a diſtinction, which, though novel, I ſhall venture to employ, becauſe it compriſes and diſtinguiſhes ſome things, which I think ought neither to be overlooked nor confounded.

I CONCEIVE then, that when we ſpeak of the ends, which nature, or rather the Author of nature, is ſaid to have in things corporeal, one of theſe four things may be ſignified, or, if you like that expreſſion better, the end deſigned by nature may be fourfold:

FIRST, there may be ſome grand and general ends of the whole world, ſuch as the exerciſing and diſplaying the Creator's immenſe power and admirable wiſdom, the communication of his goodneſs, and the admiration and thanks due to Him from his intelligent creatures, for theſe his divine excellencies, whoſe productions manifeſt

his glory. And theſe ends, becauſe they regard the creation of the whole univerſe, I call the univerſal ends of God or nature.

SECONDLY, in a ſomewhat more reſtrained ſenſe, there may be ends deſigned in the number, fabric, placing, and ways of moving the great maſſes of matter, that, for their bulks or qualities, are conſiderable parts of the world; ſince it is very probable, that theſe bodies, ſuch as the ſun, moon, and fixed ſtars, and the terraqueous globe, and perhaps each of its two chief parts, the earth and the ſea, were ſo framed and placed, as not only to be capable of perſevering in their own preſent ſtate, but alſo as was moſt conducive to the univerſal ends of the creation, and the good of the whole world, whereof they are notable parts. Upon which account theſe ends may, for diſtinction's ſake, be called coſmical or ſyſtematical, as regarding the ſymmetry of the great ſyſtem of the world.

THERE is a third ſort of ends, that do more peculiarly concern the parts of animals, (and probably plants too) which are thoſe, that the particular parts of animals are deſtinated to, and for the welfare of the whole animal himſelf, as he is an entire and diſtinct ſyſtem of organized parts, deſtinated to preſerve himſelf and propagate his ſpecies, upon ſuch a theatre (as the land, water, or air) as his ſtructure and circumſtances determine him to act his part on. And theſe ends, to diſcriminate them from others, may be called animal ends.

FOURTHLY, and laſtly, there is another ſort of ends, which, becauſe they relate particularly to man, may, for brevity's ſake, be called human ends; which are thoſe that are aimed at by nature, where ſhe is ſaid to frame animals and vegetables, and other of her productions, for the uſe of man. And theſe ends themſelves may be diſtinguiſhed into mental, that relate to his mind, and corporeal, that relate to his body, not only as he is an animal, framed, like other animals, for his own preſervation, and the propagation of his ſpecies (mankind); but alſo as he is framed for dominion over other animals and works of nature, and fitted to make them ſubſervient to the deſtinations, that one may ſuppoſe to have been made of them to his ſervice and benefit.

THIS diſtinction of final cauſes, which, I hope, will not prove altogether uſeleſs, being premiſed, I ſhall begin my intended diſcourſe, by owning a diſſent from both the oppoſite opinions; theirs, that, with the vulgar of learned men, will take no notice of final cauſes but thoſe we have ſtiled human ones; and theirs, that (as they think with *Des Cartes*) reject final cauſes altogether; ſince, though I judge it erroneous to ſay in the ſtricteſt ſenſe, that every thing in the viſible world was made for the uſe of man, yet I think it is more erroneous to deny, that any thing was made for ends inveſtigable by man.

IT is a known principle of the Carteſian philoſophy, that there is always juſt the ſame quantity of motion in the world at one time that there is at another: of which aſſertion this reaſon is given, that there is no cauſe, why God, who is immutable, ſhould at the beginning of things, when He firſt put matter into motion, have given it ſuch a quantity of motion, as would need to be afterwards augmented or leſſened. But I ſee not how, by this negative way of arguing, thoſe, that employ it, do not (implicitly at leaſt) take upon them to judge of the ends, that God may have propoſed to Himſelf in natural things. For, without a ſuppoſition, that they know what God deſigned in ſetting matter a-moving, it is hard for them to ſhew, that his deſign could not be ſuch, as might be beſt accompliſhed by ſometimes adding to, and ſometimes taking from, the quantity of motion He communicated to matter at firſt. And I think it may be worth conſidering, whether, by this doctrine of theirs, the Carteſians do not more take upon them, than other philoſophers, to

judge of God's deſigns. For, if a man be known to be very wiſe, and have various ways of compaſſing his ſeveral ends, he, that, ſeeing ſome of thoſe ways have a direct tendency to ſome rational end, ſhall conclude that end to be one of thoſe, that is intended, does thereby leſs preſume, and expreſs more reſpect to that wiſe man, than he, that ſhould conclude, that thoſe cannot be his ends, and that he can have no other deſign, knowable by us, except a certain general one named by the aſſertor. And indeed, it ſeems more eaſy to know, that this or that particular thing, for which an engine is proper, may be, among others, intended by the artificer, though never ſo ſkilful, than to know negatively, that he can have no other, than ſuch or ſuch an end.

And how will a Carteſian aſſure me, that, among the many ends, that he grants that God may have propoſed to Himſelf in the production of his mundane creatures, one may not be, that we, whom He has vouchſafed to make intelligent beings, and capable of admiring and praiſing Him, ſhould find juſt cauſe to do ſo, for the wiſdom and goodneſs He has diſplayed in the world? which attributes we could not well diſcern or celebrate, unleſs we knew as well, that the creatures were made for ſuch uſes, as that they are exceedingly well fitted for them. I know God's immutability is alledged, to prove, that the quantity of motion is never varied; but to me it is not evident, why God's having particular ends, though ſome of them ſeem to require a change in his way of acting in natural things, muſt be more inconſiſtent with his immutability, than his cauſing many things to be brought to paſs, which though *ab æterno* he decreed to do, are yet not actually done, unleſs in proceſs of time. And particularly it ſeems not clear, why God may not as well be immutable, though He ſhould ſometimes vary the quantity of motion, that He has put into the world, as He is, though, according to the opinion of moſt of the Carteſians themſelves, He does daily create multitudes of rational ſouls, to unite them to human bodies; eſpecially conſidering, that theſe newly created ſubſtances are, according to *Des Cartes*, endowed with a power to determine and regulate the motions of the ſpirits and the conarion, which are things clearly corporeal. I ſay not this, as if I abſolutely rejected the Carteſian doctrine, about the continuance of the ſame quantity of motion in the whole maſs of matter; for, whether or no it be a truth, I think it no unuſeful nor improbable hypotheſis; and I have not ſo much argued againſt it, as upon the grounds on which they argue for it.

Wherefore, to come now to the thing itſelf, whereas monſieur *Des Cartes* objects, that it is a preſumption for man to pretend to be able to inveſtigate the ends, that the omniſcient God propoſed to Himſelf in the making of his creatures; I conſider, by way of anſwer, that there are two very differing ways, wherein a man may pretend to know the ends of God in his viſible works: for, he may either pretend to know only ſome of God's ends, in ſome of his works; or he may pretend to know all his ends. He, that arrogates to himſelf to diſcover God's ends in this latter ſenſe, will ſcarce be excuſed from a high preſumption, and no leſs a folly, from the reaſon lately intimated in the Carteſian objection. But to pretend to know God's ends in the former ſenſe, is not a preſumption, but rather to take notice of them is a duty. For there are ſome things in nature ſo curiouſly contrived, and ſo exquiſitely fitted for certain operations and uſes, that it ſeems little leſs than blindneſs in him, that acknowledges, with the Carteſians, a moſt wiſe Author of things, not to conclude, that, though they may have been deſigned for other (and perhaps higher) uſes, yet they were deſigned for this uſe. As he, that ſees the admirable fabric of the coats, humours, and muſcles of the eyes, and how excellently all the parts are adapted to the making up of an organ of viſion, can ſcarce forbear to believe, that the Author

of

of nature intended it ſhould ſerve the animal to which it belongs, to ſee with. The Epicureans indeed, that believe the world to have been produced but by the caſual concourſe of atoms, without the intervention of any intelligent being, may have a kind of excuſe, whereof other philoſophers are deſtitute, that acknowledge a Deity, if not alſo a Providence. For the very ſuppoſition, for inſtance, that a man's eyes were made by chance, argues, that they need have no relation to a deſigning agent; and the uſe, that a man makes of them, may be either caſual too, or at leaſt may be an effect of his knowledge, not of nature's. But when, upon the anatomical diſſection, and the optical conſideration, of a human eye, we ſee it is as exquiſitely fitted to be an organ of ſight, as the beſt artificer in the world could have framed a little engine, purpoſely and mainly deſigned for the uſe of ſeeing; it is very harſh and incongruous to ſay, that an artificer, who is too intelligent either to do things by chance, or to make a curious piece of workmanſhip, without knowing what uſes it is fit for, ſhould not deſign it for an uſe, to which it is moſt fit.

It is not to be denied, that He may have more uſes for it than one, and perhaps ſuch uſes as we cannot divine: but this hinders not, but that, among its ſeveral uſes, this, to which we ſee it ſo admirably adapted, ſhould be thought one. And I ſee not, how it does magnify God's wiſdom, or expreſs our veneration of it, to exclude, out of the number of his ends in framing human eyes, that moſt obvious and ready uſe, which we are ſure is made of them, and which they could not be better fitted for. This may perhaps be not unfitly illuſtrated by the following compariſon, whereof the application were ſuperfluous. Suppoſe that a countryman, being in a clear day brought into the garden of ſome famous mathematician, ſhould ſee there one of thoſe curious gnomonic inſtruments, that ſhew at once the place of the ſun in the zodiac, his declination from the æquator, the day of the month, the length of the day, *&c.* It would indeed be preſumption in him, being unacquainted both with the mathematical diſciplines, and the ſeveral intentions of the artiſt, to pretend or think himſelf able to diſcover all the ends, for which ſo curious and elaborate a piece was framed: but when he ſees it furniſhed with a ſtyle, with horary lines and numbers, and, in ſhort, with all the requiſites of a ſun-dial, and manifeſtly perceives the ſhadow to mark, from time to time, the hour of the day, it would be no more a preſumption than an error in him to conclude, that (whatever other uſes the inſtrument is fit or was deſigned for) it is a ſun-dial, that was meant to ſhew the hour of the day.

AND here I ſhall demand of thoſe, that will not allow us to think, that any natural things are directed to ends knowable by men; whether, if the divine Author of them had really deſigned them for ſuch ends, the things themſelves are not ſo framed and directed, as in that caſe they ſhould be? and whether the fabric and management of natural things do really countenance or contradict our ſuppoſition?

FOR my part, after what has been already diſcourſed, I ſcruple not to confeſs, that I ſee not, why it ſhould be reputed a diſparagement to the wiſdom of any agent whatſoever, to think, that his productions were deſigned for ſuch ends, among others, as they are excellently framed and fitted for; unleſs it did appear, that thoſe ends were unworthy to be deſigned by the wiſe agent. But that cannot be juſtly ſaid in our preſent caſe; ſince it is not injurious to the divine Author of things, to believe that ſome of the ends, to which He deſtinated divers of his corporeal works, were, to exert and communicate his exuberant goodneſs, and to receive from his intelligent creatures, ſuch as men, an ardent love, a high admiration, and an obſequious gratitude, for having diſplayed ſo much wiſdom and beneficence, in exquiſitely qualifying his works to be wonderfully ſerviceable to one another, and a great number of them to be particularly ſubſervient to the neceſſities and utilities of man.

AND

And indeed I can by no means aſſent to that aſſertion of M. *Des Cartes*, * That it cannot be ſaid, that ſome of God's ends (in his corporeal works) are more manifeſt than others; but that all of them lie equally hid in the abyſs of the divine Wiſdom; ſince there are many of his creatures, ſome of whoſe uſes are ſo manifeſt and obvious, that the generality of mankind, both philoſophers and plebeians, have in all ages, and almoſt in all countries, taken notice of and acknowledged them. And as to what he adds, (by which he ſeems to intimate the motive that led him to make the forementioned aſſertion) that, in phyſics, all things ought to be made out by certain and ſolid reaſons; to this I anſwer, firſt, that I ſee not, why the admitting, that the Author of things deſigned ſome of his works for theſe or thoſe uſes, amongſt others, may not conſiſt with the phyſical accounts of making of thoſe things; as a man may give a mechanical reaſon of the ſtructure of every wheel and other part of a watch, and of their way of acting upon one another, when they are rightly put together, and, in ſhort, of the contrivance and phænomena of the little machine; though he ſuppoſe, that the artificer deſigned it to ſhew the hours of the day, and though he have that intended uſe in his eye, whilſt he explicates the fabric and operations of the watch. I anſwer, ſecondly, that I readily admit, that in phyſics we ſhould indeed ground all things upon as ſolid reaſons as may be had; but I ſee no neceſſity, that thoſe reaſons ſhould be always preciſely phyſical; eſpecially if we be treating, not of any particular phænomenon, that is produced according to the courſe of nature eſtabliſhed in the world, already conſtituted as this of ours is; but of the firſt and general cauſes of the world itſelf; from which cauſes, I ſee not, why the final cauſes, or uſes, that appear manifeſtly enough to have been deſigned, ſhould be excluded. And to me it is not very material, whether or no, in phyſics, or any other diſcipline, a thing be proved by the peculiar principles of that ſcience or diſcipline, provided it be firmly proved by the common grounds of reaſon. And on this occaſion let me obſerve, that the fundamental tenets of M. *Des Cartes*'s own philoſophy are not by himſelf proved by arguments ſtrictly phyſical, but either by metaphyſical ones, or the more catholic dictates of reaſon, or the particular teſtimonies of experience. For when, for inſtance, he truly aſcribes to God all the motion that is found in matter, and conſequently all the variety of phænomena that occur in the world; he proves not, by an argument preciſely phyſical, that God, who is an immaterial agent, is the efficient cauſe of motion in matter; but only by this, that, ſince motion does not belong to the eſſence and nature of matter, matter muſt owe the motion it has to ſome other being: and then it is moſt agreeable to common reaſon to infer, that ſince matter cannot move itſelf, but it muſt be moved by ſome other being, that being muſt be immaterial, ſince otherwiſe ſome matter muſt be able to move itſelf, contrary to the hypotheſis. And when *Des Cartes* goes to demonſtrate, that there is always in the univerſe the ſelf-ſame quantity of motion, (that is, juſt as much at any one time, as at any other) and conſequently, that as much motion as one body communicates to another, it loſes itſelf; he proves it by the immutability of God, which is not a phyſical argument ſtrictly ſo called, but rather a metaphyſical one; as he formerly proved God's being the cauſe of all motion in matter, not by principles peculiar to phyſics, but by the common grounds of reaſon.

† Though *Monſieur Des Cartes* does, as I have formerly ſhewn, ſpeak very dogmatically and univerſally againſt men's endeavouring or pretending to know any final cauſes

* *Nec fingi poteſt, aliquos Dei fines, magis quam alios, in propatulo eſſe; omnes enim in imperſcrutabili ejus ſapientiæ abyſſo ſunt eodem modo reconditi. Reſp. Quart. ad object. Gaſſendi.*

† *C'eſt une choſe, qui de ſoy eſt manifeſte, que nous ne pouvons connoiſtre les fins de Dieu, ſi luy meſme ne nous les revele. Et encore qu'il ſoit vray en morale, eu egard a nous autres hommes, qui toutes choſes ont eſte faites pour la gloire*

cauſes in natural things; for which reaſon I have, as well as the generality of his other readers, and even his diſciples, looked upon the ſenſe of thoſe poſitive expreſſions, as containing his opinion; yet, ſince I writ the foregoing part of this treatiſe, I lighted on a paſſage of his, wherein he ſeems to ſpeak more cautiouſly or reſervedly, oppoſing his reaſoning to their opinion, who teach, that God hath no other end, in making the world, but that of being praiſed by men. But in that ſhort diſcourſe, whereof this paſſage is a part, there are two or three other things, wherein I cannot acquieſce. As firſt, that it is ſelf-evident, that we cannot know the ends of God, unleſs He Himſelf reveal them to us; (he muſt mean in a ſupernatural way, if he will not ſpeak impertinently): for what he ſays to be evident of itſelf, is not at all ſo to the generality of mankind, and even of philoſophers; and therefore, I think, it ought not to be barely pronounced, but (if it can be) ſhould be proved. And next, he does not ſhew, how we are obliged to praiſe God for his works, if He had no intention to have us do ſo, or that we ſhould diſcover any of the ends for which He made them. If a judicious man ſhould ſee a great book, written in ſome Indian language, which he is utterly a ſtranger to, and ſhould know nothing of it, but that it was made by a very intelligent phyſician; he might indeed conclude, that the work was not made by chance, but would have no means to be convinced, by the inſpection of the book itſelf, that it was compoſed with great ſkill and kindneſs, and deſerved his praiſe and thanks; ſince he could not know any of the particular ends, to which the ſeveral chapters of it were deſtinated, nor conſequently diſcover how ſkilfully they were fitted to reach ſuch ends. What *Des Cartes* ſays, that it is childiſh and abſurd to think, that God had created the ſun, which is many times bigger than the earth, only to afford light to man, who is but a ſmall part of it, is ſomewhat invidiouſly propoſed; there being few able writers, that confine the utility of the ſun directly to the affording light to man; and the littleneſs of his bulk ought not to make it thought abſurd, that God may have had an eſpecial eye to his welfare, in framing that bright globe; ſince not only, for aught appears to us, that moſt excellent engine of man's body is a more admirable thing than the ſun, but the rational and immortal ſoul, that reſides in it, is incomparably more noble than a thouſand maſſes of brute matter, and that not ſo much as organized, can be juſtly reputed, (as will be hereafter more fully declared.) And ſince, in this very diſcourſe, the acute author of it confeſſes, that we may know the ends of God's corporeal works, if He reveal them to us; a Chriſtian philoſopher may be allowed to think the ſun was made, among other purpoſes, to enlighten the earth, and for the uſe of man, ſince the ſcripture teaches us, that not only the ſun and moon, but the ſtars of the firmament, which *Des Cartes* not improbably thinks to be ſo many ſuns, were made to give light to the earth, and were divided to all the nations that inhabit it. Perhaps it were not raſh to add, that I ſee not, why the belief, that a man may know ſome of God's ends in things corporeal, ſhould more derogate from our veneration of his wiſdom, than to think we know ſome of his ends in other matters, of which the ſcripture furniſhes us with a multitude of inſtances, as (particularly) that of *Job* ſacrificing for his friends; and the declared uſes of the Urim and Thummim: ſince God may, if He pleaſes, declare truths to men, and inſtruct them, by his creatures and his actions, as well as by his words: as when

Deut. iv. 19.

gloire de Dieu, a cauſe que les hommes ſont obligez de louer Dieu pour tous ſes ouvrages; & qu'on puiſſe auſſi dire, que le ſoleil a eſté fait pour nous eclairer, pour ce que nous experimentons, que le ſoleil en effet nous eclaire: ce ſeroit toutesfois une choſe puerile & abſurde, d'aſſurer en metaphyſique, que Dieu, a la façon d'un homme ſuperbe, n'auroit point eu d'autre fin en baſtiſſant le monde, que celle d'eſtre loue par les hommes; et qu'il n'auroit cree le ſoleil, qui eſt pluſieurs fois plus grand que la terre, a autre deſſein, que d'eclairer l'homme, qui n'en occupe qu'une tres petite partie.

He

He taught *Noah* by the rain bow, and *Jonah* by a gourd and a worm, and regulated the incampment of the *Iſraelites* by the guidance of a cloud and a fiery pillar. Laſtly, whereas *Monſieur des Cartes* objects, that thoſe, he diſſents from, talk, as if they looked upon God as a proud man, who deſigned his works only to be praiſed for them; I know not, whether in this place he ſpeaks ſo cautiouſly and reverently of God as he ought, and elſewhere is wont to do. For as humility, though it be a virtue in men, is extremely remote from being any of God's perfections; ſo that may be pride in a man, who is but a creature, imperfect, dependent, and hath nothing that he has not received, which would be none at all in God, who is uncapable of vice, and who may, if He pleaſe, juſtly propoſe to Himſelf his own glory for one of his ends, and both require and delight to be praiſed by men for his works; ſince He is moſt worthy of all praiſe, and it is their duty and reaſonable ſervice, which He is graciouſly pleaſed to approve of, to pay it Him.

It is not without trouble, that I find myſelf obliged, by the exigency of my deſign, ſo much to oppoſe, in ſeveral places of this preſent diſcourſe, ſome ſentiments of *M. Des Cartes*, for whom otherwiſe I have a great eſteem, and from whom I am not forward to diſſent: and this I the rather declare to you, becauſe I am not at all of their mind, that think *M. Des Cartes* a favourer of atheiſm, which, to my apprehenſion, would ſubvert the very foundation of thoſe tenets of mechanical philoſophy that are particularly his. But judging, that his doctrine (at leaſt as it is underſtood by ſeveral of his followers, as well as his adverſaries) about the rejection of final cauſes from the conſideration of naturaliſts, tends much to weaken (as is elſewhere noted) if not quite to deprive us of one of the beſt and moſt ſucceſsful arguments to convince men that there is a God, and that they ought to admire, praiſe, and thank Him; I think it my duty to prefer an important truth before my reſpect to any man, how eminent ſoever, that oppoſes it, and to conſider more the glory of the great Author of nature, than the reputation of any one of her interpreters.

And to ſtrengthen what I have been ſaying, give me leave to mind you more expreſly here of what I have elſewhere intimated, *viz.* that the excellent contrivance of the great ſyſtem of the world, and eſpecially the curious fabric of the bodies of animals, and the uſes of their ſenſories, and other parts, have been made the great motives, that in all ages and nations induced philoſophers to acknowledge a Deity, as the author of theſe admirable ſtructures; and that the nobleſt and moſt intelligent praiſes, that have been paid Him by the prieſts of nature, have been occaſioned and indited by the tranſcending admiration, which the attentive contemplation of the fabric of the univerſe, and of the curious ſtructures of living creatures, juſtly produced in them. And therefore it ſeems injurious to God, as well as unwarrantable in itſelf, to baniſh from natural philoſophy the conſideration of final cauſes; from which chiefly, if not only, I cannot but think (though ſome learned men do otherwiſe) that God muſt reap the honour, that is due to thoſe glorious attributes, his wiſdom, and his goodneſs. And I confeſs I ſometimes wonder, that the Carteſians, who have generally, and ſome of them ſkilfully, maintained the exiſtence of a Deity, ſhould endeavour to make men throw away an argument, which the experience of all ages ſhews to have been the moſt ſucceſsful (and in ſome caſes the only prevalent one) to eſtabliſh, among philoſophers, the belief and veneration of God. I know the *Carteſians* ſay, that their maſter has demonſtrated the exiſtence of a God, by the innate idea, that men have of a being infinitely perfect, who left it upon the mind of man, as the mark of an artiſt impreſt upon his work: and alſo, that they aſcribe to God the having made matter out of nothing, and alone put it into motion; which ſufficiently argue the immenſity of his power. But though I would by no means weaken the argu-

ment drawn from the inbred notion of God, ſince I know, that divers learned men have acquieſced in it; yet, on the other ſide, I ſee not, why we may not reaſonably think, that God, who, as themſelves confeſs, has been pleaſed to take care men ſhould acknowledge Him, may alſo have provided for the ſecuring of a truth of ſo great conſequence, by ſtamping characters, or living impreſſes, that men may know his wiſdom and goodneſs by, as well without, upon the world, as within, upon the mind. The bare ſpeculation of the fabric of the world, without conſidering any part of it, as deſtinated to certain (or determinate) uſes, may ſtill leave men unconvinced, that there is any intelligent, wiſe, and provident Author and Diſpoſer of things; ſince we ſee generally the *Ariſtotelians* (before ſome of them were better inſtructed by the Chriſtian religion) did, notwithſtanding the extent, ſymmetry, and beauty of the world, believe it to have been eternal. And though they, whatever their maſter thought, did not believe it to have been created by God; yet, becauſe they aſſerted, that animals, plants, *&c.* act for ends, they were obliged to acknowledge a provident and powerful being, that maintained and governed the univerſe, which they called nature; though they too often dangerouſly miſtook, by ſometimes confounding this being with God himſelf, and at other times ſpeaking of it as coordinate with Him, as in that famous axiom of *Ariſtotle*, *Deus & natura nihil faciunt fruſtra.* I acknowledge therefore, that, as I ſet a juſt value upon the *Carteſian* proof of God's exiſtence, ſo I ſee no reaſon, why we ſhould diſfurniſh ourſelves of any other ſtrong argument to prove ſo noble and important a truth; eſpecially, ſince the *Carteſian* way of conſidering the world is very proper indeed to ſhew the greatneſs of God's power, but not, like the way I plead for, to manifeſt that of his wiſdom and beneficence. For, whereas a *Carteſian* does but ſhew, that God is admirably wiſe, upon the ſuppoſition of his exiſtence; in our way the ſame thing is manifeſted by the effect of a wiſdom, as well as power, that cannot reaſonably be aſcribed to any other than a moſt intelligent and potent Being: ſo that by this way men may be brought, upon the ſame account, both to acknowledge God, to admire Him, and to thank Him.

SECT. II.

TO give you now my thoughts of the ſecond queſtion, *viz. Whether we may conſider final cauſes in all ſorts of bodies, or only in ſome peculiarly qualified ones*; I muſt divide natural bodies into animate or inanimate. The former of which terms I here take in the larger ſenſe of thoſe, who under it comprehend, not only animals, but vegetables; though I ſhall not diſdainfully reject the opinion of thoſe learned men, that are unwilling to allow plants a ſoul or life, at leaſt as properly ſo called as that which is confeſſedly granted to animals.

OF the inanimate bodies of the univerſe, the nobleſt, and thoſe, which, on this occaſion, deſerve chiefly to be conſidered, are the ſun, planets, and other cœleſtial bodies. For, when men ſaw thoſe vaſt and luminous globes, and eſpecially the ſun, move ſo conſtantly, and ſo regularly, about the earth, and diffuſe on it light and heat; and by their various revolutions produce day and night, ſummer and winter, and the viciſſitudes of ſeaſons, that are ſo opportune for the inhabitants of the earth: the obſervers, I ſay, of all this concluded, both that theſe motions were guided by ſome divine Being, and that they were deſigned for the benefit of man. Whether this be a demonſtrative concluſion, I ſhall not now debate; but I ſee not, why it may not have thus much of probability in it, that in caſe a man ſhall think, that the fabric of the cœleſtial parts of the world was the curious production of an intelligent and

divine Agent, the regular phænomena of the heavens will not contradict him; ſince there is nothing in that fabric that miſbecomes a divine Author; and the motions and operations of the ſun and ſtars are not ſuch, but that they will allow us to think, that, among other purpoſes, they were made to illuminate the terreſtrial globe, and bring heat and other benefits to the inhabitants of it: ſo that the contemplation of the heavens, which ſo manifeſtly *declare the glory of God*, may juſtly excite men, both to admire his power and wiſdom in them, and to return Him thanks and praiſes for the great benefits, that accrue to us by them. Ps. xix. 1.

But now, on the other ſide, it may be ſaid, that in bodies inanimate, whether the portions of matter they conſiſt of be greater or leſſer, the contrivance is very rarely ſo exquiſite, but that the various motions and occurſions of the parts of matter may be, without much improbability, ſuſpected to be capable, after many eſſays, to caſt one another into divers of thoſe circumvolutions of matter, that, I remember, *Epicurus* calls συσφαῖρας, and *Des Cartes vortices*; which, being once made, may continue very long, by the means expreſſed by *Carteſius*, or by ſome other as probable ones. But, without allowing this hypotheſis to be more than not very improbable, when I conſider, what cauſes there may be to fear, that we are not yet ſufficiently acquainted with the true ſyſtem of the world, and are not uſually ſenſible enough, how ſmall a part we, and the terreſtrial globe we inhabit, make of the univerſe; I am apt to fear too, that men are wont, with greater confidence than evidence, to aſſign the ſyſtematical ends and uſes of the cœleſtial bodies, and to conclude them to be made and moved only for the ſervice of the earth and its inhabitants. And though, even as a meer naturaliſt, I will not deny, that, as man actually receives benefits by the eſtabliſhed order and motion of the ſtars, ſo one of the ſeveral uſes intended by the Author of nature in them may particularly reſpect men; yet I am apt to think, that, by what we hitherto know, it will not be eaſy to be proved, that ſome, at leaſt, of the cœleſtial bodies and motions may not be intended more for other purpoſes, than to caſt their beams, or ſhed their influences (ſuppoſing they have ſome) upon the earth. And, at leaſt, I cannot but think, that the ſituations of the cœleſtial bodies do not afford by far ſo clear and cogent arguments of the wiſdom and deſign of the Author of the world, as do the bodies of animals and plants. And, for my part, I am apt to think, there is more of admirable contrivance in a man's muſcles, than in (what we yet know of) the cœleſtial orbs; and that the eye of a fly is (at leaſt as far as appears to us) a more curious piece of workmanſhip than the body of the ſun.

As for other inanimate bodies, as ſtones, metals, &c. whoſe matter ſeems not organized, though there be no abſurdity to think, that they were made for diſtinct particular purpoſes, if not alſo for human uſes; yet moſt of them are of ſuch eaſy and unelaborate contextures, that it ſeems not abſurd to think, that various occurſions and juſtlings of the parts of the univerſal matter may at one time or other have produced them; ſince we ſee in ſome chymical ſublimations, and chriſtallizations of mineral and metalline ſolutions, and ſome other phænomena, where the motions appear not to be particularly guided and directed by an intelligent cauſe, that bodies of as various contextures, as thoſe are wont to be, may be produced; of which I have elſewhere given ſome inſtances.

If it be objected, that if we allow chance, or any thing elſe, without the particular guidance of a wiſe and all-diſpoſing Cauſe, to make a finely ſhaped ſtone, or a metalline ſubſtance, growing, as I have ſometimes ſeen ſilver to do, in the form of a plant, it ought not to be denied, that chance may alſo make vegetables and animals, I can by no means allow the conſequence. There are ſome effects, that are ſo eaſy, and

ſo ready to be produced, that they do not infer any knowledge or intention in their cauſes; but there are others, that require ſuch a number and concourſe of conſpiring cauſes, and ſuch a continued ſeries of motions or operations, that it is utterly improbable they ſhould be produced without the ſuperintendency of a rational Agent, wiſe and powerful enough to range and diſpoſe the ſeveral intervening agents and inſtruments, after the manner requiſite to the production of ſuch a remote effect. And therefore it will not follow, that if chance could produce a ſlight contexture in a few parts of matter, we may ſafely conclude it able to produce ſo exquiſite and admirable a contrivance as that of the body of an animal. What then, if ſometimes in ſawing pieces of variegated marble, men happen, though rarely, to meet with the delineations or pictures (ſome of which I have beheld with pleaſure) of towns, woods, and men? for, beſides that the pleaſingneſs and rarity of ſuch ſpectacles inclines the imagination to favour them, and ſupply their defects; would any wiſe man therefore conclude, that a real town or wood, much leſs numbers of men, ſhould be made by ſuch a fortuitous concourſe of matter? What compariſon is there betwixt the workmanſhip, that ſeems to be expreſſed in a few irregular lines drawn upon a plane ſuperficies, and perhaps two or three colours luckily placed, and the great multitude of nerves, veins, arteries, ligaments, tendons, membranes, bones, glandules, *&c.* that are required to the compleating of a human body; of which numerous parts (for the bones alone are reckoned to amount to three hundred) every one muſt have its determinate ſize, figure, conſiſtence, ſituation, connexion, *&c.* and many, or all of them together, muſt conſpire to ſuch and ſuch determinate functions or uſes? And indeed, though I keep by me ſome curious ones, yet I never ſaw any inanimate production of nature, or, as they ſpeak, of chance, whoſe contrivance was comparable to that of the meaneſt limb of the deſpicableſt animal: and there is incomparably more art expreſſed in the ſtructure of a dog's foot, than in that of the famous clock at *Straſburg*.

AND though the paw of a dog will be confeſſed to be of a ſtructure far inferior to that of the hand of a man; yet even this, however *Ariſtotle* prettily ſtiles it the inſtrument of inſtruments, is a leſs conſiderable inſtance to my preſent purpoſe, than another inſtance, which therefore, ſince my intended brevity permits me not to conſider many, I ſhall pitch upon, as that, which I ſhall almoſt only inſiſt on in the following part of this tract: and this inſtance is afforded me by the eye. For though the parts, that concur to make up that admirable organ of viſion, are very numerous, yet how little any of them could have been ſpared or altered, unleſs for the worſe, may appear by that great number of diſeaſes, that have been obſerved in that little part of the body: ſince each of thoſe diſeaſes conſiſt in this, that ſome of the coats, humours, or other parts of the eye, are brought into a ſtate differing from that, whereto nature had deſigned it, and whereinto ſhe had put it. It would be tedious ſo much as to enumerate the ſeveral diſtempers of the eye, whereunto phyſicians have given particular names; wherefore I ſhall only mention two or three things, wherein one would ſcarce imagine, that a ſmall receſs from the natural ſtate could bring any conſiderable, or perhaps ſenſible, inconvenience. That, which we call the pupil, is not (you know) a ſubſtantial part of the eye, but only a hole of the uvea; which aperture is almoſt perpetually changing its bigneſs, according to the differing degrees of light that the eye chances from time to time to be expoſed to: and therefore one would not think, but that, whilſt this hole remains open, it performs well enough its part, which is, to give admiſſion to the incident beams of light, whether direct or reflected. And yet I lately ſaw and diſcourſed with a woman, who, after a fever, was not able to dilate the pupils of her eyes as formerly; and

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though they were ſo very little narrower than ordinary, that I ſhould ſcarce have taken any notice that it was at all ſo, if ſhe had not told me of it, yet ſhe complained ſhe had thereby almoſt loſt her ſight, ſeeing objects in certain lights but very dimly and imperfectly. And though the præternatural conſtriction of the pupil be not a frequent diſtemper, yet it is not ſo rare, but that phyſicians have given it a place among the ſtated diſeaſes of the eye. And, on the other ſide, though it appear by what hath been newly related, that a competent wideneſs of the pupil is requiſite to clear and diſtinct viſion, yet, if its wideneſs exceed due limits, there is produced that diſtemper called *dilatatio pupillæ*; which is worſe than the former, becauſe it oftentimes deprives the patient almoſt totally of his ſight. And though it may ſeem but a ſlight circumſtance, that the tranſparent coats of the eye ſhould be devoid of colour, and of as little moment, that the *cornea* ſhould be very ſmooth, provided it be tranſparent; yet, when either of theſe circumſtances is wanting, the ſight may be much vitiated: as we ſee, that in the yellow-jaundice, when it is come to a high degree, the adventitious tincture, wherewith the eye is imbued, makes men think they ſee a yellowneſs in many objects, to which that colour does not belong. And I know an ingenious gentleman, who having had a ſmall *puſtula* excited and broken upon the *cornea*, though the eye have been long whole; yet a very little inequality or depreſſion, that ſtill remains upon the ſurface of the tranſparent *cornea*, does ſo affect him, that, though he can read well in a room, yet, when he comes into the open fields or the ſtreets, he for a pretty while (as himſelf has particularly complained to me) thinks many of the objects he looks on very glaring, and ſees many others, as men do ſtones at the bottom of a brook or running water; which I impute to the want of uniformity in the refraction of thoſe reflected beams of light that fall upon the *cornea*, whoſe ſurface is not ſo ſmooth and equal as it ſhould be.

To give ſome further proof, that the eye was made with deſign, I ſhall here take notice of an obſervation or two, that do not occur in the diſſection of a human eye, and therefore are not wont to be mentioned by anatomiſts.

I HAVE obſerved in frogs (as I preſume ſome others alſo may have done) that, beſides thoſe parts of the eye, which they have in common with men, dogs, cats, and the moſt part of other animals, they have a peculiar, whether membrane or cartilage, or both, which ordinarily is not perceived, wherewith they can at pleaſure cover the eye, without too much hindering the ſight, becauſe this membrane is as well tranſparent as ſtrong; ſo that it may paſs for a kind of moveable *cornea*, and (if I may ſo call it) a kind of falſe-ſcabbard to the eye. In furniſhing frogs with this ſtrong membrane, the providence of nature ſeems to be conſpicuous: for they being amphibious animals, deſigned to paſs their lives in watery places, which for the moſt part abound with ſedges, and other plants endowed with ſharp edges or points, and the progreſſive motion of this animal being to be made, not by walking, but by leaping; if his eyes were not provided of ſuch a ſheath as I have been mentioning, he muſt either ſhut his eyes, and ſo leap blindly, and by conſequence dangerouſly, or, by leaving them open, muſt run a venture to have the *cornea* cut, prickt, or otherwiſe offended, by the edges or points of the plants, or what may fall from them upon the animal's eyes: whereas this membrane, as was ſaid, is like a kind of ſpectacle, that covers the eye without taking away the ſight; and as ſoon as the need of employing it is paſt, the animal at pleaſure withdraws it into a little cell, where it reſts out of the way, till there be occaſion to uſe it again. This you may ſee, if you apply the point of a pin, or a pen, or any ſuch ſharp thing, to the eye of a frog, whilſt you hold his head ſteady: for, to ſcreen his eye, he will preſently cover it (at leaſt for the greateſt part) with this membrane, which, when the danger is over,

he will again withdraw. And becauſe many, if not moſt ſorts of birds are wont or deſtinated to fly (as more would do if not kept tame) among the branches of trees and buſhes; leſt the prickles, twigs, leaves, or other parts, ſhould wound or offend their eye, nature hath given them ſuch another kind of horny membrane, as we have been mentioning in frogs.

IT is known, that men, and the generality of four-footed beaſts, and of birds, have ſeveral muſcles belonging to their eyes; by the help of which muſcles they can turn them this way, or that way, at pleaſure; and ſo can obvert the organ of ſenſe to the object, whether it be placed on the right hand or the left, or above or beneath the eye. But nature having not given that mobility to the eyes of flies, (the reaſon whereof I ſhall not now ſtay to conſider) ſhe hath in recompenſe furniſhed them with a multitude of little protuberant parts, finely ranged upon the convex of their large and protuberant eyes: ſo that by the means of the number of theſe little ſtuds (if I may ſo call them) many beams of light, that rebound from objects placed on either hand, or above, or beneath, the level of the eye, fall conveniently enough upon that organ, to make the objects they come from viſible to the animal; which you will the more eaſily believe, if you contemplate (as I have often done with great pleaſure) even the eye of an ordinary fleſh-fly, (for bees and other greater inſects have immoveable eyes too, but I find them not ſo pretty) in a good microſcope and a clear day; for you may reckon ſome hundreds of theſe little round protuberances curiouſly ranged on the convexity of a ſingle eye.

BUT perhaps ſome, whoſe partiality for chance makes them willing to aſcribe the ſtructures of animals rather to that, than to a deſigning cauſe, will make them draw an objection, fit here to be obviated, againſt our doctrine, from what we have obſerved of the difference between human and other eyes; ſince they will pretend, that all organs of ſight ought to be conformed to thoſe of men, as thoſe that are the beſt and moſt perfect. It is true, that man being juſtly reputed the moſt perfect of animals, it is not ſtrange that he ſhould (as men generally do) preſume, that his eyes and other parts of his body are the beſt contrived of any, that are to be found in nature. But yet I think we cannot from hence ſafely conclude, that all eyes, which in other animals are of ſtructures differing from thoſe of man, are for that reaſon defective. For I conſider, firſt, that the admirable wiſdom diſplayed by the Author of things, in fitting the eyes, and other organical parts of animals, for the uſes that ſeem manifeſtly to have been deſigned in their fabric, and for the reſpective functions we actually ſee them exerciſe, may juſtly perſuade us, that the things, whoſe reaſons or uſes we do not alike diſcern, are yet moſt wiſely conſtituted; ſuch an author as God having too much knowledge to do any thing unſkilfully, and we having too much preſumption, if we think He can have, in the framing of his creatures, no ends that are beyond our diſcovery. And, ſecondly, we may repreſent, that the eye is not to be conſidered abſtractedly as an inſtrument of viſion, but as an inſtrument belonging to an animal of this or that kind, and who is ordinarily to make uſe of it in ſuch and ſuch circumſtances. And therefore I think it ought not at all to diſparage, but rather highly recommend, the wiſdom and providence of the great Author of things, that He has furniſhed various ſpecies of animals with organs of ſight, that are very differingly framed and placed; ſince this diverſity notably manifeſts his great providence, and (if I may ſo call it) forecaſt, that has admirably ſuited the eyes of the differing kinds of animals both to the reſt of their bodies, and (which I here mainly conſider) to thoſe parts of the great theatre of the world, on which He deſigns that they ſhall live and act. Thus, though divers beaſts, as horſes, oxen, and ſome others, have their eyes furniſhed with a ſeventh muſcle, beſides the

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ſix they have in common with men; we muſt not conclude, either that the organs of viſion are imperfect in men, or that thoſe of theſe beaſts have ſomething ſuperfluous. For horſes, *&c.* being to feed for the moſt part on graſs and herbs of the field, and, that they may the better chuſe their food, being obliged to make their eyes look very long downwards; the ſeventh muſcle does excellently ſerve them to do ſo, without that wearineſs, which, if they were not furniſhed with it, that durably conſtrained poſture would be ſure to give them; whereas man, who has no ſuch neceſſity of looking aſſiduouſly downwards, would be but incumbered by a ſeventh muſcle.

On the other ſide, the defectiveneſs obſervable in the eyes of ſome animals, in compariſon of thoſe of man, may be aſcribed to the thriftineſs (if I may ſo ſpeak) of nature, that, on moſt occaſions, declines doing that, which is not neceſſary to the particular ends ſhe aims at in the fabric of a part. Thus moles being deſigned to live for the moſt part under ground, the eyes, which nature hath given them, are ſo little, in proportion to their bodies, that it is commonly believed, and even by ſome learned men maintained, they have none at all. But though by anatomy, I, as well as ſome others, that have tried, have found the contrary; yet their eyes are very differing from thoſe of other four-footed beaſts. Which is not to be wondered at, conſidering, that the deſign of nature was, that moles ſhould live under ground, where a ſight was needleſs and uſeleſs, and where greater eyes would be more expoſed to danger; and their ſight, as dim as it is, is ſufficient to make them perceive, that they are no longer under ground, (at leaſt ſo as they are wont to be) which ſeems to be the moſt neceſſary uſe they have of light and eyes.

Zoographers obſerve, that the cameleon has a very uncommon ſtructure of his viſive organs; ſince, to omit leſſer, though not inconſiderable, peculiarities, his eyes often move independently from one another; ſo that, for inſtance, he may look directly forward with the right eye, and with the other at the ſame time directly backwards towards his tail; or may turn the pupil of the former ſtraight upwards, whilſt he looks downwards with the other: which peculiar power ſeems to have been granted him by Providence, that, being a very ſlow animal, and deſtinated to live for the moſt part in trees and buſhes, and there chiefly feed on flies, he may perceive them, which way ſoever they chance to come within the reach of his long tongue, by ſuddenly darting out of which he catches his nimble prey.

Whereas it may be obſerved, that many or moſt, if not all, meer fiſhes have the chryſtalline humours of their eyes almoſt ſpherical, as to ſenſe, and conſequently far more round than that humour is wont to be found in man, and other terreſtrial animals; this difference of figure, though it would be inconvenient to us, does very well accommodate fiſhes; ſince they living in the water, which, as a thicker medium, does much more refract the beams of light, than the air, through which they paſs to our eyes, it was fit, that the chryſtalline humour of fiſhes ſhould be very globous, that, by the help of their figure, the beams, already refracted by the water, ſhould be yet ſo much refracted and made convergent, as to paint the images ſo near as upon the bottom of the eye.

One, that, being curious, had more opportunity, than I have, to ſurvey and reflect on the various ſtructures of the organs of viſion in differing animals, may, if I miſtake not, be able to find, by comparing them with the other parts of the ſame animal, and the ſcene he is deſigned to act on, and the uſes he is to make of his eyes in his moſt ordinary circumſtances; ſuch a perſon, I ſay, may be able to offer a probable reaſon of ſeveral differences in thoſe organs, that, if commonly taken notice of, would ſeem to the cenſorious to be aberrations of nature, or defects.

defects. To which purpose I remember, that an ingenious cultivator of optics gives this reason of what both he and I have taken notice of (though it be usually overlooked) about the figure of the pupil; namely, that though it be oblong in horses, oxen, and divers other quadrupeds, as well as in cats, yet in the former kinds of animals the pupil lies transversly from the right side of the eye to the left, but in cats its situation is perpendicular; whereof he ingeniously guesses the reason may be, that horses and oxen being usually to find their food growing on the ground, they can more conveniently receive the images of the laterally neighbouring grass, *&c.* by having their pupils transversly placed; whereas cats, being to live chiefly upon rats and mice, which are animals, that usually climb up or run down walls and other steep places, the commodiousest situtation of their pupil, for readily discovering and following these objects, was to be perpendicular. But it is time we proceed in our discourse.

OTHER instances to the same purpose with this are elsewhere delivered; and therefore I shall now, to strengthen the apology for Divine Providence, take notice, that the differing structures and situations of the eyes in several animals are very fit to shew the fœcundity of the divine Author's skill, (if I may so speak) in being able to frame so great a variety of exquisite instruments of vision. And indeed, if I may presume to guess at any of God's ends, that are not manifest, (for other of his ends seem conspicuous) I should think, that this delightful and wonderful variety, that we may observe, not only in animals themselves considered as entire systems, but in those parts of them, that appear destinated for the same function, as particularly that of seeing was designed, at least among other ends, to display the multiplicity of the great Creator's wisdom, and shew his intelligent creatures, that his skill is not confined to one sort of living engines, nor in the parts of the same kind (as eyes, ears, teeth, *&c.*) to the same contrivances; but is able to make, for the same use, a multitude of surprising organs or instruments, though not perhaps all equally perfect, (since, to do so, we may think He must make no animals but men) yet all of them curious and exquisite in their kinds, and in order to their differing ends. To be able to frame both clocks and watches, and ships, and rockets, and granadoes, and pumps, and mills, *&c.* argues and manifests a far greater skill in an artificer, than he could display in making but one of those sorts of engines, how artificially soever he contrived it. And the same superiority of knowledge would be displayed, by contriving engines of the same kind, or for the same purposes, after very differing manners. As weights indeed are of great use and necessity in the famous clock of *Strasburg*; and therefore it recommends the inventors of watches, not only that they can make clocks of a very little and easily portable bulk, which the *Strasburg* machine is not, but can make a clock without weights, and by means of a spring perform their office. And thus, though to fly it seems absolutely necessary that an animal should be furnished with feathers, the wise Creator hath shewn, that He is not confined to make use of them for that purpose; since a flying fish is able to move a great way in the air; and the Indies have lately furnished us with a sort of flying squirrels, whereof I saw one alive at *Whitehall.* And though the flight of these is not long, yet there is another kind of animals without feathers, that can fly long enough, namely, the batt; though some of these, as I have seen, be little less than hens: and I have been assured by a credible eye-witness, that in the kingdom of Golconda he had seen much bigger.

BUT though this consideration may suffice to justify the wisdom of the Creator, who being an agent most free, as well as most wise, men ought not to find fault, if He think fit to recommend his wisdom by displaying it in very different manners; yet this is not all that may be said on this occasion. For there are many cases, and perhaps

perhaps far more than we imagine, wherein the peculiar, and in ſome regards leſs perfect, fabric or ſituation of an eye or other organical part, may be more convenient, than the correſpondent organ of man, to attain the ends, for which it was given to an animal, that was to act upon ſuch a theatre, and live by ſuch proviſion. Beſides that an organical part may, in ſome animals, be intended for more uſes than in others, and therefore may require a differing ſtructure, as in moles, the feet are otherwiſe framed or ſituated, than in other quadrupeds, becauſe the chief uſe they were to make of them was not to walk upon the ground, but to dig themſelves ways under ground; the provident Δημιουργὸς wiſely ſuiting the fabric of the parts to the uſes, that were to be made of them: as a mechanic employs another contrivance of his wheels, pinions, *&c.* when he is to grind corn with a mill, that is to be driven by water, than when he is to do the ſame thing by a mill, that is to be moved by the wind. And the cameleon has a tongue, both peculiarly ſhaped, and of a length diſproportionate to that of his body, becauſe he was to take his prey by ſhooting out (if I may ſo ſpeak) his tongue at the flies he was to live upon, and could not often approach them very near without frighting them away. And in many caſes, in which this reflection does not ſo properly take place, we may obſerve, that there is a wonderful compenſation made for that, which ſeems a defect in the parts of an animal of this or that particular ſpecies, compared with the correſpondent ones of a man, or an animal of ſome other ſpecies.

THUS birds, that (except the batt, and one or two more) want teeth to chew their food, are not only furniſhed with hard bills to break it; and birds of prey, as hawks, *&c.* with crooked ones to tear it; but, which is more conſiderable, have crops to prepare and ſoften it, and very ſtrong muſcular ſtomachs to digeſt and grind it: in which work they are uſually helped by gravel and little ſtones, that they are led by inſtinct to ſwallow, and which are often found (and ſometimes in amazing numbers) in their ſtomachs, where they may prove a vicarious kind of teeth.

I SHALL hereafter have occaſion to ſay ſomewhat more againſt their opinion, that find fault with thoſe animated ſtructures, that we think to be productions of the divine wiſdom, under pretence, that the parts of ſome living creatures are not ſo curious and ſymmetrical, as not to have been caſually producible. But, in the mean time, I ſhall here note, for thoſe that aſcribe ſo much to chance, that chance is really no natural cauſe or agent, but a creature of man's intellect. For the things, that are done in the corporeal world, are really done by the parts of the univerſal matter, acting and ſuffering according to the laws of motion eſtabliſhed by the Author of nature. But we men, looking upon ſome of theſe parts as directed in their motions by God, or at leaſt by nature, and diſpoſed to the attainment of certain ends; if by the intervention of other cauſes, that we are not aware of, an effect be produced very differing from that, which we ſuppoſed was intended, we ſay, that ſuch an effect was produced by chance. So that chance is indeed but a notion of ours, and ſuch a thing, as a ſchoolman might call an extrinſical denomination, and ſignifies but this; that in our apprehenſions the phyſical cauſes of an effect did not intend the production of what they nevertheleſs produced. And therefore I wonder not, that the philoſophers, that preceded *Ariſtotle*, ſhould not treat of chance, among natural cauſes; as we may learn from *Ariſtotle* himſelf, who is more juſt to them in ſuſpecting they owned not ſuch a cauſe, than in taxing them of an omiſſion for not having treated of it.

AND on this occaſion I ſhall only add, before I proceed, that whereas ſome of the moſt curiouſly ſhaped kind of ſtones, as the *Aſtroites*, have emboldened many of the favourers of *Epicurus* to bring them into competition with theſe animals, or parts of

animals, from their likeneſs to which they have received their names; it is fit to be conſidered, firſt, that ſome learned men have of late made it very probable, that ſome of the curiouſeſt ſorts of theſe ſtones were once really the animals whoſe ſhapes they bear, or thoſe parts of animals which they reſemble; which animal ſubſtances were afterwards turned into ſtones, by the ſupervening of ſome petreſcent matter, or petrifying cauſe; of which metamorphoſis I have met with, and do elſewhere mention, more inſtances than are fit to be ſo much as named in this place. Secondly, though ſome of thoſe ſorts of ſtones were the production of the mineral kingdom, (for I will not be dogmatical in this point); yet, beſides that it would not clearly follow, that they owe their ſhapes to chance, ſince there is no abſurdity to admit ſeminal principles in ſome more elaborate ſorts of foſſils; I think it would be very injurious to make theſe productions vie with the animals, to which they are compared. For the reſemblance of ſhapes, wherein alone they and the animals agree, being but the outward figure, is but a ſuperficial thing, and not worthy to be mentioned, in compariſon of that wherein they differ; the rude and ſlight contexture of the beſt ſhaped ſtones, being incomparably inferior to the internal contrivance of an animal, which muſt conſiſt of a multitude of parts, of ſuch a figure, bulk, texture, ſituation, *&c.* as cannot but be obvious to any, that have ſeen diſſections ſkilfully made. And it is not only in the ſtable and quieſcent parts, that this great internal difference, between ſtones and the animals they reſemble, is to be found; but there is in a living animal a greater difference, than any of the knives of anatomiſts can ſhew us in a dead one betwixt a ſtone, though never ſo curiouſly figured, and an animal. For there are, I know not how many, liquors, ſpirits, digeſtions, ſecretions, coagulations, and motions of the whole body, and of the limbs and other parts, which are lodged and performed in a living body, and not in a cadaver; and are perchance far more admirable, even than the ſtructure of the ſtable and quieſcent parts themſelves. So that though a ſtone, outwardly very like a ſhell-fiſh, were made by chance; yet from thence to conclude, that chance may make a real living ſhell-fiſh, would be to argue worſe than he, that ſhould contend, that becauſe even an unſkilful ſmith may make a hollow piece of metal like a watch-caſe, though he can fill it but with filings of iron, or ſome other rude ſtuff, he muſt be able to make a watch; there being leſs difference betwixt the ſkill expreſſed in making the caſe of a watch and the movement, than in making a body like a ſhell, and the internal parts of a real fiſh: or to ſay, that becauſe putrefaction and winds have ſometimes made trees hollow, and blown them down into the water, where they ſwim like boats; therefore the like cauſes may make a galley, built and contrived, as well within as without, according to the laws of naval architecture, and furniſhed with mariners to row it, ſteer it, and, in a word, to excite and guide all its motions to the beſt advantage, for the preſervation and various uſes of the veſſel. In ſhort, if chance ſometimes does ſome ſtrange things, it is in reference to what ſhe herſelf, but not to what nature, uſes to perform.

AND now, to give you the ſummary of my thoughts, about the ſecond queſtion; 1. I think, that from the ends and uſes of the parts of living bodies the naturaliſt may draw arguments, provided he do it with due cautions, of which I ſhall ſpeak under the fourth queſtion. 2. That the inanimate bodies here below, that proceed not from ſeminal principles, have but a more parable texture, (if I may ſo ſpeak) as earths, liquors, flints, pebbles, and will not eaſily warrant ratiocinations drawn from their ſuppoſed ends. 3. I think the cœleſtial bodies do abundantly declare God's power and greatneſs, by the immenſity of their bulk, and (if the earth ſtand ſtill) the celerity of their motions, and alſo argue his wiſdom and general providence

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as to them; becauſe he has for ſo many ages kept ſo many vaſt vortices, or other maſſes of matter, in ſcarce conceivably rapid motions, without deſtroying one another, or loſing their regularity. And I ſee no abſurdity in ſuppoſing, that, among other uſes of the ſun, and of the ſtars, the ſervice of man might be intended; but yet I doubt, whether, from the bare contemplation of the heavens, and their motions, it may be cogently inferred, at leaſt ſo ſtrongly as final cauſes may be from the ſtructure of animals, that either the ſole or the chief end of them all is to enlighten the earth, and bring benefits to the creatures that live upon it.

In what has been hitherto ſaid on our ſecond queſtion, it is plain, that I ſuppoſe the naturaliſt to diſcourſe meerly upon phyſical grounds. But, if the revelations contained in the holy ſcriptures be admitted, we may rationally believe more, and ſpeak leſs heſitantly, of the ends of God, than bare philoſophy will warrant us to do. For if God is pleaſed to declare to us any thing concerning his intentions, in the making of his creatures, we ought to believe it, though the conſideration of the things themſelves did not give us the leaſt ſuſpicion of it; which yet in our caſe they do. And therefore a late ingenious author did cauſleſsly reflect upon me, for having mentioned the enlightning of the earth, and the ſervice of men, among the ends of God, which he thought undiſcoverable by us. For whether or no we can diſcover them by meer reaſon, as divers of the heathen philoſophers thought they did; yet ſure we may know thoſe, that God is pleaſed to reveal to us: and the perſons I argued with were apparently ſuch, as admitted the authority of the ſcriptures; which expreſsly teach us, that God made *the two great luminaries*, (for ſo I ſhould render the Hebrew words את־שני המאורת הגדלים) *the greater for the rule of the day, and the leſſer for the rule of the night.* And that *he made the ſtars alſo*, and ſet them in the firmament, or rather expanſum of the heaven, *to give light upon the earth.* And a little above, among the uſes of the luminaries theſe are reckoned, *to divide the day from the night, and to be for ſigns, and for ſeaſons, and for days and years.* And in another place, the prophet *Moſes*, dehorting the Iſraelites from worſhipping the ſun, the moon, and the ſtars, tells them, that *the Lord had imparted them unto all nations under the whole heaven.* And therefore thoſe Carteſians, that, being divines, admit the authority of holy ſcripture, ſhould not reject the conſideration of ſuch final cauſes, as revelation diſcovers to us; ſince it is certainly no preſumption to think we know God's ends, when He Himſelf acquaints us with them; nor to believe that the ſun, though it be generally eſteemed to be a nobler body than the terreſtrial globe, was made, among other purpoſes, to give light to its inhabitants. It is recorded in the book of *Geneſis*, the deſign of God in making man was, that *men* ſhould *ſubdue the earth* (as vaſt a globe as it is) *and have dominion over the fiſh of the ſea, and over the fowl of the air, and over the cattle, and over all the earth, and* (to ſpeak ſummarily) *over every living thing, that moveth upon the earth.* And the ſame book informs us, that, after the deluge, God *delivered all terreſtrial beaſts, and fowl, and fiſhes, and every moving thing, that lives*, into the hands of men; and intended, that they ſhould eat animals, as before the flood he had appointed them all the ſorts of wholeſome vegetables for their food. And ſince God was pleaſed to appoint, that men ſhould live on theſe creatures, it cannot be abſurd to ſay, that, among other purpoſes, to which He deſtinated the ſun, his ſhining upon the earth was one; ſince, without his light and heat, men could not provide for or enjoy themſelves; and neither thoſe plants, that men and cattle muſt live upon, could grow and ripen; nor (conſequently) thoſe animals, that were to be their principal food and ſerve them for many other uſes, could be ſuſtained and provided for. Many other texts, that ſhew, how much God was pleaſed to intend man's welfare, and

Gen. i. 16.

Deut. iv. 19.

Gen. i. 26, 27, 28.

Gen. ix. 3.

dominion over many of his fellow-creatures, might be here alledged. But I ſhall content myſelf to mention what the kingly prophet ſays in the eighth pſalm, where, ſpeaking of man to his Maker, he ſays: *Thou haſt made him a little lower than the angels, and haſt crowned him with glory and honour. Thou madeſt him to have dominion over the works of thine hands, and haſt put all things under his feet.* Indeed if in man we conſider only that viſible part, his body; the ſmallneſs of it may make it thought improbable, that portions of the univerſe incomparably greater than he, ſhould be at all intended to be ſerviceable to him. But Chriſtians ought not to think this incredible, if they conſider man, as he chiefly conſiſts of a rational mind, which proceeds immediately from God, and is capable of knowing Him, loving Him, and being eternally happy with Him. They, that deſpiſe man conſidered in this capacity, do very little know the worth of a rational ſoul; and eſtimate things like maſons, and not like jewellers, who juſtly value a diamond no bigger than a bean, more than a whole quarry of ordinary ſtones. And particularly to thoſe undervaluers of their own ſpecies, that are divines, it may be repreſented, that God, who will not be denied to be the beſt judge in this caſe, as in all others, was pleaſed to conſider men ſo much, as to give *David* cauſe to admire it in the words lately cited; and not only to endow them with his image at their firſt creation, but, when they had criminally loſt and forfeited it, He vouchſafed to redeem them by no leſs than the ſufferings and death of his own Son, who is incomparably more excellent than the whole world. And it is not incredible, that God ſhould have intended, that many of his other works ſhould be ſerviceable to man; ſince by miraculous operations He hath ſometimes ſuſpended the laws of nature, and ſometimes overruled them, upon the account of man: as may appear by *Noah*'s flood; by the paſſage of the *Iſraelites* on dry land through the Red Sea, and the river of *Jordan*; by the ſtanding ſtill of the ſun and moon (or the terreſtrial globe) at *Joſhua*'s command; by the inefficacy of the burning fiery furnace on *Daniel*'s three companions; and (to be ſhort) by the ſtupendous eclipſe of the ſun at the full moon, at the crucifixion of the *Meſſias*. To which I might add, that the chief part of mankind, namely the children of God, will, by their moſt bountiful Remunerator, be thought fit to inhabit the new world (for that, by an Hebraiſm, is meant by *the new heavens and the new earth* St. *Peter* ſpeaks of) which ſhall ſucceed the renovation and refinement of the preſent world by the laſt fire, that will not only diſſolve, but, if I may ſo ſpeak, transfigure it.

Pſ. viii. 5, 6.

2 Pet. iii. 10, 11, 12, 13.

AND we ſhall the leſs ſcruple to admit, that ſuch vaſt and bright bodies as the ſun and moon may be deſigned (among other things) to be ſerviceable to men, if we conſider, that it is ſo far from being a conſtant rule, that a thing more excellent cannot (by a wiſe agent) be employed for the good of one that is leſs ſo, that not only the firſt angel, whoſe apparition we read of in the ſcripture, was ſent to relieve *Hagar*, a ſlave wandring in a wilderneſs; another had regard to the life of a ſoothſayer's aſs; and many others (and ſometimes companies of them) were employed on earth to do good offices to particular perſons: but of all the angels in general, the excellent epiſtle to the *Hebrews* informs us, That they *are miniſtring ſpirits, ſent forth to miniſter unto them, who ſhall be heirs of ſalvation.*

Gen. xvi. 9, &c. Num. xxii. 23. Gen. xxxii. 1, 2. 2 Kings 16, 17. Heb. i. 14.

SECT. III.

TO handle the third queſtion *, it will be neceſſary for us to clear the grand difficulty, that has, ever ſince *Ariſtotle*'s time, and even before that, perplexed

* Viz. *Whether, and in what ſenſe, the acting for ends may be aſcribed to an unintelligent (and even inanimate) body.*

thoſe, that allow, in natural philoſophy, the conſideration of final cauſes. The difficulty is obvious enough; for much the greater part of bodies being void of knowledge, and moſt of them (as all inanimate bodies) of life itſelf, it ſeems not conceivable, how they ſhould act conſtantly for ends they are not capable of predeſigning, and appoſitely employ means, that they have no knowledge, wherewith to make choice of.

ARISTOTLE, who expreſly teaches, that nature does nothing in vain, and rightly judged, that the actions of natural agents tended to certain ends, takes notice of this difficulty, but ſeems rather to ſhift it off than reſolve it; the ſolution he frames regarding ſo peculiarly the words, wherein he has expreſſed the objection, that I much doubt whether it would ſignify much to clear the ſame difficulty propoſed in other terms: and to me he ſeems to ſpeak ſo darkly, not only in his tranſlator's Latin, but in his own Greek, that if he have given a good ſolution of the difficulty, I muſt ingeniouſly confeſs my dulneſs, in not being able to underſtand it. *Vide Ariſt. de Cœlo, l. II. c. 5. & eund. de Gen. & Interitu l. II. c. 10.*

BUT, to conſider the difficulty itſelf, there are two accounts, on which the actions of natural agents may be ſaid to tend to a certain end: one, when the agent has a knowledge of that end, and acts with an intention to obtain it; as when a man ſhoots an arrow to hit a mark: the other is, when the action of the proximate agent is indeed ſo directed, as it ought to be to obtain an end, and yet that end is neither known nor intended by the proximate agent, but by a remoter agent, that is intelligent. In the former of theſe ſenſes I cannot admit, that (not now to examine, whether any living but not rational works of nature may) any inanimate bodies can act for an end; for to do ſo, preſuppoſes, that the agent both knows the end he is to attain, and purpoſes to attain it; which are things whereof inanimate bodies are uncapable. And to fancy with ſome, that they may have a knowledge *ſui generis*, (as they ſpeak) which, though confined to the actions proper to this or that particular kind of body, is yet ſufficient to determine to thoſe actions, is to offend againſt that rational and received rule of philoſophizing, *Entia non ſunt multiplicanda ſine neceſſitate*, and to introduce a ſort of knowledge, which I fear the propoſers do not well conceive, or, at leaſt, I am ſure I do not.

IT remains then, that I embrace the ſecond ſenſe, in which we formerly ſaid, that natural things may be ſaid to work for an end; though indeed, in this caſe, we muſt ſpeak ſomewhat improperly: for, by him, that conſiders, the action will be oftentimes more juſtly attributed to the inteiligent, but remoter, than to the immediate agent, which is but, as it were, the inſtrument of the other. But how this is poſſible to be done, appears difficult to be explained. To me it ſeems, it may be thus conceived: the moſt wiſe and powerful Author of nature, whoſe piercing ſight is able to penetrate the whole univerſe, and ſurvey all the parts of it at once, did, at the beginning of things, frame things corporeal into ſuch a ſyſtem, and ſettled among them ſuch laws of motion, as He judged ſuitable to the ends He propoſed to Himſelf in making the world: and as by virtue of his vaſt and boundleſs intellect, that He at firſt employed, He was able not only to ſee the preſent ſtate of things He had made, but to foreſee all the effects, that particular bodies ſo and ſo qualified, and acting according to the laws of motion by Him eſtabliſhed, could in ſuch and ſuch circumſtances have on one another; ſo, by the ſame omniſcient power, He was able to contrive the whole fabric, and all the parts of it, in ſuch manner, that, whilſt his general concourſe maintained the order of nature, each part of this great engine, the world, ſhould, without either intention or knowledge, as regularly and conſtantly act towards the attainment of the reſpective ends which He deſigned them for, as if themſelves really underſtood, and induſtriouſly proſecuted, thoſe ends.

Juſt.

Juſt as in a well-made clock, the ſpring, the wheels, the balance, and the other parts, though each of them act according to the impulſes it receives, and the determination that is given it, by the other pieces of the engine, without knowing what the neighbouring parts (or what themſelves) do; yet their tendencies are ſo determined, and ſometimes over-ruled, and their motions ſo quickened, by the ſtructure of the clock, that they would not move more conveniently, nor better perform the functions of a clock, if they knew, that they were to make the index truly mark the hours, and intended to make it do ſo. It is true, that it is not eaſy to conceive, how one agent ſhould, by ſo ſimple an inſtrument as local motion, be able to direct a multitude of agents, as numerous as the bodies that make up a world, to act as regularly, as if each of them acted upon its own particular deſign, and yet all of them conſpired to obey the laws of nature. But if we conſider, that it is to God, that is an omniſcient and almighty Agent, that this great work is aſcribed, we ſhall not think it incredible; eſpecially if we conſider, that, whereas it is manifeſt enough, that a multitude of bodies act, as we have ſuppoſed, if we will not aſcribe the direction and ſuper-intendence of the motions, that are manifeſtly fitted for the attainment of ends, unto God, we muſt do it to nature, which will not leſſen (but increaſe) the difficulty: and when I have ſeen, as ſometimes I have, with pleaſure, a great engine, wherein the works of I know not how many trades, and a great many other motions, were performed by little puppets, that managed the tools of the artificers; and all theſe were ſet a-work by one ſpring, which communicated motions, that were regulated and determined by the particular ſtructure of the little ſtatues and other bodies: when, I ſay, I conſider ſuch things as theſe, I cannot think it impoſſible, that the
Heb.xi.10. divine and great Δημιουργὸς, as both philoſophers and ſacred writers have ſtiled the world's Creator, ſhould be able, by the motions and ſtructure of matter, to ſet a-work very many partial and ſubordinate engines. For it will not, I hope, be denied, that the multitude of theſe does not any thing near ſo much ſurpaſs the number of thoſe, which I ſaw in the hand of an illiterate tradeſman, as the narrow knowledge of that artificer is ſurpaſſed by the boundleſs underſtanding of an omniſcient artiſt. And it is more, in the making ſo many and ſo various bodies act according to their particular deſignations, and yet all of them conſpire to the general ends of the univerſe, that God's wiſdom, and (if I may ſo ſpeak) his ſkill is diſplayed, than barely in the making bodies act appoſitely for ends to themſelves unknown. For if moving bodies be duly diſplayed, and have a ſufficient connection, it is not difficult to direct a few of them to the attainment of an end propoſed by an underſtanding agent, though unknown to the immediate agents: as anciently among the Jewiſh huſband-men, (and at this day in ſome parts of the Eaſt) the ox, that intended no ſuch matter, did, by treading the corn, as well ſeparate the grain from the ſtraw, as our plowmen do, when they threſh it purpoſely to make that ſeparation: and a horſe or an aſs in a mill may as well, by his going round, grind the corn, as the miller himſelf could do.

NOR is this doctrine inconſiſtent with the belief of any true miracle; for it ſuppoſes the ordinary and ſettled courſe of nature to be maintained, without at all denying, that the moſt free and powerful Author of nature is able, whenever He thinks fit, to ſuſpend, alter, or contradict thoſe laws of motion, which He alone at firſt eſtabliſhed, and which need his perpetual concourſe to be upheld.

THE laws of method would oblige me to conclude here this ſection, and paſs to another; but in regard, that all I thought myſelf obliged to ſay about it, leaves it ſo very ſhort, as to be very diſproportionate in bulk to the other ſections of this diſcourſe, I will crave leave to lengthen it in this place, with ſomething, which, though it

it may be judged to belong more properly to another, will not perhaps be thought to be impertinent here; and much leſs to be uſeleſs to the deſign of this diſcourſe.

HERE then you may pleaſe to take notice, that in all that I have diſcourſed in the ſecond ſection, or may elſewhere have occaſion to ſay, againſt the received opinion, that the whole material world was made for man, I would not be underſtood to ſpeak either too dogmatically, or too excluſively; my deſign being to deliver, what I thought might probably be repreſented to take off the prejudice, that men are generally prepoſſeſſed with in their own favour. For though the arguments I alledge againſt the vulgar opinion, ſeem as yet to me more probable, than thoſe I have hitherto met with for it, eſpecially as it relates to the vaſt celeſtial region of the world; yet I am not only willing to grant, that, among the ends deſigned by the Author of nature, in ſeveral of his works, eſpecially plants, animals, and metals, the utility of men may be one, and perhaps one of the principal; but I am not averſe from thinking, that human ends (or uſes that relate to men) may have been deſigned by God in ſeveral creatures, whoſe human uſes men are not yet aware of; and that He may have intended, that of ſeveral of his creatures, whereof men do already know, and make ſome uſes, they ſhall hereafter diſcover other utilities, and perhaps nobler ones.

THOSE, that reflect on the providence of God, whilſt they repreſent, what they call nature, as a ſtep-mother to man, whom ſhe brings naked, toothleſs, and helpleſs into the world, whilſt ſhe furniſhes the new-born fœtuſes of brutes with wooll or other clothing, and both with a power to walk and ſeek their food, and (as to many of them) with teeth to eat it: thoſe men, I ſay, have been long ago anſwered by the eloquent *Lactantius*, and other champions of Providence. And therefore I ſhall only add this, that God, by giving man neceſſity and reaſon, has effectually excited him, and richly furniſhed him with ability, to procure for himſelf far greater accommodations and advantages, than thoſe beaſts come into the world with; and, by vouchſafing him that noble faculty of underſtanding, He has put it in his power to convert to his own uſe thoſe very things, for which profane wits would have the condition of beaſts preferable to his. For man, by his reaſon employing ſkilfully ſuch admirable inſtruments as his hands, is able to maſter and apply to his own uſes the fierceneſs of ſeveral wild beaſts, as leopards (which the Perſians hunt with) the vaſt ſtrength of elephants, the huge bulk of whales, the ſagacity of ſpaniels, hounds, and ſetters, the ſwiftneſs of grey-hounds, the ſubtlety of tumblers, and the furs of beavers, martins, *&c.* to omit a multitude of others, which God, by the ſingle gift of reaſon to man, has enabled him to maſter and make uſe of to his own advantage. And though at firſt he be helpleſs enough, and unable to exerciſe his dominion over inferior creatures, yet God has ſufficiently provided for him, by giving his parents, whilſt he needs them, that (στοργὴ) natural affection for him, which engages them to take care of him, till he be in a condition to take care of himſelf, and become qualified to obtain ſuch knowledge and induſtry, as may make him poſſeſſor of the advantages, whereof his indulgent and bountiful Creator made him capable.

THOSE moderns, that think it ridiculous to imagine, that, in framing ſuch vaſt bodies as the earth, and ſome of the celeſtial globes, their Creator ſhould have any regard to ſo ſmall a part of the earth as man, and deſigned, that they ſhould be ſome way or other ſerviceable to him, look upon things rather as ſurveyors, who conſider mainly their extent, than as philoſophers, that eſtimate them by their intrinſic value. For though it be true, that man, conſidered barely as an animal, is a creature little enough to be contemptible; yet as he is endowed with a ſoul, immaterial, rational, and immortal, he is a creature much more noble and excellent than the whole terraqueous globe, or a much vaſter maſs of corporeal ſubſtance,

that is ſtupid and inanimate. For the rational ſoul is capable of underſtanding and willing, (which are higher faculties than mere matter can reach to) and, which is more, of knowing, ſerving, and enjoying God. And man being the only viſible creature, that is capable to underſtand the wiſdom, power, and beneficence of God in the creation, and in many ways to ſubdue a great variety of the other creatures, and apply them to his uſes; it ought not to ſeem ſtrange, that the wiſe Author of the univerſe, that made all things ſo as to bring glory to Himſelf, ſhould have a more eſpecial regard to ſo noble a piece of his workmanſhip, than to any, that, being merely corporeal, can neither underſtand his wiſdom and his power, nor render Him thanks nor praiſes for the manifold and admirable effects of them. And that littleneſs, that is alledged to make man a contemptible creature, is ſo far from being a diſparagement to that noble part of him, the ſoul, which makes him a man, that is, a rational creature; that its excellency conſiſts in being leſs than the minuteſt body; ſince, not having extenſion, it is not diviſible; which is the prerogative of ſubſtances, which, for that reaſon, are immaterial and immortal.

THIS mention of the human mind leads me to a further reflexion, which is, that many parts of the material world, whereof man has not been known to make any advantage in the capacity of a mere animal, may yet be highly uſeful to him as he is a rational creature, that is capable, by contemplating the great and admirable works of God, to raiſe his mind to the acknowledgment of the divine Architect's power, wiſdom, and beneficence, and thereby find produced in him due ſentiments of veneration, gratitude, and love. And theſe may be ſafely reckoned among thoſe ends or uſes, which in the firſt ſection we have ſtiled human ones; ſince ſome of the heathen philoſophers themſelves called the world a temple, and one of the more philoſophical fathers of the church loftily ſtiles it, παιδευτήριον τῆς θεογνωσίας, καὶ ψυχῶν λογικῶν διδασκαλεῖον.

AND indeed we find, that the pſalmiſt alone may furniſh us with divers inſtances to our preſent purpoſe: for not only he teaches us that *the heavens declare the glory of God*, and that in a language, that, notwithſtanding what happened at *Babel*, reaches to all the nations of the world; but he employs the contemplation of God's viſible works, to excite in himſelf and others true ſentiments, both of devotion and of particular virtues. Thus the conſideration of his having been wonderfully formed in his mother's womb, moves him to revere and celebrate the admirable ſkill of the Opificer. Elſewhere the conſideration of the regular viciſſitudes obſervable in the courſe of nature, invite him to admire and extol the providence of God. And when, in another place, he beholds thoſe vaſt bodies and ſhining ones, that compoſe and adorn the cœleſtial part of the world, he juſtly falls into ſentiments of great humility and deſerved gratitude.

Pſ. xix. 1, 2, 3.

Pſ. cxxxix. 14.

Pſalm civ. throughout, eſpecially ver. 24.

Pſalm viii. 3, 4.

AND as to this uſe, the diſtance and vaſtneſs of the fixed ſtars, the immenſity of the heavens, and the regular motion of the ſuperior planets, (ſuppoſing they can bring man no other advantage) may do him good ſervice, ſince they afford him rational and ſolid grounds to believe, admire, adore, and obey the Deity. For by thus ſpiritualizing (if I may ſo ſpeak) the corporeal works of God, there may accrue to the pious ſoul uſes far more valuable than they can afford the body; ſince they will perfectionate the mind here, and continue to be advantageous to it, when the body will not need the world, and the world itſelf, as to its preſent conſtitution, ſhall be deſtroyed.

BUT to proceed from this uſe of the world, which is theological, to a human uſe, that is more phyſical, as relating to the preſent welfare of man, as he is an animal, as well as a rational creature; I ſhall repreſent, that as a nation is oftentimes, in the

account

account of Providence, conſidered as one man, notwithſtanding its various diſperſions, and perhaps long continuance; as the *Iſraelitiſh* people, during many ages, notwithſtanding its diviſions and captivities, was addreſſed to and treated, by the prophets and apoſtles commiſſioned by God, as one perſon, named *Iſrael*, whom God, ſometimes in the ſcripture, is pleaſed to call his ſon: ſo perhaps it will not be abſurd to conceive, that mankind itſelf may in ſome regards, or as to ſome purpoſes, be looked upon, by its Author, as one man, who, by ſucceſſive improvements of his knowledge, may, from time to time, be enabled to make new and conſiderable uſes of the things, that the wiſe and bountiful providence of his Maker had framed with a foreſight that he would, and with intention that he might, make them advantageous to him. And therefore it cannot ſafely be concluded that every thing, whoſe uſefulneſs to man is not yet obvious, nay, that every thing, that ſeems hurtful to him, can never be made beneficial to him. For we ſee, that opium was, for many ages, looked on only as a poiſon, but now is employed as a noble remedy, (as indeed it is, if ſkilfully prepared, and judiciouſly exhibited) in many violent, and oftentimes dangerous diſtempers. Vipers are venomous animals, but yet their fleſh is a main ingredient of that famous antidote treacle; and being in great part diſſolved in tract of time in good Spaniſh wine, I have tried it with ſurpriſing ſucceſs, in an uncommon and very difficult caſe. Scorpions alſo afford, by bare infuſion, an oil that not only cures their own ſtings, but is very available in ſeveral diſtempers. And I remember, that a learned profeſſor of *Padua*, having cured the widow of a ſovereign prince of a fit of the ſtone, anſwered me ſome few days after, that the chief remedy he employed and relied on, was a preparation (which he intimated to conſiſt mainly in a light kind of calcination) of ſcorpions, which, ſomewhat to my wonder, he made his patient take inwardly. And, though the roots of maudioca be reckoned among poiſons, when the juice is in them, of which I elſewhere relate a notable inſtance; yet when the juice is preſſed out, and the firm part reduced to meal, it affords the caſſava, which is the common bread of a great part of the *Americans*; and I did not ſcruple to eat of it here in *England:* nay, the poiſonous juice itſelf, in divers places of the Weſt-Indies, is, even by the unſkilful inhabitants, turned into an ordinary, and, by them, beloved drink. But enough of this ſort of inſtances. I ſhall be more brief in thoſe of another kind, whereof the firſt is afforded by the loadſtone, which (though, for many ages, admired by the Greeks and Romans, for what is commonly called its attractive virtue) had not its directive virtue known, at leaſt any thing vulgarly, in theſe parts of the world, till within leſs than four ages; ſince when, of what vaſt uſe this ſtone has proved to mankind, the diſcovery of the *Weſt-Indies*, and of the way of ſailing by the *Cape-of-Good-Hope* to the *Eaſt-Indies*, ſufficiently declares. I will ſay nothing of the uſes of the ſilk-worm, and the ſugar-cane, which were little taken notice of for many ages, even by the civilized and luxurious *Greeks* and *Romans*; but now, together with the lately diſcovered cochineal, which is but an inſect, and far leſs than the ſilk-worm, make a good part of the trade of *Europe*, and furniſhes the tables of the delicate with ſweet-meats, and the courts of princes with many of their fineſt ornaments. But not to inſiſt on ſuch things as theſe, but to proceed.

Ex. iv. 22. Hoſ. xi. 1.

It deſerves alſo to be conſidered, on this occaſion, that many things, that are not thought uſeful to men, becauſe we ſee not, that they directly bring in any immediate advantages, may yet be of great uſe to them, as they miniſter to (or are neceſſary for) other things that are very ſerviceable to them. As the exceſſive rains, that cauſe the over-flowings of rivers in divers parts of *Afric*, and ſome other countries, though they ſeem rather deſtructive than profitable, do yet, by their ſeaſonable

inundations, make *Egypt*, and ſome other countries, exceedingly fertile, that without them would be very barren: and among us, thoſe clouds, that do us no immediate ſervice, do oftentimes, by watering our fields and gardens in ſummer, and by manuring them, as it were, in winter, nouriſh thoſe trees, graſs, corn, herbs, and other plants, whereof ſome ſerve immediately for aliments to man, and others are neceſſary for the nouriſhment of ſheep, oxen, deer, and other beaſts, that men uſually feed upon.

NOT only plants and animals, and ſtones and metals, and ſuch other ſmaller bodies, as are within man's reach, are capable of being made uſe of by him; but, to advance a ſtep farther, to far greater maſſes of matter, and even ſome of thoſe remote cœleſtial globes, which he is thought able only to contemplate; one of thoſe ends, to which the indulgent Creator deſtinated them, may be to be ſerviceable to man.

To ſay nothing of the advantage, that ſkilful ſeamen make of the ebbing and flowing of that vaſt collection of waters, the ocean; the declination of the mariner's needle, and the variation of it, which probably depends upon the motions or changes of ſome vaſt internal portion of the terraqueous globe, is found to be of great uſe by experienced pilots and navigators, in their voyages through thoſe vaſt ſeas they uſe to paſs between *Europe* and the *Eaſt-Indies*; as I learned by particular inquiry from eminent perſons, that have more than once ſailed upon thoſe ſeas. The moon, to omit her light, ſerves men, not only to make moon-dials by, and to foretel regularly the times and quantities of the various ebbings and flowings of the ſea, the knowledge of which is very beneficial, if not neceſſary, to mariners, but ſerves mathematicians for divers other purpoſes. The ſun, not to mention his ordinary light and heat, and the neceſſity of them to the plants and animals, that afford man food and medicines, and to the production of many other effects, whereon his welfare depends, do enable him, by concave and convexed glaſſes, to burn with cœleſtial beams, without the help of culinary fire; and enable the gnomoniſt to make accurate dials, to know exactly how the time paſſes; the coſmographer to make very uſeful diſcoveries of the elevation of the pole, and latitudes of places; and the heedful obſerver of his riſing and ſetting, to diſcover what artiſts call his amplitude, which is of good uſe to aſtronomers, and more to navigators, by helping them to eſtimate, among other things, the variation of the compaſs, from true north and ſouth points. And the conjunction or oppoſition of the ſun and moon in eclipſes, though it be a frightful thing to the ſuperſtitious vulgar, yet to knowing men, that can ſkilfully apply them, theſe eclipſes are of great uſe, and ſuch as common heads would never have imagined; ſince not only they may, on divers occaſions, help to ſettle chronology, and rectify the miſtakes of hiſtorians, that writ many ages ago; but, which is, though a leſs wonder, yet of greater utility, they are, as things yet ſtand, neceſſary to define, with competent certainty, the longitude of places or points aſſigned on the terraqueous globe, which is a thing of very great moment, not only to geography, but to the moſt uſeful and important art of navigation. And laſtly, at how ſtupendous a diſtance ſoever the fixed ſtars are placed, yet their remoteneſs cannot hinder the induſtry of man from making even theſe ſerviceable to his uſes; ſince, if we ſhould admit thoſe determinate cœleſtial influences, that are little leſs than the idols of aſtrologers, they would enable us to predict the changes of weather, the fertility and dearth, the ſicklineſs or healthineſs, of any propoſed ſeaſon: and, not to lay any ſtreſs upon ſo controverted a ſcience, it is plain, that ſkilful navigators can make uſe of any of the fixed ſtars, to know by any of them, what hour it is of the night: and it is more known, that fiſhermen and pilots did generally, for many ages, till within theſe four laſt centuries, make very great uſe of the pole-ſtar, and

and other of the northern fixed ones, to guide them, when nothing elſe could, in the perilous courſes of their navigations.

I HAVE ſeen, and been maſter of a teleſcope, made in the form of a walking-ſtaff, ſo that it was fitted to ſerve for ſeveral purpoſes, whereof though one was very different from the other, yet all of them were in the idea of the artificer, and intended by him. The like may be ſaid of a concave metalline burning-glaſs, which though it is employed to magnify the pictures of objects, to caſt their images into the air, and to concenter the ſun-beams to a focus, in which they will burn ſeveral bodies, yet theſe and many other things, which, though they ſeem to have little affinity with theſe, are performed by a metalline concave, were before-hand deſtinated by the artiſt, who foreſaw and intended, that in ſuch various junctures of circumſtances it ſhould produce all thoſe determinate effects.

AND indeed, if we conſider God's omniſcience and providence, and how indulgent a Creator He has been to man, it may well ſeem reaſonable to think, that as God foreſaw, that men might make very various and profitable uſes of divers of his other creatures, by the help of that prerogative of reaſon, which He had vouchſafed them; ſo He deſigned, that men ſhould reap the advantages He had made many of his other works capable of affording them. And I confeſs, I think this reflection may juſtly ſerve to recommend the doctrine about Final Cauſes, that we embrace, to philoſophers, that are truly pious; ſince it furniſhes them with juſt arguments for gratitude to the Author of ſo many good things, as the corporeal world, by being contemplated or poſſeſſed, affords them. For to look upon the world, as vaſt and curious a work as it is, only as a vaſt and curious piece of workmanſhip, may indeed give a man a great idea of the power and ſkill of the divine Architect; but will rather exact his wonder than his gratitude: and therefore the ancient Ariſtotelians, who looked upon the world as eternal and ſelf-exiſtent in a condition like its preſent ſyſtem, did not uſe to thank God for the benefits they received from things corporeal; though ſome of them thought themſelves obliged to thank nature, which they looked upon as acting with deſign, and propoſing to herſelf, for ends, the welfare of the univerſe and of men. To illuſtrate this with ſomething, whoſe application is obvious: if a traveller, being in ſome ill-inhabited eaſtern country, ſhould come to a large and fair building, ſuch as one of the moſt ſtately of thoſe they call Caravanzeras, though he would eſteem and be delighted with the magnificence of the ſtructure, and the commodiouſneſs of the apartments, yet, ſuppoſing it to have been erected but for the honour or the pleaſure of the founder, he would commend ſo ſtately a fabric, without thanking him for it: but if he were ſatisfied, that this commodious building was deſigned, by the founder, as a receptacle for paſſengers, who were freely to have the uſe of the many conveniencies the apartments afforded, he would then think himſelf obliged, not only to praiſe the magnificence, but, with gratitude, to acknowledge the bounty, and the philanthropy, of ſo munificent a benefactor.

SECT. IV.

IT remains now, that we diſcourſe a while of the fourth and laſt queſtion, propoſed at the beginning of this tract, which was, *With what cautions Final Cauſes are to be conſidered by the naturaliſt?*

BUT the caſes, whereto this queſtion may relate, are ſo many and ſo differing, that what I ſhall endeavour, upon ſo diffuſed and difficult a ſubject, will be rather to point you out ſome ſea-marks, that may direct you to ſhun thoſe latent rocks, againſt which divers learned men have daſhed, than to preſent you with a mariner's

compaſs, and a ſea-card, that may conſtantly guide you, in the courſes of your navigation, through ſo unfrequented a ſea.

AND to make way for what I am to offer, by a diſtinction, the want of which ſeems to have contributed to the obſcurity of my ſubject, I ſhall obſerve to you, that there are two ways of reaſoning from the final cauſes of natural things, that ought not to be confounded. For ſometimes, from the uſes of things men draw arguments, that relate to the Author of nature, and the general ends He is ſuppoſed to have intended in things corporeal: as when from the manifeſt uſefulneſs of the eye, and all its parts, to the function of ſeeing, men infer, that at the beginning of things the eye was framed by a very intelligent Being, that had a particular care, that animals, eſpecially men, ſhould be furniſhed with the fitteſt organ of ſo neceſſary a ſenſe as that of ſight: and ſometimes alſo, upon the ſuppoſed ends of things men ground arguments, both affirmative and negative, about the peculiar nature of the things themſelves; and conclude, that this affection of a natural body or part ought to be granted, or that to be denied, becauſe by this, and not by that, or by this more than by that, the end, deſigned by nature, may be beſt and moſt conveniently attained. This latter ſort of arguments I am wont to call purely or ſimply phyſical ones; and thoſe of the former ſort may, for diſtinction's ſake, be ſtiled *phyſico-theological* ones; or, (if we will, with *Verulamius*, refer final cauſes to the metaphyſics) by a ſomewhat ſhorter name, metaphyſical ones.

WHAT has been premiſed, about theſe two ways of arguing, allows me to proceed to what I ſhall venture, though not without much diffidence, to offer you, concerning our grand queſtion, about which I ſhall refer my preſent thoughts to the five enſuing propoſitions.

PROPOSITION I.

AS to the generality of cœleſtial bodies, it ſeems not ſafe to propound arguments of their nature, from the ſuppoſition of particular ends, at leaſt of the human ones, deſigned by the Author of nature in framing them.

I will not only allow you, but encourage you, to take a riſe from the contemplation of the cœleſtial part of the world, and the ſhining globes that adorn it, and eſpecially the ſun and moon, to admire the ſtupendous power and wiſdom of Him, that was able to frame ſuch immenſe bodies, and, notwithſtanding their vaſt bulk, and (if the earth ſtand ſtill) ſcarce conceiveable rapidity, keep them, for ſo many ages, ſo conſtant, both to the lines and paces of their motion, without juſtling or interfering with one another. And I ſhall moſt willingly join with you, in returning thanks and praiſes to the divine providence and goodneſs, for having ſo placed the ſun and moon, and determined the former (or the earth) to move in ſuch lines, under that oblique circle aſtronomers call the ecliptic, that there needs ſkill in coſmography to be able to apprehend, how uſeful theſe ſituations and motions are for the good of men and other animals; and how diſadvantageous it would have been to the inhabitants of the earth, if the luminaries had been otherwiſe placed or moved than they are. But, for all this, I dare not imitate their boldneſs, who not only affirm, that the ſun and moon, and all the ſtars, and other cœleſtial bodies, were made ſolely for the uſe of man; but preſume to ground arguments, to evince ſuch a ſyſtem of the world to be true, and ſuch another erroneous, becauſe the former is, as they think, better fitted to the conveniency of mankind, or the other leſs ſuited to that end, or perhaps altogether uſeleſs or unneceſſary to it: as when they argue, that the ſun and other vaſt globes of light ought to be in perpetual motion to ſhine upon the

the earth; becauſe, as they fancy, it is more convenient for man, that thoſe diſtant bodies, than that the earth, which is his habitation, ſhould be kept in motion. But, conſidering things as meer naturaliſts, it ſeems not very likely, that a moſt wiſe Agent ſhould have made ſuch vaſt bodies, as the ſun and fixt ſtars, eſpecially if we ſuppoſe them to move with that inconceivable rapidity, that vulgar aſtronomers do and muſt aſſign them, only or chiefly to illuminate a little globe, that, without hyperbole, is but a phyſical point, in compariſon of the immenſe ſpaces compriſed under the name of heaven; whoſe lights might as well illuminate the earth, if they were a thouſand times leſſer than they are, provided they were placed at a proportionably leſs diſtance from it. And it will be very hard to aſſign, what conſiderable uſe the terreſtrial globe or its inhabitants derive from that multitude of cœleſtial globes, that make the milky way; ſince each of thoſe ſtars is ſo far from being ſingly able to enlighten the earth, that *Ariſtotle*, and the generality of philoſophers for many ages, (therein followed by divers of the Peripatetic ſchools at this day) took the whole aggregate of them for a meteor. And what light, or other known advantage, can the earth or its inhabitants derive from thoſe many fixt ſtars, that the teleſcope only can diſcover, (and which for that reaſon I ſometimes call teleſcopical ſtars) among the ſix or ſeven conſpicuous ones of the *Pleiades*, or among thoſe, that the naked eye can ſee in the belt or girdle of orion? which (conſtellations) I ſcarce ever look upon, through a good teleſcope, without wonder.

I FORESEE, it may be ſaid, that theſe and other the like cœleſtial bodies may be at leaſt thus far uſeful to man, as to diſcover to him, and give him a riſe to admire and praiſe the greatneſs and power of the divine Maker: and if this be ſaid, I ſhall not quarrel with the allegation, but readily grant, that though perhaps his wiſdom ſhines as bright to us men, in the ſtructure of a glow-worm, as in the diſpoſition of the unſeen ſtars, that make up the galaxy; yet the immenſity of his power could not perhaps be ſo well declared by leſs vaſt productions of it. But ſtill theſe arguments are not purely phyſical, but of that ſort, that I call phyſico-theological, whoſe inferences relate to the general intendments of God in the univerſe, which I therefore ſtyle coſmical ends, but do not reach to prove any thing about the determinate nature of particular bodies. And ſince the utmoſt, that philoſophy teaches us, is, that in general the good of man was one of the ends deſigned by God, in ſo framing the world as we ſee it is framed; there may be other ends deſigned by the ſame omniſcient Author of nature, of thoſe teleſcopical and other ſmall or remote ſtars, whoſe uſes to us are doubtful or inconſiderable; towards the attainment of which ends, thoſe cœleſtial bodies and motions may be admirably contrived and directed. And we not being able by meer reaſon to inveſtigate what thoſe ends are, though we have not near ſo much reaſon to aſſure us, that there may not be ſuch ends, as the infiniteneſs of God's wiſdom gives us to think there may be; it is preſumptuous for us to judge of the ſyſtem of the world, and of the deſtinations of fixt ſtars ſo remote, that, though they be probably like ſo many ſuns, we cannot ſo much as diſcern them without good teleſcopes, by that ſyſtem's greater or leſſer advantageouſneſs to us: eſpecially ſince, though it were certain, that, among other uſes, God intended they ſhould be in ſome ſort ſerviceable to us, yet He has no way declared to us in what capacity, or to what degree, they ſhall be uſeful to us. And therefore if they be ſo in any meaſure (as for example mentally) they are ſo, for what we know, as much as He deſigned they ſhould be; and that itſelf, being an unmerited favour, deſerves our humble thanks. And it ſeems very likely, that God did not deſign to all the parts of the earth itſelf, equal, and conſequently not the greateſt, advantages by the preſent ſyſtem of the univerſe; ſince the countries inhabited by the

Samoids and *Novazemblans*, and other nations, that live very near the arctic pole, want many conveniences and advantages enjoyed by the inhabitants of the temperate zones, that lye nearer the way, in which the ſun moves.

BUT, though bare philoſophy does not favour the bold opinion I dare not aſſent to, yet I know it will be pretended, that revelation does. And I readily confeſs, that the terraqueous globe, and its productions, (among which perhaps the atmoſphere may be reckoned) and eſpecially the plants and animals it is furniſhed with, do by the ſcripture appear to have been deſigned for the uſe and benefit of man, who has therefore a right to employ as many of them, as he is able to ſubdue: and that
Pſ. civ. 19. the two luminaries themſelves, the ſun and moon, were appointed by God to give light upon the earth, and be uſeful to all the nations, that inhabit it: and that there-
Pſ. civ. 24. fore the kingly prophet had reaſon to exclaim, *How manifold are thy works, O Lord! how wiſely haſt thou made them all!* when in the precedent and ſubſequent words he applies this to the terraqueous globe, and its inhabitants. And he might juſtly
Pſ. xix. 1. ſay, as he elſewhere did, *that the heavens declare the glory of God, and the firmament ſheweth his handy work.* But theſe general declarations, though they be juſt motives of our wonder and thankfulneſs, yet I fear they are not good topics to draw ſuch phyſical concluſions from, in particular caſes, as ſome learned men adventure to do. For I do not remember, that it is any where declared in the ſcripture, that the ſervice of man was the only, or perhaps ſo much as the chief, uſe of all the cœleſtial lights, and other bodies of that immenſe part of the world. And this ſingle conſideration ought to oblige us, to be very wary in making aſcriptions to ourſelves, as if the great ſyſtem of the world were to be eſtimated by our conveniences. And if it be ſaid, that things merely corporeal have not, and man alone has, a rational faculty, whereby to refer the great and wonderful works of God to the glory of their Maker; I ſhall take the liberty to anſwer, that, though this has been affirmed by many, if not alſo aſſented to by all, yet I have not found it proved by any. And I ſomewhat wonder, that divines ſhould on this occaſion overlook that paſſage in the 38th chapter of *Job*, which they generally interpret of the angels: for the queſtion, which
Job xxxviii. 4, 5, 7. God there puts to *Job*, may be juſtly applied to *Adam* himſelf; *Where waſt thou, when I laid the foundations of the earth? declare if thou haſt underſtanding. When the morning-ſtars ſang together, and all the ſons of God ſhouted for joy.* And indeed, if we even may preſume to conjecture of ſuch things, it ſeems to me reaſonable to think, that God created the angels before the material world, that He might have intelligent beings to pay Him the juſt tribute of praiſes for ſo admirable a ſpectacle as that of the riſing world, or rather the beginning and progreſs of the creation. However, by the words laſt cited out of the book of *Job*, it appears, that before man was made (for that he was not till the ſixth day) God wanted not intelligent ſpectators and applauders of his corporeal works. And ſince the angels are a nobler order of intellectual creatures than men, and are not unconcerned ſpectators of the works of God; how do we know, but that in the ſyſtem of that part of heaven, of which we need teleſcopes to know, that there is ſuch a thing in *rerum natura*; and in the plants, animals, or other furniture, whatever it be, of thoſe particular, and to our naked eyes inviſible, ſtars, that ſerve us men barely for declarations of their Maker's power; ſuch intelligent ſpirits as angels may diſcern as wiſe deſtinations, and as admirable contrivances, as thoſe, which, at the forming of the earth and its furniture, invited their devout hymns and acclamations? and in this caſe, God will not loſe any thing of the glory due to the divine attributes diſplayed in the fabric of the cœleſtial part of the world, though the fixt ſtars ſhould be neither only nor principally deſigned for the ſervice of men.

To what has been hitherto ſaid, to let you ſee the reaſonableneſs of my firſt caution, which repreſents the making particular and meerly phyſical inferences from the ſuppoſed deſtinations of cœleſtial bodies, as a thing unſafe, I ſhall now add, in the ſecond place,

THAT it is yet more unſafe to ground arguments of the nature of particular bodies, that are inanimate in the ſublunary world, upon the uſes we think they were deſigned for.

THIS will not appear an unreaſonable caution, if we conſider, how little we know of the particular purpoſes of nature in thoſe bodies here below, which not being organical, like thoſe of animals and plants, cannot by the curiouſneſs of their ſtructure diſcloſe to us the particular ends, to which they were ordained. And as for their motions, ſince they are extremely far from being ſo conſtant and regular as thoſe of the cœleſtial bodies, the caution we gave about drawing arguments from the ſyſtem of the heavens, will not, ſure, be thought unfit to take place, when we ſpeak of clays, chalks, and ſtones, and the like terreſtrial bodies, whoſe textures are, comparatively to thoſe of living creatures, very ſimple and ſlight, and ſeldom more curious, than may be made by art, by diſſolving ſtones and metals in chymical menſtruums, and afterwards chryſtallizing the ſolutions; of which I elſewhere give examples. It is true, that, though revelation ſpeaks rather of God's having deſtinated animals and vegetables, than inanimate bodies, to the ſervice of men; yet there is no abſurdity to conceive, that, generally ſpeaking, that may be one of the ends deſigned by the Author of nature, in making metals, ſtones, and thoſe other inanimate parts of the terreſtrial globe, that man is able to maſter and make uſe of. But whereas in this globe the ſurface is diſtant from the center above three thouſand and five hundred miles; and I do not find, that either men's ſpades or their plumming lines have reached above one mile of that great number; nor is it very likely, that human induſtry will ever make its way down to the thouſandth part of that vaſt depth: it ſeems very improbable, that the remaining internal part of the earth, that is above ſeven thouſand miles thick, and may, for aught we know, contain great varieties of foſſils and other creatures, ſhould be made chiefly or only for the ſervice of men, from whoſe ſight they lie hid in a deeper well than that of *Democritus*, and who do not ſo much as know, what kind of bodies they are. And though it will not hence follow, that the terraqueous globe was made by chance, no more than that any of the other planets was ſo; becauſe the admirable ſtructure of plants and animals evinces the exiſtence and providence of a moſt wiſe and powerful Author of things, who may juſtly be ſuppoſed to have made nothing in vain, even among the inanimate portions of our globe, whoſe animated portions are ſo wiſely and exquiſitely framed: yet, that thoſe inanimate bodies were made for determinate ends, is more eaſy to be deduced from the knowledge we have by other mediums, that they are the productions of a wiſe and provident Author, than by the contemplation of theſe inanimate bodies themſelves. And perhaps it may be worth inquiry, whether ſome things may not be made, even by a wiſe Agent, not out of a primary intention, but as productions, that will naturally follow upon the eſtabliſhment and preſervation of thoſe grand laws and rules of motion, that were moſt fit to be ſettled among things corporeal. And it is very poſſible, that, according to that coſmical eſtabliſhment, (if I may ſo call it) many parts of the terreſtrial globe ſhould be ſo placed or diſpoſed of, as not to be ſerviceable to men; becauſe the whole aggregate, or globulous maſs, could not otherwiſe be ſo well ſuited to the general deſtinations of the univerſe, which, if otherwiſe contrived, would perhaps have been leſs ſerviceable than now it is to man himſelf. To countenance which conſideration, I ſhall obſerve, that,

See the Tract of the Origin and Virtues of Gems.

that, though the eclipſes of the ſun and moon be uſually unwelcome, and, if aſtrologers may be credited, often very prejudicial to multitudes of men; yet the great *Former of all things*, or, as the original will bear it, *of the whole*, did not think fit to alter the tracts or lines of motion, that He aſſigned the luminaries, to avoid the eclipſes, that muſt yearly enſue upon their moving in ſuch lines. Whence we may alſo learn, that ſome phænomena may not belong to the primary intention of nature, but are only the neceſſary conſequences and effects of the primitve conſtitution of the world, and the catholic laws of motion. And if it be here demanded, what the ends are, for which the deep and hidden parts of the terraqueous globe, and the teleſcopical ſtars of the firmament, were made, if they were not made for the uſe of man, I ſhall frankly anſwer, that I cannot tell: and I know not, but ſuch an anſwer may be more expreſſive of the profound reverence we owe the great Author of nature, than their opinion is, that would have all theſe made for the uſe of man; ſince to ſay, that we know not, why ſome part of a work is made by an artiſt, whom other parts proclaim to be moſt wiſe and ſkilful, does both acknowledge our own ignorance, and leave it highly probable, that ſuch pieces of work are ſuited to purpoſes worthy of Him, and ſuitable to them; and ſeems therefore a ſafer and more reſpectful opinion, than to ſuppoſe Him to have made ſuch things for a particular end, which we cannot make out to be in any conſiderable meaſure worthy of his wiſdom, and attainable by them.

Jotzer haccol, Jer. x. 16.

PROPOSITION II.

IN the bodies of animals it is oftentimes allowable for a naturaliſt, from the manifeſt and appoſite uſes of the parts, to collect ſome of the particular ends, to which nature deſtinated them. And in ſome caſes we may, from the known natures, as well as from the ſtructure, of the parts, ground probable conjectures (both affirmative and negative) about the particular offices of the parts.

To obviate miſtakes, you may pleaſe to take notice, both that in this propoſition I ſpeak only of thoſe ends and uſes of the parts of an animal, that relate to the welfare and propagation of the animal itſelf, and which therefore I formerly called animal ends; and yet that I do not thereby deny any declaration, that is made in the holy ſcriptures, that God deſigned, that the entire animals, as well as their parts, ſhould be in ſeveral ways ſerviceable to man. And having premiſed this to explain my meaning in the propoſition, I ſhall now conſider diſtinctly the two parts, whereof it conſiſts.

AND 1. There is no part of nature known to us, wherein the conſideration of final cauſes may ſo juſtly take place, as in the ſtructure of the bodies of animals. And I confeſs, that, when I aſſiſt at a well-adminiſtred anatomy, I do ſo wonder at the admirable contrivance of a human body, that I cannot but ſomewhat wonder, that there ſhould be found, among philoſophers, men that can aſcribe it to blind chance. The Stoic, that (in *Cicero*) aſked an Epicurean, why chance did not make palaces and other buildings, ſeems not to me to have made an impertinent queſtion. For the commodiouſeſt houſes, men's bodies dwell in, are far leſs curious ſtructures, than the manſions their ſouls reſide in: which you will not think a groundleſs paradox, if you conſider, that, whereas even in a palace, the materials being wood, ſtone, brick, mortar, glaſs, and four or five metals, are but few in compariſon of the parts of differing textures, as bones, nerves, ligaments, membranes, muſcles, veins, arteries, griſtles, glandules, jellies, humours, *&c.* and their diſpoſition is exceeding ſlight, in compariſon of the curious and elaborate contrivance of the numerous parts, both

both ſolid and fluid, of the human body; whereof though the ſtable parts alone have been reckoned to amount to ſome hundreds, yet in every one of theſe parts, the bulk, figure, conſiſtence, texture, ſituation, connexion and aptneſs for motion, is the moſt commodious, that can be deviſed; and all of them are wonderfully ſymmetrical, both to one another and the whole body; to divers of whoſe motions, as leaping, running, ſpeaking, ſwimming, ſneezing, *&c.* a great number of them conſpire. And this number of parts is ſo artificially contrived and packed together, that though in a body, where no room is loſt, many parts do at the ſame time exerciſe very differing motions, each of them moves freely, and does not at all hinder another, but rather they promote each other's motions.

I WILL not ſuffer indignation to tranſport me ſo far as to wiſh, that thoſe, that deny the uſefulneſs of all the parts of their bodies, may fall ſick, or receive ſome wound, to be thereby at once convinced and puniſhed: but I will venture to ſay, that diſeaſes or hurts alone may ſhew, how excellently all the parts of our bodies are contrived in order to our welfare. For if ſo much as a finger be made bigger by tumors, or diſplaced by being put out of joint, or kept in a wrong poſture by contractions, or have its continuity violated by cutting, or its tone changed by ſtrains or contuſions, or its ſenſe or motion taken away by the palſey, or its membranes fretted by ſharp humours, or its motions diſordered by the cramp or convulſions; in any of theſe caſes we quickly find, how commodiouſly the parts affected were framed or diſpoſed, when any diſeaſe or hurt gives them a præternatural conſtitution; that is, changes that figure, connexion, tone, *&c.* which, according to the inſtitution of nature, whilſt the body is in full health, does belong to it.

THE eye (to ſingle out again that part for an inſtance) is ſo little fitted for almoſt any other uſe in the body, and is ſo exquiſitely adapted for the uſe of ſeeing, and that uſe is ſo neceſſary for the welfare of the animal, that it may well be doubted, whether any conſidering man can really think, that it was not deſtinated to that uſe. The ſix or ſeven muſcles, that move the whole bulbe of the eye, upwards, downwards, to the right hand, to the left, and to various oblique poſitions; and the ſeveral coats and humours, that make up the ſenſory, have not only their bigneſs, ſhape, conſiſtence, ſituation and connexion, admirably adapted to that end; but the tranſparency of the cornea and the humours, the opacity of the uvea, and the ſemi-opacity of the retina, and the ſeveral motions of the parts of the eye, being requiſite to receive, tranſmit, refract, and diſpoſe the viſive beams, that come from the object, after the manner requiſite to make the livelieſt picture of it in the bottom of the eye, do no leſs concur to compleat this matchleſs organ of viſion: which is ſo rarely contrived in order to that uſe, and comparatively ſo little to any other, that there is no more raſhneſs to ſay, that an eye, than that a teleſcope, was made for an inſtrument to ſee with; that is, to diſcover the colours, magnitudes, ſhapes and motions of diſtant objects. And in that admirable perforation of the uvea, which we call the pupil, nature has much outdone art; for whereas we are fain to apply to the object-glaſſes of teleſcopes opacous bodies with ſeveral circular apertures, that ſome may let in leſs light, and others more, according as the objects are more or leſs bright or inlightened; that part of the uvea, that hangs in the aqueous humour, is an aperture, as the artiſts call it, that narrows and opens itſelf in a trice, according to the exigency of the objects we look on; which if they be ſo conſtituted or placed, that they reflect but a dim light, the curtain is preſently drawn open, and the pupil circularly widened, to let in the more beams of light; and the contrary happens, as often as the object, being too luminous or illuſtrated, would offend the organ, or diſturb the ſight, if the contraction of the pupil did not ſhut out ſome of its beams. But for the uſes of

the ſeveral parts of the eye, I ſhall refer you to the induſtrious Jeſuit *Scheiner*'s *Oculus*, and *Des Cartes*'s excellent Dioptrics; where you will eaſily perceive, that, in framing the eye, nature did not only act with deſign, but with ſo much ſkill in optics, that a more than ordinary inſight into that ſcience, is neceſſary to underſtand the wiſdom of the contrivances; and perhaps no degree of ſkill in it would enable a man to alter them for the better. It were tedious to mention the other parts of the body, that manifeſtly appear to have been pre-ordained to certain uſes. The books of anatomiſts are full of paſſages applicable to this purpoſe; of which I ſhall ſay in general, that though what they deliver ſuffices to ſhew, that all the parts of the body are the effects of an intelligent cauſe: yet, unleſs their deſcriptions and reflexions be improved by men verſed in mathematics and mechanics, and, I ſhall venture to add, in chymiſtry too, we ſhall but imperfectly underſtand, how intelligent that cauſe is, or how much wiſdom it has diſplayed, in the ſtructure of a human body, and each of its parts.

Illud in his rebus vitium vehementer ineſto effugere, illorumque errorem præmeditemur, lumina qui facunt oculorum clara creata proſpicere ut poſſimus, Lucret. de Nat. l. iv. Nihil ideo quoniam natum eſt in corpore ut uti poſſemus, ſed quod natum eſt, id procreat uſum. ibid.

I KNOW it is objected by the Epicureans, that the parts of animals were firſt made, and their uſes afterwards found out by men's ſagacity. But this is a ſophiſtical objection. For, firſt, as to many of the inner parts, as the heart, liver, ſpleen, kidneys, *&c.* they perform their functions without ſo much as our knowledge of their ſtructure, or perhaps their ſituation; ſo far are they from being applied to ſuch uſes by our ſagacity. And as for the limbs and other parts, which we can move at pleaſure, it is true, that they cannot be actually employed to the reſpective uſes, till they be actually formed; but that hinders not, but that in their formation they were therefore ſo formed, that they may be in due time fit for ſuch uſes. And therefore we ſee, that the chick is furniſhed with compleat eyes, and with wings and feathers, before he be hatched; though, whilſt he is yet incloſed in the egg, he cannot make uſe of them to ſee or fly. And why was it, do the Epicureans think, that nature provided a whole ſet of temporary parts for pregnant females, and animals in the womb, which, when they are come into a freer ſtate, partly fall away of themſelves, and partly turn to a ligament, fitted no longer for the former, but for a more ſeaſonable uſe? And it is to be noted, that the production of theſe umbilical veſſels, and the placenta or analogous body in the womb, to which they are faſtened, is of no neceſſity nor uſe to the female before conception; and thereby thoſe temporary parts appear to have been deſigned by nature, not ſo much for the perſonal preſervation of the female as for the propagation of the ſpecies: which deſtination not coming to be accompliſhed, till a woman, for inſtance, has attained to a competent age, appears to have been pre-ordained by the author of mankind for the continuation of it.

AND though it be true, that the ſagacity of men may have found out ſome uſes of ſome parts of their bodies, that cannot be made appear to have been primarily intended by the author of nature; yet that is no good argument, that thoſe uſes were not intended, which either are made within us, or do, as it were, obtrude themſelves upon us. And as for other uſes, the preſcience and goodneſs of God are ſuch, that it ought not to appear incredible, that he, that gave man both the limbs of his body, and the rational endowments of his mind, and that has made many parts, as the eyes and the ears, double, that one may ſupply the want of the other; did both foreſee what uſes men might, according to their ſagacities and emergencies, make of theſe parts, and ſo contrive the parts, that they ſhould be applicable to ſuch uſes. Suppoſe a wiſe man ſhould ſend his ſon to travel, and among other things give him a pocket-dial with a magnetic needle; and this traveller having loſt his way in ſome wild plain, or being at ſea in a veſſel, whoſe compaſs was broken or ſpoiled by a ſtorm, or ſome other miſchance: if, I ſay, in this caſe, though the traveller ordinarily

rily employed his dial only to find the hour of the day, he ſhall now employ it to guide his courſe or ſteer the veſſel, by the help of the needles pointing northward; though this would be an effect of his own ſagacity, yet his father, being a wiſe and experienced man, may reaſonably enough be ſuppoſed to have foreſeen, that his ſon might have need of knowing the northern and ſouthern points of the horizon; and accordingly may have given him a dial furniſhed with a magnetic needle, rather than an ordinary gnomical dial. And ſo a man, that has taught another to paint landſkips, when he gives him a pencil and a pallet furniſhed with colours, to draw a particular proſpect, is not to be ſuppoſed to have deſigned, that he ſhould not employ them to any other purpoſe, if urgent circumſtances made it requiſite for him to do ſo.

HAVING inſiſted longer than I intended upon the former part of my propoſition, I now proceed to the latter; namely, that in ſome caſes we may from the known ends of nature, as well as from the ſtructure of the parts, ground probable conjectures, both affirmative and negative, about the particular offices of the parts: which I could not ſeaſonably do before, becauſe the arguments, that were founded on the uſes of the parts of animals, ſuppoſe not only, that thoſe parts were deſtinated to particular uſes knowable by us, but that the ſeveral parts of the body were contrived as wiſely and commodiouſly, as men are able to deviſe, in order to the ends of nature; which is always to be underſtood to have united in her deſigns the uſes of the parts, and the welfare of the whole.

AND indeed if we conſider, how admirable a fitneſs there is in the parts of the human body, for inſtance, to thoſe particular ends we can diſcover them to have been predeſigned for; it ſeems allowable to conjecture, that ſuch a part was not primarily deſigned to ſuch an uſe, becauſe it is, on the account of its ſtructure or otherwiſe, leſs fitted for it, than the conſtant wiſdom of nature ſeems to require; eſpecially if there be any other parts, by which that office may be more commodiouſly performed. And on the other ſide it may be a probable ground, though not altogether ſo probable as the former, to conclude, that ſuch a part was deſtinated to ſuch an uſe, if the uſe itſelf appear to be neceſſary, and the part better fitted for it than any other is.

THUS, though anatomical and optical writers, as well as the ſchools, did for many ages unanimouſly conclude the cryſtalline humour to be the principal ſeat of viſion; yet the induſtrious *Scheiner*, in his uſeful tract, intituled *Oculus*, does juſtly enough reject that received opinion, by ſhewing, that it ſuits not with the ſkill and providence of nature, to make that part the ſeat (or chief organ) of viſion, for which it wants divers requiſite qualifications, eſpecially moſt of theſe being to be found in the retina. And I remember, that when I aſked our famous *Harvey*, in the only diſcourſe I had with him, (which was but a while before he died) what were the things, that induced him to think of a circulation of the blood? he anſwered me, that when he took notice, that the valves in the veins of ſo many parts of the body were ſo placed, that they gave free paſſage to the blood towards the heart, but oppoſed the paſſage of the venal blood the contrary way; he was invited to imagine, that ſo provident a cauſe as nature had not ſo placed ſo many valves without deſign; and no deſign ſeemed more probable, than that ſince the blood could not well, becauſe of the interpoſing valves, be ſent by the veins to the limbs, it ſhould be ſent through the arteries, and return through the veins, whoſe valves did not oppoſe its courſe that way.

THUS, whereas former anatomiſts and phyſicians generally believed the nutrition of the parts by the venal blood, the more recent writers are wont to teach, that the parts are nouriſhed by the blood in its paſſage through the arteries. Not that they think the blood, that runs through the veins, altogether unfit to irrigate the parts with that vital liquor; but that they judge the veins to be leſs fit than the arteries,

into which the blood comes immediately from the left ventricle of the heart, agitated and ſpirituous, and with a briſk impulſe, which forces out the particles of the blood, at thoſe pores of the arteries, that they find congruous to their ſhape and ſize, and which anſwer to the ſeveral parts, that are to be nouriſhed by corpuſcles ſo qualified. It were not difficult, if it were neceſſary, to accumulate inſtances to the ſame purpoſes with thoſe already mentioned; there being nothing more frequent in the books of anatomiſts, and thoſe that treat of the phyſiological and pathological parts of phyſic, than to draw arguments, as well affirmative as negative, about the uſe of the parts of the body, from their fitneſs or unfitneſs, or their greater or leſſer fitneſs, to attain ſuch ends, as are ſuppoſed to have been deſigned by nature. And indeed theſe argumentations occur ſo frequently, that I think there is leſs need of my increaſing them, than of my proceeding to give you a caution about them, which I ſhall do in the following propoſition.

PROPOSITION III.

IT is rational, from the manifeſt fitneſs of ſome things to coſmical or animal ends or uſes, to infer, that they were framed or ordained in reference thereunto by an intelligent and deſigning agent.

DIVERS things have incidently been ſaid in this paper, eſpecially in the firſt ſection of it, and others may hereafter be occaſionally added, that may juſtly be employed againſt that part of the Epicurean hypotheſis, which aſcribes the origin of things to chance, and rejects the intereſt of a deity, and the deſigning of ends, in the production and management of natural things. But becauſe I obſerve, not without grief, that of late years too many, otherwiſe perhaps ingenious men, have with the innocent opinions of *Epicurus* embraced thoſe irreligious ones, wherein (as I was ſaying) the deity and providence are quite excluded from having any influence upon the motions of matter, all whoſe productions are referred to the caſual concourſe of atoms: for this reaſon, I ſay, I thought it a part of my duty, as well to the moſt wiſe author of things, as to their excellent contrivance and mutual ſubſerviency, to ſay ſomething, though but briefly, yet diſtinctly and expreſsly, to ſhew, that, at leaſt in the ſtructure and nature of animals, there are things, that argue a far higher and nobler principle, than is blind chance. But that I may do what I here intend, with as much brevity as I can, I will do little more than name ſome particulars, that I have not obſerved to be ſo uſually reflected on to the purpoſe, for which I mention them. And I ſhall confirm theſe conſiderations but with one inſtance, and that too taken from a ſort of parts, that are as little elaborate, and therefore ſeem to be as little fit for my purpoſe, as almoſt any in the human body.

I WILL not now inculcate what has been delivered, and may be farther ſaid, of that exquiſite ſtructure of the bodies of dead animals, that is diſcoverable by the knives of anatomiſts, (though I ſhall not ſcrupulouſly forbear to touch lightly on a few things of that kind, that are requiſite to my purpoſe;) my preſent deſign being to ſet down very briefly a few arguments, to ſtrengthen the propoſition lately delivered.

FIRST then, I obſerve that there ſeems to have been care taken, that the body of an animal ſhould be furniſhed, not only with all things, that are ordinarily neceſſary and convenient, but with ſome ſuperabundant proviſion for caſualties. Thus, though a man may live very well, and propagate his kind, (as many do,) though he have but one eye; yet nature is wont to furniſh men with two eyes, that, if one be deſtroyed or diſeaſed, the other may ſuffice for viſion. And ſo, if one ear grow deaf, a man may be converſed with, by the help of the other, that remains ſound. In ſhort,

nature has furniſhed men with double parts of the ſame kind, where that duplicity may be highly uſeful, and can be permitted without incongruity to the reſt of the body. And this is the more conſiderable, becauſe in other parts nature appears to huſband things ſo, as to ſhun doing things ſuperfluous: as within the ſkull, ſome veſſels, that would in other parts of the body have double coats like other arteries, are much thinner, almoſt like veins; the thickneſs of the ſkull being ordinarily a ſufficient fence to them from external injuries.

ANOTHER argument, that divers things, that nature does about animals, are done with deſign, may be taken from what anatomiſts obſerve of thoſe parts of the womb or the fœtus, that are to be found but at certain times, at which there is need of them, and not at others, when they would be uſeleſs. Thus, when a woman is with child, the vaſa umbelicalia are produced, to be channels either for the blood or alimental juice and ſpirits, that then ought to paſs between the womb and the fœtus; which is to be nouriſhed, either only or chiefly, by the liquors derived to it through thoſe veſſels, aſſiſted by the placenta, that ſupply to it the want of eating with the mouth, which the unborn infant either does not at all, or does but very imperfectly, employ to feed himſelf. And though as long as he continues impriſoned in the womb-ſtate, theſe temporary parts, (if I may ſo call them) continue with him; yet, as ſoon as he comes abroad into the world, theſe umbilical veſſels, particularly the two arteries and the vein, together with the membranes they are wrapt up in, and thoſe (commonly called the chorion and the amnios,) that involve the fœtus, are thrown off, as unneceſſary to the born infant's new ſtate, and, when it has quitted the womb, are expelled after it, whence they are called the after-birth; there remaining only that part of the umbilical veſſels, that lies within the child's abdomen, between the navel and the liver, where its uſe is conſiderable, though new; it ſerving no more to convey blood, or an alimental liquor, to and fro, but degenerating into a ligament.

To the ſame purpoſe with this contrivance, we may mention that other, wherein nature employs the foramen ovale, that gives paſſage to the blood from the right ventricle of the heart to the left; that the circulation of it may be maintained, though it cannot in the embryo, as it does in a born child, paſs through the veſſels of the lungs from one of the ventricles to the other. For this foramen ovale being but (if I may ſo call it) an expedient, that nature employs, as long as that, which is intended to be an infant, remains an embryo; this temporary conformation is obliterated, when the child, breathing the free air, is in a condition to make the blood circulate through the pulmonic veſſels, according to the primary intention of nature. From which and the like inſtances we may infer, that theſe temporary parts were framed by a fore-caſting, as well as deſigning agent, who intended they ſhould ſerve for ſuch a turn, and then be laid aſide; it being utterly improbable, that an undeſigning agent ſhould ſo appoſitely and exquiſitely frame ſcaffolds for the future buildings, if he did not before-hand deſtinate both the one and the other to concur to the ſame ultimate effect.

ANOTHER argument for our preſent purpoſe may be drawn from the conſideration of thoſe things, that in animals are commonly called inſtincts; whereof ſome more directly regard the welfare of the individuals they belong to, others the propagation of their ſpecies, and ſome again reſpect them both. The writers of voyages, and thoſe, that profeſſedly deliver natural hiſtory, recount ſtrange, and ſcarce credible, inſtances of the inſtincts obſervable in certain animals. But we need not lay the ſtreſs of our argument upon dubious, or ſuſpected relations; ſince what I have met with in authors of good authority, or received from the mouths of travellers of good

good credit, may ſerve my preſent turn; eſpecially if it be allowed, (as I ſee not, why it may not be,) to take the word inſtinct in a latitude, ſo as to compriſe thoſe untaught ſhifts and methods, that are made uſe of by ſome animals, to ſhun or eſcape dangers, or to provide for their future neceſſities, or to catch their preys.

DIVERS ſtrange things are delivered, not only by poets, but by more credible writers, about the wonderful ſagacity and government of bees, in point not only of oeconomy, but of politics too. But though I ſhall not build any thing upon the authorities, that I myſelf ſuſpect, yet, having had the curioſity to keep for a good while in my cloſet a tranſparent hive, whence there was a free paſſage into a neighbouring garden; and having thereby had the opportunity to make frequent obſervations of the actions of theſe little animals, and particularly to ſee them at work about making their combs, and filling them with honey; I confeſs I diſcovered ſome things, that I did not believe before, and was induced to look upon them as very fit inſtances of creatures endowed with natural inſtincts and providence. For it were hard for a mathematician, in contriving ſo many cells, as they make in the area of one of their combs, to huſband ſo little ſpace more ſkilfully, than they are wont to do. And not only they carefully and ſeaſonably lay up their honey, to ſerve them all the winter, but curiouſly cloſe up the particular cells with covers of wax, that keep the included liquor from ſpilling, and from external injuries. I do not here mention the prognoſtication of weathers, that may be made in the morning by their keeping within their hives, of flying early abroad to furniſh themſelves with wax or honey, or by their unexpected return before a ſtorm unſeen by men; becauſe I ſuſpect, that theſe things may not be ſo much the effects of inſtincts, as of a tenderneſs and quickneſs of ſenſe, ſuch as may be ſeen in a good weather-glaſs, and found in divers wounded and crazy perſons, that are affected with ſuch beginnings of the changes of the air, as are not yet perceived by other men. But among the peculiarities to be obſerved in the conduct of bees, I cannot but take notice, that after a fight, I have not without ſome wonder, ſeen them take up the dead, that lay on the ground, and fly away with them to I know not what diſtance from their hive.

ANOTHER obvious inſtance of the inſtinct, that nature has given even to ſome deſpicable inſects, may be taken from ants, to whom *Solomon* ſends the ſluggard to ſchool, to learn the providence of making ſeaſonable proviſion for the future. For it is known, that theſe little creatures do in the ſummer hoard up grains of corn againſt the winter. And their ſagacity is the more conſiderable, if it be true, what divers learned perſons affirm, that they eat or bite off the germens of the grains of corn they lay up, leſt the moiſture of the earth expoſed to the rains ſhould make it ſprout. But whatever become of this tradition, theſe inſects do ſome other actions, reſembling ſagacity and induſtry, that are not ſo contemptible as their bulk, though I muſt not ſtay to mention them particularly in this place.

THE untaught ſkill of ſpiders, in weaving their curious webs, that are ſo fitly contrived both to catch their flying prey, and give them immediate notice of its being caught, is a thing, which, if it were not familiar, would be looked upon as admirable. And this ſkill is not, as ſome imagine, an effect of imitation of their parents: for if the eggs be taken away and incloſed in a glaſs, when they come to be hatched by the heat of the ſun, the little creature will immediately fall to ſpinning in the glaſs itſelf, as was related to me by an eminent mathematician, that made the experiment. And I ſaw the leſs reaſon to diſtruſt it, becauſe, having by an external heat hatched many eggs of ſilk-worms, in a place, where there had not been any of a long time before, nor probably ever till then, yet the worms produced by theſe eggs did in autumn, of their own accord, climb up to thoſe convenient

places

places I had prepared for them, and there weave thoſe curious oval priſons, in which they encloſed themſelves, and which are unravelled into ſilk, of whoſe extreme fineneſs or ſlenderneſs I have elſewhere given an account.

NOR is the provident induſtry of animals confined to inſects, of whom the poet, (if his words be taken in a popular ſenſe,) truly ſaith:

Ingentes animos anguſto in pectore verſant:

Since it is to be found in divers of the greater animals, particularly in beavers; of whom though ſome things, that are recounted by authors and travellers, are but fabulous; yet what has been related to me by ſober and judicious perſons, that were either born or lived in *New-England*, where, theſe animals abounding, they had the opportunity to obſerve them, is ſufficient to confirm ſuch relations, as may give one juſt cauſe of wonder. For theſe credible perſons affirmed, that the beavers with their ſharp teeth (whoſe ſhape and ſtrength I have admired) cut pieces of wood ſo, as to make them fit for their purpoſe: that, by aſſociating their labours, they lay theſe together ſo, as to build themſelves ſtrong winter-houſes, in which there is ſometimes a kind of ſecond ſtory, for the inhabitants to retire to, when the water chances to overflow: that for theſe houſes they chuſe a very convenient ſituation, juſt by ſome river, or other water, that can furniſh them with fiſh: and that the overture or hole, that belongs to each of theſe houſes, is placed juſt by the water, that they may immediately flounce into it, and ſo ſave themſelves, when their houſes are attacked. And to facilitate their ſwimming away, and the catching of their prey in the waters, nature has furniſhed them, as I have obſerved with pleaſure in a live beaver, with two feet, not made like thoſe of dogs, or cats, or like their own two other feet, but furniſhed with broad membranes betwixt the toes, like the feet of geeſe, ducks, and other aquatic animals, that are to uſe them as oars, to thruſt away the water, and facilitate their motions upon it, and in it.

IT were eaſy to accumulate inſtances of the ſagacity and induſtry of animals, for their own preſervation; but it is more eaſy to find notable ones among thoſe actions, that concern the propagation of their ſpecies.

The various arts employed by animals of differing kinds about the materials, the conſtruction, and the ſituation of their neſts, is uſually remarkable, and ſometimes wonderful. Of this ſkill we have divers eminent inſtances, ſome of which I have been delighted to ſee, but have not time to recount. Yet one there is, whoſe oddneſs will not ſuffer me to pretermit it. For in a country that abounds with apes and monkeys, that are very greedy of birds-eggs, and oftentimes climb trees to come at them, there is a ſort of birds, whoſe eggs they peculiarly affect, that do, as it were, hang their neſts at or near the end of ſome long flexible branch or wand, that grows over the water; by which means their inſidious enemies, who do not ſwim, cannot come at them underneath; and by reaſon of the yielding of the flexible branch or twigs, whereto the neſt is faſtened, they are frighted from venturing to paſs on, for want of a firm ſupport.

THE ſtructure of the neſts of waſps, which they often make under ground to ſecure them, I have obſerved to be very curious and artificial, eſpecially when the young ones are formed in the little cells, where they lie hid and ſheltered, till they are ready to fly away.

I MIGHT here multiply examples of this kind, but I think it fitter to proceed, by telling you, that the inſtincts, that nature has implanted in animals to preſerve themſelves, though they would ſeem admirable if they were leſs familiar, are much inferior.

inferior to that providence, that ſhe has furniſhed animals with, for the propagation of their ſpecies.

THERE are divers notable things to be met with in the neſts of ſeveral birds, both as to their materials, their ſtructure, and the very ſituations of the places pitched upon to build them in. I have ſeen ſome neſts, eſpecially Indian ones, which would make a man wonder, how the birds, that built them, ſhould ſeek and find ſuch odd, and yet, all circumſtances conſidered, commodious materials to build with. Of which we have an eminent inſtance in the neſts of certain Eaſtern birds, whoſe names I remember not, that make their neſts of a white ſubſtance, (which has been preſented me by ſome of our Eaſt-India merchants,) that looks almoſt like ichthyocolla, in the ſhops commonly called iſinglaſs, and is diſſoluble in liquors, and ſo very well taſted, that it makes the chief ſawce, that they uſe in the ſouthern parts of India at their feaſts. The ſtructure alſo of the neſts of divers birds, both as to their figure, their capacity ſuitable to the bulk of the builders, and the accommodations they are furniſhed with for warmth and ſoftneſs, may deſerve to be applauded by mathematicians themſelves; eſpecially if it be conſidered, that theſe little untaught architects had no tools to make their curious buildings with, ſave their beaks and their feet. And yet much more of providence and foreſight appears in the ſituation of the places, that ſome birds make choice of to build their neſts in: as may be obſerved, not only in the pendulous neſts of ſwallows, and the crafty hidden ones of ſome European birds, but very conſpicuouſly in the hanging and moveable neſts, that we lately mentioned to be ſo oddly placed by ſome birds, to ſecure their eggs from apes and monkeys; and by the ſituation of the well-taſted neſts I was newly ſpeaking of, which are to be found only upon high and ſteep rocks, and are ſo faſtened to thoſe concave parts of them, that look downwards, and, for the moſt part, hang directly over the ſea, that there is no getting them without much trouble and danger, by the help of boats and poles: upon which account, as well as that of their deliciouſneſs, they are very dear in the *Eaſt-Indies* themſelves. The like care to contrive their neſts advantageouſly, and make them in ſecure places, is taken by divers inſects themſelves; as may be obſerved in the ſubterraneal neſts of the waſps formerly mentioned, and in the eggs of ſnails, which I have ſometimes found hid under ground, and had the curioſity to hatch in glaſſes furniſhed with the ſame earth they were found in.

IF I ſhould here reckon up and diſplay the ſeveral effects, and conſequently arguments, of the wonderful providence, that the moſt wiſe author of nature exerciſes about the propagation of animals, by diſtinguiſhing them into male and female; by furniſhing both ſexes with mutual appetites and organs, exquiſitely adapted to the increaſe of their kind; by the admirable formation of the fœtus in the womb, without the female's knowledge, how it is performed; by the ſtrange ſubtilties and courage, that ſeveral of them, either oviparous or viviparous, have, to hide and defend their young; by the full proviſion, that is made for the nouriſhment of the fœtus, and the welfare of the female after ſhe has brought it forth; and by divers other ways, that I muſt not now ſtay to ſpecify: if, I ſay, I ſhould venture to do this, I might indeed much enrich and adorn my argument, but ſhould make this diſcourſe too much exceed the limits, that my deſign, and ſmall ſtock either of ability or leiſure, would allow. And therefore, inſtead of purſuing a ſpeculation, that would lead me a great deal too far, I ſhall look back upon the intimation I gave not long ſince, that even thoſe meaner parts of animals, which ſeem to have been framed with the leaſt care or contrivance, are yet not unworthy of their author.

FOR

For proof of which I ſhall now obſerve, that, though the teeth be ſome of the leaſt elaborate parts of the human body, yet even theſe afford more obſervations, appliable to our preſent purpoſe, than my intended brevity will permit me to take notice of. And therefore I ſhall only, and that little more than tranſiently, conſider a few of them here; and ſome of the others elſewhere, on thoſe particular occaſions, on which it will be more proper to bring them in.

I. And firſt, it is conſiderable, that whereas, when a man is come to his full ſtature, all the other bones of the body ceaſe to grow, the teeth continue to grow in length, during a man's whole life.

This growth of the teeth appears, not only by their continuing ſo many years of the ſame length, but by the unſightly length of one tooth, when that, which was oppoſite to it in the other jaw, happening to fall out or be pulled out, the tooth we ſpeak of has liberty to grow into the gap made by the removal of the other. Of this difference in point of growth betwixt the teeth and other bones, what reaſon can be ſo probably given, as, that it is deſigned to repair the waſte, that is daily made of the ſubſtance of the teeth, by the frequent attritions that are made, between the upper and lower tyre, in maſtication?

II. Whereas the other bones of the body (ſome few ſmall ones excepted) are inveſted with a very thin and ſenſible membrane, which, for its cloſe adheſion to the bone, is by anatomiſts called the *perioſteum*; that part of each tooth, which is not covered by the gums, has none of this membrane, which would be ſubject to frequent and very painful compreſſions and lacerations.

III. To enable the teeth to break, and make comminutions of, the more ſolid kind of aliments, nature has providently framed them of a cloſer and harder ſubſtance, than almoſt any other bones of the whole body; though theſe be ſo numerous, that anatomiſts reckon above three hundred of them. And I have met with relations in authors of good credit, that ſome men's teeth have been ſo hard, as, when ſtruck with another fit body, to produce ſparks of fire.

IV. That theſe bones, whoſe uſe (to prepare aliments for nutrition) is ſo great, and almoſt neceſſary, may themſelves be continually fed and cheriſhed, though they grow in other bones, the all-wiſe Author of things has admirably contrived an unſeen cavity in each ſide of the jaw-bone, in which greater channel are lodged an artery, a vein, and a nerve, which thorough leſſer cavities, or, as it were, gutters, ſend their twigs to each particular tooth; which, by theſe little veſſels, that reach to it, receives a continual ſupply of nouriſhment and ſtrength.

V. In regard that babes are, according to nature's inſtitution, to feed for a conſiderable time on milk, for which there is no need of teeth, and which would alſo hurt the nipples of her that gives them ſuck; nature forbears, for many months, to produce teeth in human infants: whereas the fœtuſes of divers brute animals, that are oftentimes reduced early to ſeek out aliments, that are not fluid, nor very ſoft, are born with teeth already formed in their jaws.

VI. The bony ſubſtance, appointed for the comminution of aliments, ought not, for ſeveral reaſons (which for brevity's ſake I here omit) to be in either jaw entire, or all of one piece; and therefore nature has providently made for that uſe a competent number of diſtinct bones in either jaw. And becauſe men may often have occaſion to feed upon very differing ſorts of aliments, and uſually the ſame aliment may require differing preparations in the mouth to facilitate the digeſtion of it in the ſtomach; nature has provided men with two rows or ſets of teeth, equal for the moſt part in number, (each jaw in men uſually having ſixteen, and in women fourteen or fifteen) and anſwering to each other, but yet of differing ſhapes, for differing uſes. For

ſome, as the fore-teeth, are broader, and with a kind of edge, to cut the more yielding ſort of aliments; whence theſe teeth are called *inciſorii*. Others are ſtronger, and more fitly ſhaped to tear the more tough and reſiſting ſort of aliments: theſe are they, that by the vulgar are in Engliſh called eye-teeth, and which, for their reſemblance to thoſe of dogs, are by anatomiſts called *canini*. And then there is a third ſort, whoſe principal office is to grind the aliments, that are cut or torn by the others; and for this purpoſe they are made much broader, and ſomewhat flattiſh, but yet with their upper ſurfaces uneven and rugged, that by their knobs and little cavities they may the better retain (grind and commix) the aliments, that are to be chewed by them; and for this reaſon they are called *molares*.

VII. AND becauſe the operations to be performed by the teeth oftentimes require a conſiderable firmneſs and ſtrength, partly in the teeth themſelves, and partly in the inſtruments that move the jaw wherein the lower ſet of them is fixed; nature has provided the lower jaw (which alone is moveable, unleſs, as ſome affirm, in crocodiles) with ſtrong muſcles, to make it bear forcibly againſt the upper jaw; and has not only placed each tooth in a diſtinct cavity of the jaw-bone, as it were in a cloſe, ſtrong, and deep ſocket, but has furniſhed the ſeveral ſorts of teeth with hold-faſts ſuitable to the ſtreſs, that, by reaſon of their differing offices, they are to be put to. And therefore, whereas the other teeth (the cutters and dog-teeth) have uſually but one root, (which in theſe laſt named are wont to be very long) the grinders, that on many occaſions are employed to crack nuts, bones, or other hard bodies, before they can be ground, are furniſhed with three roots, and oftentimes with four, in the upper jaw, whoſe ſubſtance is ſomewhat ſofter, and whoſe grinders ſerve as ſo many anvils for thoſe of the lower to ſtrike or preſs againſt. On which account, as hath been already intimated, the lower jaw (for the other belongs to the immoveable part of the ſkull) is furniſhed with a ſtrong muſcle on either ſide, capable of moving it, and conſequently the teeth in it, with great force againſt the upper jaw.

IF ſome favourer of *Epicurus*'s doctrine ſhall here object, that, though man indeed be advantageouſly furniſhed with teeth, yet there are many other animals, and even quadrupeds, whereof ſome have not near ſo many teeth as man, nor ſo commodiouſly ſhaped and placed as his; and others are not furniſhed with any teeth at all: and that likewiſe there are many other animals, that have ſome of their other parts leſs convenient in their kind, or otherwiſe are not near ſo well provided for, as they would be, if they were not rather caſual productions, than thoſe of an intelligent and deſigning Opificer: if theſe things, I ſay, be objected, I muſt own myſelf of a very differing opinion from the objector. And I think I could add much about the final cauſes of things corporeal, as the conſideration of them leads to a high veneration of their divine Author, and as it tends to manifeſt, that, when his providence is denied or condemned, it is for want of its having been ſufficiently underſtood, and duly conſidered. But beſides, that this third propoſition ought to be but one part of our diſcourſe of final cauſes, I have in great part prevented myſelf already, by what I have formerly ſaid to obviate or anſwer ſome exceptions, relating to the eyes of man, and differing animals. For moſt of the conſiderations, if not all, that have been alledged on the occaſion of thoſe organs of ſight, may well be, *mutatis mutandis*, applied to the varieties, that are to be found in the teeth, and other parts, of differing kinds of animals. For I may juſtly repreſent, that the reaſon, why this or that organical part of this or that ſpecies of living creatures has not ſuch a ſtructure, or is not ſo placed, as we might think moſt convenient, may often be, that in this caſe it would be leſs proper for other ends, of more importance to the welfare of the animal, than ſuch a fabric and ſituation of the part, as we prefer, would be. And there

there are alſo many caſes, wherein the thing, that we make bold to think wanting or amiſs, is provided for by other contrivances in the ſame animal; by which proviſion the part under conſideration is made more ſerviceable and ſymmetrical to the reſt of the body; and ſo, performing other offices beſide the main, is, upon the whole matter, more uſeful to the animal, than otherwiſe it would be.

It is known, that oxen and ſheep, and many other ruminating beaſts, are not furniſhed with near ſo many teeth as men are, and as are to be found in dogs, cats, horſes, and many other quadrupeds. But for the paucity of teeth amends is made in moſt of thoſe animals, partly by the power and inſtinct they have to chew the cud, and thereby make a ſecond attrition of their already much ſoftened aliments; and partly by the ſucceſſive cavities or ſtomachs, (diſtinguiſhed by the names of *primus venter*, *reticulum*, *omaſus* and *abomaſus*) through which the aliment is tranſmitted, and more and more elaborated, to make it fit for further uſes. The mouths (eſpecially the inward parts of them) of the beaver, the tortoiſe, the bee, the humming bird, that feeds on flowers, whoſe exudations with his long little bill he ſucks like the bee: theſe, I ſay, and many other animals, (to omit the elephant himſelf) have their mouth, and their ways of preparing their aliments for the ſtomach, very different from what is obſerved in men, and yet very convenient for them reſpectively, all circumſtances conſidered.

These and the like, whether compenſations or expedients, are in many animals ſuch, that there is no cauſe to tax the Author of nature, for not having given ſome animals all the ſame parts, that others are furniſhed with: but rather the thrifty providence (if I may ſo ſpeak) and deſigning wiſdom of God, in the contrivance of his viſible works, may be as well diſcovered by the ſeeming omiſſion of this or that part, that is uſeful to other animals, but is not neceſſary to thoſe wherein it is not found, as by granting thoſe parts to the animals, to whoſe compleatneſs or welfare they are neceſſary, or highly conducive. On which account it is not to be thought ſtrange, that He has not to men, as to frogs, and many ſorts of birds, given ſuch tough, tranſparent, and moveable membranes, as theſe animals are provided of to cover their eyes from harms, that thoſe of men are not uſually expoſed to. And it is not an omiſſion, not to have given girls ſwelling breaſts, before they are capable of generation, more than it is, not to continue to them, after their being grown mothers, the *placenta uterina*, when they are not with child.

Though batts be looked upon as a contemptible ſort of creatures, yet I think they may afford us no contemptible argument to our preſent purpoſe. For in this heteroclite animal you may diſcern the fœcundity of the divine Artificer's ſkill, which has in this formed an animal, that flies like birds, and yet is not only unfurniſhed with feathers, but is of a fabric quite differing from that of other birds. And in this little animal we may alſo obſerve, both the compenſation, that is made for parts, that ſeem either deficient, or leſs advantaged than thoſe of the ſame denomination in other birds, and the regard, which the divine Artiſt appears to have to the ſymmetry of parts in his animated works, and to their fitneſs for the places they are to live in or frequent. For the batt, being to act ſometimes like a bird, that flies freely to and fro in the air, and on ſome occaſions like a terreſtrial animal, ſuch as is that little quadruped a mouſe, ought to be furniſhed with parts ſuitable to ſuch differing deſtinations: and therefore, to fit him to anſwer the firſt of theſe, the want of feathers in the wings is ſupplied by a broad membranous expanſion, and a kind of toes furniſhed with articulations, that make up the wings: and becauſe this animal was to be able, like other birds, to forbear ſettling on the ground, otherwiſe than his occaſions required; each of his wings is furniſhed with a ſtrong crook, like the claw

of a bird's foot, by the help of which he can faſten himſelf to trees, walls, and divers other erected bodies, and keep himſelf ſuſpended in the air, and continue at what diſtance he pleaſes from the ground. And becauſe he is furniſhed with teeth, which other birds want, to chew his food, and thereby prepare it for digeſtion; he needs not have a crop, or ſuch a ſtrong and muſcular ſtomach, as is uſually found in birds. And (in ſhort) to omit the peculiar ſtructure of other internal parts, wherein the batt differs from other birds; ſince the female was not, like them, to be oviparous, but, like mice and other quadrupeds, that bring forth their young ones alive, ſhe is not only furniſhed with an uterus fitted for that purpoſe, but in regard ſhe does not, like birds, that lay eggs, exclude, together with the fœtus, a competent ſtock of aliment to nouriſh it, till it can ſhift for itſelf, the batt is furniſhed with dugs, to give ſuck to her young ones: and by Zoographers it is obſerved, that, as ſhe has but two teats, ſo ſhe brings forth but two young ones at a birth; whereas mice are much more prolific.

THE writings of Zoographers, and the relations of travellers, afford divers other inſtances of the various, and yet excellent, contrivances, that are to be found in ſeveral animals, that differ from man (who is an animal endowed with numerous teeth) in the fabric of the mouth, and other parts inſervient to the reception of aliments, and their preparation for digeſtion.

BUT paſſing by the mouths of tortoiſes, cameleons, and other animals, the hardneſs of whoſe gums, in reference to their ordinary aliments, ſuffices to make amends for their want of teeth; there is one *American* beaſt, which, I think, I ought not to forbear mentioning here, as a notable inſtance to manifeſt, how the wiſe Architect can compenſate the want of teeth, by the rare ſtructure of the mouth and tongue, and their fitneſs to ſeize on and make uſe of thoſe aliments, which, though uncommon for a beaſt of his bulk, he ſeems to have been deſtinated to live upon. The animals of this kind are by *Hernandus*, who retains their American names, called achoas and tamendoas; and of theſe, and particularly of the parts they are provided of to eat with, he gives us this account: *Offenduntur apud Yucatenſes quadrupedes quidam, dorſo præduro & fulvi, agnorum magnitudine, ſed qui ventre circiter terram attingant, dentium omnino expertes ſint, & ſolo formicarum venatu vivant, quarum cumulos duobus magnis unguibus, quibus ſinguli anteriores pedes armantur, excavant turbantque; ac dein exerta lingua, quæ dotrante longior eſt, ſcabra, teres, ac pennam anſerinam craſſa, formicas eam conſcendentes ac denſantes ſuſcipiunt, eademque contracta, & in os, quod mirum in modum anguſtum ac parvum eſt, recepta, gratum ſibi pabulum capiunt, & innocentium animalium præda potiuntur.* Of the ſame ſort of beaſts, the ingenious *Piſo*, in his Hiſtory of *Braſile*, (where he practiſed phyſic) mentions two kinds, the greater and the leſs, which he, like *Hernandus*, calls tamanduas, but adds the new coined name of myrmechophaga; and of both gives this account: *Utræque* (ſays he) *ſunt noctambulæ pabuli cauſa; cicuratæ carne quoque veſcuntur, ſed minutim conciſa, quia non ſolum capite, promuſcide, ſed & ore ſunt anguſto, accuminato, edentuloque, lingua denique, inſtar craſſioris chordæ, tereti adeoque longa præſertim: in tamandua majori, ut duorum pedum longitudinem excedat, atque proinde duplicata (quod notatu ſane dignum) quaſi canali incumbit inter inferiores genas, quam eſuriens madidam exerit, & arborum truncis diu imponit, mox formicis opertam repente retrahit. Si alte fodiendo latebræ earum detegi poſtulant, unguibus id præſtat commode, quibus pedes poſteriores inſtructi ſunt ſatis validis & longis numero quinque, anteriores quatuor, iiſque recurvis duobus in medio maximis.*

Vid. Schotti Phyſ. Curioſ. l. 8. c. 5.

Gulielmus Piſo, l. 5. Hiſt. Nat. & Med. c. 22.

IT is alſo to be conſidered, that divers things may be uſeful in an organical part, beſides that, whereby its function is primarily and mainly exerciſed: as, though the eye-lids

eye-lids and their motions, together with the little glandules, that belong to them, (moſt of which lye concealed under the edges) are not at all neceſſary to the act of viſion, (no more than curtains are to a window) yet they are to the compleatneſs and welfare of the eye, which is the neceſſary organ of viſion; as is manifeſted by the pain and prejudice the eye receives, if the eye-lids, which are ſubject to more than one diſtemper, be conſiderably diſaffected.

I MAY hereafter have occaſion to take notice, that beſides thoſe uſes of the parts of a human body, which I venture to call anatomical, becauſe they are ſuch as anatomiſts have diſcovered by meer diſſections, there may be, of ſeveral parts, other uſes, which I call chymical, becauſe theſe parts do elaborate ſpirits of ſeveral ſorts, and perhaps exerciſe ſome other ſpagyrical functions of great importance, if not neceſſary to the welfare of a living man.

AND, beſides the anatomical and chymical uſes, there may be others very fit to be conſidered in ſome parts of a human body; as the mechanical advantages, for which the various ſhapes and ſtructures of differing muſcles, and the ſeeming irregular (and, as it were, caſual) fabric of the bones, and eſpecially of the proceſſes and protuberances, are admirably fitted. And there are alſo in ſome parts, as the eyes, optical reaſons to be conſidered, before one can otherwiſe than raſhly cenſure what the Author of nature has done about them: as, though the figure of the chryſtalline humour be much more globous in moſt fiſhes, than in men and terreſtrial animals, yet he, that underſtands the doctrine of refractions, and conſiders that fiſhes, under water, are to ſee objects through a far thicker medium than air, will readily acknowledge, that this difference between the eyes of fiſhes and thoſe of men, is not an imperfection in the former; but, whilſt thoſe creatures are in their own element, a great advantage. And, to be ſhort, I think there are ſo many ſciences, and other parts of knowledge, ſome of them perhaps ſcarce yet diſcovered, that may be required to warrant a man to cenſure the ends of God in the bodies of animals, that very few have knowledge enough to be capable of condemning them without raſhneſs: and they, that have knowledge enough to judge aright, will not be forward to condemn them, but admire them. But though this conſideration be not here diſplayed, yet the now mentioned intimation of it may afford us this reflection; that men may eaſily be too raſh, if they think a part bunglingly framed, upon ſuppoſition, that, by the anatomical inſpection of it, they know all the uſes, that the ſkill of the divine Opificer could deſign it for.

NOR will it neceſſarily follow, that becauſe in ſome particular bird, or beaſt, or fiſh, we may not be able to give an account, why this or that part is not to be found, or why it is otherwiſe framed or ſituated, than that, which is analogous to it in man, it muſt therefore be caſually or improvidently framed or placed; ſince we cannot expect, from brute animals, anſwers to thoſe proper queſtions about their own bodies, which we can receive from men about their human ones. And yet, notwithſtanding the great aſſiduity, with which the more curious phyſicians are obliged to cultivate anatomy, and the frequent opportunities they have to do it, and to aſk living men queſtions about what they find, when the natural uſe of their parts is hindered or perverted; our ſagacious moderns are, to this day, at a loſs, as to the true uſes of the viſible parts of the body; to ſay nothing of the inviſible, ſuch as ſpirits, ſalts, *&c.* So that it ought to be no wonder, if in animals, whoſe fabric we have much leſs concern to inquire into, and much leſs opportunity to examine, we ſometimes find parts, of whoſe uſes, and their fitneſs for them, men are not yet able to give a ſatisfactory account. For I conſider, that even in man himſelf, though there be numerous valves found in his veins, yet for thoſe many ages, that the true uſes of them lay

day hid, an *Aſclepiades*, or ſome other bold Epicurean phyſician, might have thought himſelf well grounded to look upon them as ſuperfluous parts, which, now that the circulation of the blood is diſcovered, they are acknowledged to be far from being.

ON this occaſion it may help us, if it be conſidered, that, ſince God is both a free and a moſt wiſe Agent, it need not ſeem ſtrange, that He ſhould adorn ſome animals with parts or qualities, that are not neceſſary to their welfare, but ſeem deſigned for their beauty: ſuch as are the diſpoſition of the cameleon to change colours; and the lovely greens, blues, yellows, and other vivid colours, that adorn ſome ſorts of pigeons, and of parrots, and divers leſſer birds, as goldfinches, canary-birds, and eſpecially thoſe admirably little winged creatures humming-birds. And, on the other ſide, ſometimes God's wiſdom ſeems to be, as it were, thrifty, and ſolicitous not to beſtow on an animal, or a part of it, more than is neceſſary for the uſe, for which it is deſigned. As the veins are by anatomiſts obſerved to have but one coat or membrane, and uſually to lye more expoſed, than the arteries, that accompany them; theſe have ſtronger and double coats, becauſe they are to convey a more important liquor, (the arterial blood) which, beſides that it is more agitated and ſpirituous, is forcibly impelled into thoſe veſſels by the muſcular contraction, or ſtrong impulſe of the heart. And to the ſame purpoſe it may be obſerved, that the arteries within the ſkull are far more thinly coated than elſewhere; the ſolidity of that bony part being a fence to the veſſels that it covers. And to add, that, on this occaſion, we may obſerve, that though the nerves uſually lye deep in the parts, to be kept both ſafe and warm, being very liable to be offended, both by cold and the contact of external bodies; yet, it being neceſſary that the optic nerve ſhould expand itſelf into the eye, the membranes that inveſt the nerve and other coats of the eye (except the *retina*, which ſeems to conſiſt of the medullar fibres) are made, by great odds, more firm than the *dura* and the *pia mater*, whence they proceed; and, though expoſed to the free air, are leſs ſenſible of the cold than moſt parts of the body, and will bear, without danger, divers liquors, and other offenſive things, whoſe pungency would put other nerves of the body into convulſive (and perhaps very dangerous) motions. This (conduct) looks as if God, like an excellent writing-maſter, did, in the great volume of his creatures, intend to beſtow, on ſome of theſe, things rather ornamental than neceſſary, as flouriſhes on the capital letters of the alphabet of nature; and ſometimes to employ characters, and divers of them very differingly ſhaped, (as the *Latin* are from thoſe of the *Greek*, the *Hebrew*, the *Saxon*, *&c.*) to expreſs the ſame letter; and ſometimes alſo to imply abbreviations, as a ſtroke, or a daſh, inſtead of a letter or a ſyllable, to expreſs compendiouſly that, which might be very juſtifiable, had it been more fully ſet down or delineated.

IF that be admitted, which we have formerly propoſed as very likely, that God deſigned, by the great variety of his works, to diſplay to their intelligent conſiderers the fecundity (if I may ſo ſpeak) of his wiſdom; one may readily conceive, that a great part of the variety obſervable in the analogous parts of animals, as their eyes, their mouths, *&c.* may be very conducive to ſo reaching and comprehenſive a deſign; to which the beauty of ſome creatures and parts, as well as their more neceſſary or convenient ſtructure, may be ſubſervient; eſpecially if the innocent delight of man be alſo intended, as it may ſeem to be in the curious colours and ſhapes of divers flowers, and in the melodious muſic of ſinging birds, and in the vivid and curiouſly variegated colours of the feathers of ſeveral winged animals, particularly thoſe that make up the peacock's train.

WE are not near ſo competent judges of wiſdom, as we are of juſtice and veracity; for theſe laſt named are to be eſtimated by external and fixed bounds or rules, which

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are very intelligible to a moderate underſtanding: but as for wiſdom, the more profound it is, the leſs we are able to look through it, and penetrating to the bottom of that, to judge knowingly of its actions. And therefore, though we may ſafely conclude, that God acts wiſely, when He does ſomething that has an admirable tendency to thoſe ends we juſtly ſuppoſe Him to have deſigned; yet we cannot ſafely conclude, in a negative way, that this or that is unwiſe, becauſe we cannot diſcern in it ſuch a tendency. For ſo wiſe an Agent may have other deſigns than we know of, and further aims than we can diſcern, or perhaps ſuſpect; and may have at hand, or furniſh Himſelf with, ſuch means to compaſs his ends, and that even by the cooperation of thoſe means we think uſeleſs or improper, as far as above the reach of our conjectures, and without the knowledge of which we but raſhly cenſure the wiſdom of his proceedings.

In the double horizontal dial, formerly mentioned, it would be raſhly done of thoſe, who ſhould condemn or deſpiſe the various lines, they find traced upon that uſeful inſtrument, becauſe they ſee, that they are not neceſſary to ſhew the hour of the day; ſince the mathematician, that drew thoſe lines ſo curiouſly, may be well ſuppoſed to have more ends than one or two in making the inſtrument, and not to have drawn them by chance or unſkilfully, though the inconſiderate cenſurers do not know, for what other or further purpoſes the artiſt may have deſigned them.

Suppose ſome Indian fiſherman, unacquainted with European arts and affairs, ſhould happen to come aboard a man of war under ſail; though he would quickly perceive, by the uſe that was made of the ropes, pully, *&c.* that this floating building was very artificially contrived; yet if he ſhould fix his eyes upon one of the guns, and the anchors, and perceive that no uſe was made, nor like to be made, of them in ſailing, he would be ſtrongly tempted to think, that thoſe heavy maſſes were uſeleſs clogs and burdens to the veſſel: but if he were told the neceſſity and uſefulneſs of the guns for defence, and of the anchors to ſtay the ſhip in convenient places in ſtorms, he would eaſily alter his mind, and confeſs, that he blamed the builders and furniſhers of the ſhip, for that, which nothing but his ignorance kept him from highly commending.

I have dwelt much longer than I intended on this third propoſition, becauſe I think it a duty our reaſon owes to its Author, to endeavour to vindicate his manifold wiſdom, in this libertine age; wherein too many men, that have more wit than philoſophy or piety, have, upon Epicurean (and ſome alſo even upon Carteſian) principles, laboured to depreciate the wiſdom of God, and ſome of them preſumed to cenſure the contrivances of theſe living *automata*, that (in their protoplaſts) were originally his. And it was not only the ſeaſonableneſs of ſaying, about ſo important a ſubject, ſome things, that poſſibly have not yet been met with, or at leaſt duly conſidered, that has made me thus prolix; but a deſire, that my reader ſhould not barely obſerve the wiſdom of God, but be, in ſome meaſure, affectively convinced of it. To which purpoſe, in my opinion, it is very conducive, if not neceſſary, beſides general notions, to obſerve, with attention, ſome particular inſtances of the divine ſkill, wherein it is conſpicuouſly diſplayed. It is true, that, in the idea of a Being infinitely perfect, boundleſs wiſdom is one of the attributes that is included: but, for my part, I ſhall take leave to think, that this general and indefinite idea of the divine wiſdom, will not give us ſo great a wonder and veneration for it, as may be produced in our minds, by knowing and conſidering the admirable contrivance of the particular productions of that immenſe wiſdom, and their exquiſite fitneſs for thoſe ends and uſes, to which they appear to have been deſtinated.

PROPOSITION IV.

That we be not over-haſty in concluding, nor too poſitive in aſſerting, that this or that muſt be, or is, the particular deſtinated uſe of ſuch a thing, or the motive, that induced the Author of nature to frame it thus.

IT has been above declared, that ſome parts are ſo excellently and ſo manifeſtly fitted for a certain uſe, as the eye for ſeeing; and ſo much better fitted for that, than for any other; that it were little leſs than heedleſsneſs or perverſeneſs, to doubt of its being deſtinated thereto. But the like cannot be ſaid of all the other parts of the body, eſpecially of the internal. And there are divers uſes, either neceſſary, or highly conducive, to the welfare of the animal, to which no one part is ſo much more conſpicuouſly fitted than any other, but that it is more difficult than many think, to determine the true and primary uſes or offices of ſome parts, eſpecially with ſo much certainty, as thereon to ground phyſiological inferences: and of this difficulty I conceive there may be four reaſons, though they do not all, nor perhaps moſt of them, occur in each particular caſe.

AND firſt, the whole animal itſelf, the uſe of whoſe particular parts is under inquiry, is but a part of that greater body, the univerſe; and therefore cannot eaſily be ſuppoſed to have been framed and furniſhed with the parts it conſiſts of, meerly for its own ſake. And when we ſay, that all its parts are contrived for the beſt advantage for the animal, I conceive it to be underſtood in this limited ſenſe; that the parts are excellently framed for the welfare of the animal, as far forth, as that welfare is conſiſtent with the general ends of the Author of nature, in the conſtitution and government of the univerſe; which ends, becauſe they relate to the whole world, or to very conſiderable maſſes of it, as the terraqueous globe, the planets and other ſtars, I have formerly, for brevity's ſake, ſtiled coſmical: and though it has not been proved, that none of theſe coſmical ends are inveſtigable by us, yet to diſcover them all, is not an eaſy taſk. And yet it ſeems preſumptuous to ſuppoſe, that the welfare of particular animals is any further deſigned and provided for, than will conſiſt with the coſmical ends of the univerſe, and the courſe of God's general providence, to which his ſpecial or particular providence, about this or that mere animal, ought in reaſon to be ſubordinated. And though I think it a great raſhneſs for us men to determine poſitively, and excluſively to others, what ends the omniſcient Creator propoſed to Himſelf, in giving to the world the frame we ſee it has; yet, as far as I can hitherto diſcern, I ſee nothing, that is more likely to have been one grand motive of ſo great a variety, as we may obſerve in his corporeal works, eſpecially in animals, than that which hath in part been elſewhere intimated, *viz.* that He might, by ſo many and ſo very differing contrivances, as are to be met with in the ſtructure of men, four-footed beaſts, birds, fiſhes, reptiles, *&c.* exerciſe and diſplay (what could not be by a leſs variety ſo fully manifeſted) that, which an apoſtle, ſpeaking
Eph. iii. 10. of things of another order, emphatically ſtiles the πολυποίκιλος σοφία τοῦ Θεοῦ (the multifarious or manifold wiſdom of God.) Man being acknowledged, upon the account of his very body, the moſt perfect of animals, if God had ſimply deſigned the giving of every animal the moſt advantageous ſtructure, that could be deviſed, it ſeems, that He ſhould have made no other animals than men. But then there could not have been that diverſity of contrivance among living *automata*, that does ſo much recommend the wiſdom of Him, that could frame ſo many and ſo differing animals, though not all of them equally perfect, yet all of them admirably furniſhed for

for thoſe purpoſes to which He deſtinated them. And therefore it does not argue any want of providence, that He has not furniſhed man with wings, as He hath birds; nor fiſhes with four feet; nor birds with fins and ſcales; becauſe theſe parts would have been either ſuperfluous and burthenſome, or would not have ſuited with his deſign, of making ſome animals live on the earth, and ſome in the water: and if he deſigned any to live, though not equally, in both, he furniſhed them with parts of a peculiar ſtructure, as I have elſewhere noted of the beaver and the frog. If it were not for the fore-mentioned conſideration, it would be hard to give a reaſon, why vegetables were not made the food of all animals; but ſome ſhould be carnivorous, and furniſhed with appetites and organs to devour others, and live as birds and beaſts of prey do, upon the deſtruction of the weaker. And it will be hard to ſhew, why, even in animals of the ſame kind, the ſafety of ſome ſhould be ſo much better provided for, than that of others; as we ſee, that ſome ants, and ſome glow-worms, are furniſhed with wings, and ſome not. And in mankind itſelf, thoſe of the female ſex are not ſo happily framed, in order to their own welfare, as thoſe of the maſculine: ſince the womb, and other things peculiar to women, which are not neceſſary to the good of individual perſons, but to the propagation of their ſpecies, ſubject that tender ſex to a whole ſet of diſeaſes, belonging to them either peculiarly as they are women, or as they are with child, or brought to-bed; from all which men are exempt. So that, to apply theſe things to our preſent purpoſe, men may ſometimes miſtake, when they peremptorily conclude, that this or that part of an animal muſt, or cannot have been framed for ſuch an uſe, without conſidering the coſmical, and therefore primary and over-ruling ends, that may have been deſigned by nature in the conſtruction of the whole animal.

SECONDLY, men ſometimes erroneouſly conclude, that ſuch an office cannot belong to ſuch a part, becauſe they think it is not ſo commodiouſly framed for it, as may be wiſhed or deviſed; without conſidering, whether the ſtructure, which they fancy would do better for that particular uſe, would not, in ſome other as conſiderable regard, oppoſe the welfare of the animal; or, whether it would be conſiſtent with the other uſes deſigned by nature in that ſort of living creatures. For in the living works of ſo excellent an engineer as nature, it muſt not be expected, that any particular end ſhould be proſecuted to the prejudice of the whole; but rather it muſt be ſuppoſed, that ſhe aims not only at particular expedients, but univerſal ſymmetry; and does indeed excellently fit the ſeveral parts for their reſpective offices, but yet only as far forth, as a due regard to the deſign and welfare of the whole will permit. The reaſonableneſs of this obſervation, one need but be moderately exerciſed in zootomy (as that is diſtinguiſhed from androtomy) to diſcern. For though man be confeſſed to be the moſt perfectly framed animal in the world, yet his body is not made the model, on which nature has framed the correſpondent parts of other animals. The lungs of dogs, of birds, of frogs and vipers, and I know not how many others, are of a ſtructure very differing from thoſe of man. He is not furniſhed with ſo many ſtomachs as an ox or a ſheep, becauſe nature intended not he ſhould ruminate like them. Though his gall be lodged in a peculiar bag, ſo placed in the liver, as to give *Helmont* a colour to call it *nucleus hepatis*, yet it were unadviſed to ſay, that the ſecretion of gall is none of the uſes of thoſe livers, wherein ſuch a cyſtis is not to be met with; ſince in ſome animals, as in horſes and pigeons, that bitter humour, (which in frogs I have often obſerved to be of a deep and tranſparent green) is not uſually, as in man, collected into one bag: and in vipers, though it be included in one cyſtis, yet, as far as I have obſerved, that bag does not

not at all touch the liver: and ſtore of ſuch inſtances may be met with among the remarks of zootomiſts: wherefore I paſs on to obſerve,

THAT, in the third place, it is difficult to determine the true and primary uſe of a part, becauſe nature does often fit one part for ſeveral uſes. To which I ſhall add,

IN the fourth place, that the difficulty is ſometimes increaſed, becauſe nature may compaſs the ſame end by ſeveral means, each of them ſufficiently, though not equally commodious. I join theſe two together, becauſe, in effect, they do often concur in making it difficult to determine the true uſe of a part. And the latter of theſe two is ſometimes increaſed by this, that nature does not as conſtantly, as ſome men preſume ſhe does, employ only one part to perform ſuch an office; but the intended effect is ſometimes produced, by a ſeries of ſucceſſive operations, to which ſeveral parts may, in differing manners, contribute.

AND here I obſerve, (what perhaps has not been conſidered) that neither the mechaniſm of a human body, nor that of very conſiderable parts of it, is to be judged of only by the ſtructure of the viſible parts, whether they be thoſe ſolid or ſtable ones, that the anatomiſt's knife is wont to expoſe to ſight; or even by the texture of thoſe fluid ones, which are to be found in the veſſels and cavities of a dead body, when diſſected, though never ſo ſkilfully. For I take the body of a living man to be a very compounded engine, ſuch as mechanicians would call *hydraulico-pneumatical*; many of whoſe functions, (if not the chiefeſt,) are performed, not by the blood and other viſible fluids barely as they are liquors, but partly by their circulating and other motions, and partly by a very agile and inviſible ſort of fluids, called ſpirits, vital and animal, and partly perhaps, (as I have ſometimes gueſſed) by little ſpringy particles; and perhaps too, by ſomewhat, that may be called the vital portion of the air; and by things analogous to local ferments; the important operations of all which are wont to ceaſe with life, and the agents themſelves are not to be diſcerned in a dead body. So that beſides theſe manifeſt uſes, which the viſible fabric of the engine may ſuggeſt to an anatomiſt, there may be chymical uſes (if I may ſo call them) of ſome parts, that ſerve for the elaboration of ſpirits and other fluids: which uſes, (as it was formerly obſerved, and yet ought to be inculcated) are not ſuggeſted to the anatomiſts, as ſuch, by the inſpection of the ſtructure of the parts; but to diſcern them may require no mean ſkill in ſpagyrical principles and operations.

SUCH conſiderations as the foregoing make me think it more difficult than many do, to determine, with any certainty, the main uſe of divers particular parts, [for in ſome others it ſeems manifeſt enough;] eſpecially if it be done with the excluſion of other uſes. Nor is it enough to ſecure us, that we know the chief function and end of a part, to know, that is contrived for ſuch a purpoſe: for upon the things I have lately repreſented, one may ground this anſwer, that this fitneſs hinders not, but that the primary uſe of the part may be another, (as not anatomical, but chymical, or *vice verſa)* more conducive to the general welfare of the animal, or elſe to the coſmical ends of nature. And it ought not to ſeem ſtrange, that ſome pieces of workmanſhip, that conſiſt of many parts, all of them curiouſly contrived, may by one learned man be gueſſed to be intended for this uſe, and by others for that uſe; and yet both theſe uſes may be worthy of the artificer.

WHEN ſome very politic prince does ſome great thing, without declaring why, the gueſſes of the ſtateſmen are often very differing, whilſt yet none of them aſcribe to him a deſign miſ-becoming a wiſe man. And ſo, when a learned author expreſſes himſelf, as ſometimes it happens, ambiguouſly, though one reader interprets his

his words to this ſenſe, another to that, yet both the ſenſes pitched upon may fairly comport with the context, and the main ſcope of the writer. Theſe things I ſay, becauſe I would by no means diſparage the wiſdom of nature, by propoſing the difficulties I have hitherto mentioned; though I confeſs, that, upon the account of theſe and ſome others, I look upon many of the arguments, that ſeveral authors have made bold to draw from final cauſes, but as conjectural things. And in divers caſes I allow what is ſuggeſted to me upon the ſuppoſition of the intended uſes of particular parts, rather as good hints to excite, and give ſome aim to, a ſeverer inquiry, than as ſafe grounds to build phyſical concluſions on.

I NOW come to the laſt caution I would recommend to you, about the conſideration of *Final Cauſes*; and I ſhall preſent it you in the following propoſition.

PROPOSITION V.

That the naturaliſt ſhould not ſuffer the ſearch, or the diſcovery of a Final Cauſe *of Nature's works, to make him under-value or neglect the ſtudious indagation of their efficient cauſes.*

IT is true, that to inquire to what purpoſe nature would have ſuch or ſuch effects produced, is a curioſity worthy of a rational creature, upon the ſcore of his being ſo: but this is not the proper taſk of a naturaliſt, whoſe work, as he is ſuch, is not ſo much to diſcover, why, as how, particular effects are produced. A country-fellow here in *England* knows ſomething of a watch, becauſe he is able to tell you, that it is an inſtrument, that an artificer made to meaſure time by; and that is more than every American ſavage would be able to tell you; and more than thoſe civilized Chineſes knew, that took the firſt watch the Jeſuits brought thither for a living creature. But the Engliſh countryman, that knows no more of a watch, than that it was made to ſhew the hour of the day, does very little underſtand the nature of it. And whereas the two ſcopes, that men are wont to aim at in the ſtudy of phyſics, are to underſtand how, and after what manner nature produces the phænomena we contemplate; and, in caſe it be imitable by us, how we may, if occaſion require, produce the like effect, or come as near it as may be; theſe ends cannot be attained by the bare knowledge of the final cauſes of things, nor of the general efficient: but to anſwer thoſe aims, we muſt know the particular efficients, and the manner and progreſs of their operating, and what diſpoſitions they either find or produce in the matter they work upon. As he, that would throughly underſtand the nature of a watch, muſt not reſt ſatisfied with knowing in general, that a man made it, and that he made it for ſuch uſes; but he muſt particularly know, of what materials the ſpring, the wheels, the ſtring or chain, and the balance are made: he muſt know the number of the wheels, their bigneſs, their ſhape, their ſituation and connexion in the engine, and after what manner one part moves the other in the whole ſeries of motions, from the expanſive endeavour of the ſpring to the motion of the index, that points at the hours. And much more muſt a mechanician know this, if he means to be able to make a watch himſelf, or give ſufficient inſtructions to another man, that is more handy to do it for him. In ſhort, the neglect of efficient cauſes would render phyſiology uſeleſs; but the ſtudious indagation of them will not prejudice the contemplation of final cauſes: for, ſince it is truly ſaid, if it be rightly underſtood, that *opus naturæ eſt opus intelligentiæ*, the wiſe Author of nature has ſo excellently contrived the univerſe, that the more clearly and particularly we diſcern, how congruous the means are to the ends to be obtained

by them, the more plainly we diſcern the admirable wiſdom of the omniſcient Author of things; of whom it is truly ſaid by a prophet, that *he is wonderful in counſel, and excellent in working*. Nor will the ſufficiency of the intermediate cauſes make it needleſs to admit a firſt and ſupreme cauſe; ſince (to inculcate, on this occaſion, what I more fully deliver in another paper) that order of things, by virtue of which theſe means become ſufficient to ſuch ends, muſt have been at firſt inſtituted by an intelligent cauſe. And if it be irrational to aſcribe the excellent fabric of the univerſe, ſuch as it now is, and the actions, that have manifeſt tendencies to determinate uſeful ends, to ſo blind a cauſe as chance; it will be rather more than leſs irrational, to aſcribe to chance the firſt formation of the univerſe, of which the preſent ſtate of things is but the natural conſequence or effect: for it may indeed be plauſibly ſaid, that, in the preſent ſtate of things, the ſeveral parts of the univerſe are, by the contrivance of the whole, determined, and thereby qualified to attain their ends. But it cannot be rationally pretended, that at the firſt framing of the world, there was a ſufficiency in the ſtupid materials of it, without any particular guidance of a moſt wiſe Superintendent, to frame bodies ſo excellently contrived and fitted to their reſpective ends.

Iſa. xx. 29.

The CONCLUSION.

THE reſult of what has been hitherto diſcourſed, upon the four queſtions propoſed at the beginning of this ſmall treatiſe, amounts in ſhort to this:

THAT all conſideration of final cauſes is not to be baniſhed from natural philoſophy; but that it is rather allowable, and in ſome caſes commendable, to obſerve and argue from the manifeſt uſes of things, that the author of nature pre-ordained thoſe ends and uſes.

THAT the ſun, moon, and other cœleſtial bodies, excellently declare the power and wiſdom, and conſequently the glory of God; and were ſome of them, among other purpoſes, made to be ſerviceable to man.

THAT from the ſuppoſed ends of inanimate bodies, whether cœleſtial or ſublunary, it is very unſafe to draw arguments to prove the particular nature of thoſe bodies, or the true ſyſtem of the univerſe.

THAT as to animals, and the more perfect ſorts of vegetables, it is warrantable, not preſumptuous, to ſay, that ſuch and ſuch parts were pre-ordained to ſuch and ſuch uſes, relating to the welfare of the animal (or plant) itſelf, or the ſpecies it belongs to: but that ſuch arguments may eaſily deceive, if thoſe, that frame them, are not very cautious, and careful to avoid miſtaking, among the various ends, that nature may have in the contrivance of an animal's body, and the various ways, which ſhe may ſucceſsfully take to compaſs the ſame ends. And,

THAT, however, a naturaliſt, who would deſerve that name, muſt not let the ſearch or knowledge of final cauſes make him neglect the induſtrious indagation of efficients.

SOME UNCOMMON

OBSERVATIONS

ABOUT

VITIATED SIGHT.

ADVERTISEMENT.

THE following obſervations were not written with intention, that they ſhould be annexed to the foregoing eſſay, but to gratify a philoſophical phyſician: which is the reaſon, why, beſides thoſe things, that are more purely optical, I thought fit to mention ſome others, that might be either uſeful or grateful to an inquiſitive man of his profeſſion. But having allowed the ſtationer to expect, that this book, though it have for title but an eſſay, ſhould not be of too inconſiderable a bulk, I made choice of theſe papers, among ſeveral, that lay by me, to increaſe the bigneſs of the book; becauſe that the eyes being thoſe parts of the bodies of men and other animals, that I pitched upon in the foregoing treatiſe to ſtrengthen the doctrine delivered in it about final cauſes, it ſeemed ſuitable enough to my ſubject and deſign, to mention ſome uncommon things, that related to viſion or the organs of it, that we may be invited both to admire the wiſdom of God, which, to furniſh man with a ſenſe, that requires the concourſe of ſo very many things, has, if I may ſo ſpeak, crowded them into ſo ſmall an engine as an eye; and to celebrate his goodneſs too, which has been diſplayed in that, notwithſtanding that the eye is ſo very compounded a part, and the ſight ſo eaſily vitiated, yet the moſt part of men by far do, from their cradles to their graves, enjoy the benefit and comfort of ſo neceſſary and noble a ſenſe.

OBSERVATIONS about VITIATED SIGHT.

OBSERVATION I.

EXAMINING a gentleman, that was already almoſt blind, and feared to grow altogether ſo, about the ſymptoms of his diſeaſe, (which came with a ſtroke upon his head,) I found as I expected, by his anſwers, that, though he could not any thing well diſtinguiſh objects of other colours, yet he could well perceive thoſe, that were white, to be of that colour: which confirms what I mention in the hiſtory of colours, concerning the great quantity of light, that is reflected by white objects, in compariſon of thoſe, that are otherwiſe coloured. And

this obſervation itſelf was confirmed by another patient, who, though almoſt blind, could yet diſcern white objects.

OBSERVATION II.

I KNEW a gentleman that had a cataract growing, which, when I looked on his eye in a lightſome place, appeared to cover almoſt juſt the upper part of the pupil; and though he were a young vigorous perſon, and the weather was very clear, he could not well diſcern men from women croſs the ſtreet. But this gentleman's misfortune came by a great ſtroke he received on that ſide of his head, whereof he ſhewed me the ſcar; which circumſtance I therefore note, becauſe when no outward violence has been offered to the eye, it has been obſerved by a good oculiſt, and, if I miſremember not, I have ſeen an inſtance of it, that a ſmall part of the pupil, left uncovered by the cataract, would ſerve for more ſight than the gentleman enjoyed. In him likewiſe I had a further confirmation of what I was lately obſerving about the conſpicuouſneſs of white objects: for though he could not, as I was ſaying, diſcern men and women, that paſſed by on the other ſide of the ſtreet, yet having once deſired him to tell me, if he could diſtinguiſh any object there, he told me that he could; and that I might no longer doubt of it, when I aſked him what he ſaw, he ſaid, that it was a woman, that paſſed by with a white apron; which apron he ſaw directly, and therefore might eaſily conclude, without diſtinctly ſeeing the wearer, that the perſon, that wore it, was a woman.

OBSERVATION III.

MEETING accidentally with a man, by profeſſion a farrier, whoſe eyes looked very oddly, I queſtioned him about his diſtemper; and found by his anſwers, that he had had cataracts in both his eyes, but either had them ill couched, or had not behaved himſelf orderly afterwards: for there ſeemed ſtill to be ragged films, that covered conſiderable portions of his pupils; inſomuch, that I ſomewhat wondered to ſee him go freely about, as he did, without requiring any body to help him, ſo much as up or down ſtairs: and I hereupon aſking him, whether he were able to read in a large print, he told me he was, with the help of his cataract ſpectacles, as they call them; which I doubting of, brought him a book, whoſe title page he was not able to read. This he excuſed by ſaying, that the place was too lightſome, which though it did not ſeem to others, yet conſidering, that it was about noon, I cauſed the room to be a little darkened, and then perceived, that indeed he could read well enough.

OBSERVATION IV.

A GENTLEMAN, having in a quarrel received a ſtroke on one ſide of his head, which knocked him down, found afterwards a great weakneſs and dimneſs in his eyes; into which when I looked attentively, I plainly diſcerned, that though above one half of his pupil was yet uncovered, ſo that, when he looked downwards, he could ſee well enough with that eye, yet there was grown in it no leſs than two cataracts, which, when I looked on them attentively, and in a good light, I could manifeſtly perceive to be diſtinct; the one of them ſeeming to be ſmooth ſpread, as if its circular edge adhered cloſely to the inſide of the eye; and the other, that ſeemed not altogether of the ſame colour, hanging looſely, and as it were a rag, at ſome

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OBSERVATION VI.

IT may be worth obſerving, how long the better ſort of cataracts, tho' they hinder ſight for a time, as a thick curtain drawn croſs the pupil, yet may remain in the eye, without ſpoiling the optic nerve or hindering viſion, when once the cataract is removed; of which I remember, among other inſtances, I took notice in the caſe of a woman, who told me ſhe had cataracts in her eyes ſo long, that ſhe was brought to-bed of ſix children conſecutively, without being able to ſee any one of them, till after ſhe was cured by having the cataracts couched. But then ſhe ſaw ſo well, that with ſpectacles ſhe could read in a portable bible of a ſmall print. And divers conſiderable perſons of my acquaintance ſaw one of eighteen years old, born with cataracts in both her eyes, who not naturally wanting the faculty of ſeeing, though thus hindered of the exerciſe of it, had been ſo happily couched, as afterwards to have the benefit of ſight in them both.

OBSERVATION VII.

IT has been of late the opinion of very learned men, that though both our eyes be open and turned towards an object, yet it is but one of them at a time, that is effectually employed in giving us the repreſentation of it. Which opinion, in this place, where I am writing but obſervations, it were not proper to diſcuſs; eſpecially becauſe what is ſuppoſed to be obſerved, will not always uniformly happen, but may much vary in particular perſons, according to their ſeveral cuſtoms, and the conſtitution of their eyes. For I have, by an experiment purpoſely made, ſeveral times found, that my two eyes together ſee an object in another ſituation, than either of them apart would do. On the other ſide, I met with a perſon, who told me he had.

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had a cataract in his eye for two years, without diſcerning, that he had any ſuch impediment in either of his eyes; and when I aſked him, how he knew that, he anſwered me, that others had taken notice of a white film, that croſſed his eye, ſo long before he himſelf did; but not knowing what a cataract was, and not finding him to complain of it at all himſelf, the thing remained unheeded, till the patient having one day occaſion to rub his ſound eye, whilſt the lid covered it, was ſadly ſurprized to find himſelf altogether in the dark; and then reſorting to an oculiſt, was aſſured it was a cataract, which, a while before I met with him, had been couched. But notwithſtanding this relation, what I had tried about the uſing of both eyes, made me aſk of a very ingenious perſon, that by an accident had ſome months before one of his eyes ſtruck out, whether he did not obſerve, that upon the being confined to the uſe of one eye, he was apt to miſtake the ſituation and diſtances of things. To which he anſwered me, that having frequently occaſion to pour diſtilled waters and other liquors out of one vial into another, after this accident he often ſpilt his liquors, by pouring quite beſide the necks of the vials he thought he was pouring them directly into. Afterwards inquiring of a gentleman, that was a good fellow, and had by a wound a while before loſt the uſe of one of his eyes, he confeſſed to me, that divers times pouring the wine out of one veſſel into another, he would miſs the orifice of the bottle or glaſs, that ſhould receive it, and expoſe himſelf to the merriment of the company. A yet more conſiderable inſtance of ſuch miſtakes I afterwards had from a noble perſon, who having in a fight, where he played the hero, had one of his eyes ſtrangely ſhot out, by a muſket-bullet, that came out at his mouth, anſwered me, that not only he could not well pour drink out of one veſſel into another, but had broken many glaſſes, by letting them fall out of his hand, when he thought he had put them into another's, or ſet them down upon a table: and he added, that this aptneſs to misjudge of diſtances and ſituations continued with him, though not in the ſame degree, for little leſs than two years. But on this occaſion I ſhall take notice, that I have often employed a dextrous artificer, whoſe right eye (for in his left there is nothing more remarkable) is conſtantly drawn ſo much aſide towards the greater angle of the eye, that the edge of the pupil does almoſt touch it, and one would think it ſcarce poſſible, but that he ſhould ſee the object double with two eyes, that ſeem ſo very differingly turned; and yet he anſwered me, that he does not ſee at all, nor that he finds any inconvenience, ſave the deformity of this unuſual ſituation of his right eye, which hinders him not from reading freely as other men. This accident happened to him by an unwary miſtake of ſublimate for another thing; after which, it ſeems one of the muſcles, that moved the eye, remained contracted: but this having happened to him, as I found by inquiry, ever ſince he was two years of age, he could not remember, whether he had ſeen objects double, before he was accuſtomed to judge of them by the help of his other ſenſes, and the information of others.

OBSERVATION VIII.

IT may be worth while to obſerve, that a very great diſtention may be made of the parts of the eye, without ſpoiling the ſight; of which I lately ſaw an inſtance in a patient of that ingenious and experienced oculiſt, Dr. *Turbervill.* This was a gentlewoman of about one or two and twenty years of age, whoſe complexion and features would have made her handſome, if ſhe had not had that ſort of eyes, which, though rarely met with, ſome call ox-eyes; for hers were ſwelled much beyond the ſize of human eyes, inſomuch, that ſhe complained they often frighted thoſe, that

that ſaw her, and were indeed ſo big, that ſhe could not move them to the right hand or the left, but was conſtrained to look ſtraight forward; or if ſhe would ſee an object, that lay aſide, ſhe was obliged to turn her whole head that way. And ſo ſhe anſwered me ſhe was, when ſhe ſet herſelf to read in a book, unleſs ſhe did with her hand move the book from one ſide to another, to bring the ends of the lines directly before her eyes. She told me her eyes did not always retain the ſame meaſure of tumidneſs, and that the very day I ſaw them, they had been in the morning much more ſwelled, than when I looked upon her. But that, which was more remarkable, was, that not only ſhe could, for all this, ſee very well and diſtinctly, and, as I juſt now intimated, could read books, but her ſight had continued good, though ſhe had this diſtemper theſe twelve years. And, which is more ſtrange, ſhe anſwered me, that her viſive power was ſo little prejudiced by this diſtemper, when it firſt came upon her, that ſhe never knew any thing was amiſs in her eyes, till her friends told her of it, when they found it had continued too long to be a meerly caſual and tranſient tumor. But though this odd accident did not impair her ſight, it occaſioned great pains in her eyes, for which ſhe took purging and other medicines with ſo little ſucceſs, that both ſhe and her former phyſicians thought her caſe deſperate, there appearing no way of diſlodging a humour ſo long ſettled there. Upon which I propoſed ſalivation, as the leaſt unlikely way, that remained, to reſolve and carry off the peccant humour: but this, though much approved by her doctor, the modeſt patient would by no means conſent to.

OBSERVATION IX.

I ONCE looked into the eyes of a gentlewoman, where I could diſcern nothing, that was amiſs, or any thing, that was unuſual, ſave the narrowneſs of her pupils, which is often eſteemed a good ſign; and yet this woman was much troubled with fumes and weakneſſes of the head, and had a diſaffection of ſight very uncommon; for ſhe told me, that, whereas in the day time her ſight was ſo dim, that ſhe could hardly diſcern her way, ſoon after ſun-ſet, and during the twilight, ſhe could diſcern things far better: and in this condition ſhe had continued a good while. In which odd caſe, whether the ſmallneſs of her pupils, which might poſſibly be contracted too much by the day-light, and might be expanded by the receſs of ſo much light; or the greater diſſipation of the viſive ſpirits at one time than at the other, may have any intereſt, I ſhall not now ſtay to inquire. But this patient brings into my mind the rare caſe of a learned old divine, who complained to me, that he was forced to write his letters and books by night, becauſe, during the day-time, his right hand ſhook ſo much, that he could not manage a pen, and therefore was forced to make uſe of it only by candle-light. And I remember, that, upon his preſſing me to propoſe ſome poſſible cauſe of ſo odd a phænomenon, I told him, to put him off, that perchance the few animal ſpirits, that he had to move his hands with, were ſo ſubtle, as to be diſſipated or exhaled by the warmth of the day, but were kept in by the coldneſs of the night, that ſomewhat conſtipated his pores; and commended to him the uſe of ſtrengthening things, and, among the reſt, of chocolate; which when for ſome time he had continued to drink, he came to me, and told me with joy, that he began again to be able to write in the day, and ſo I think he can do yet. But this upon the by.

OBSERVATION X.

BEING acquainted with two ladies of very diſtant ages, but very near of kin, who were both of them troubled with diſtempers, that made me gueſs their eyes might ſometimes be oddly affected, I inquired of them, whether they were not troubled with ſudden apparitions of flame or fire? to which one of them anſwered me, that oftentimes there would appear to her multitudes, as ſhe fancied, of ſparks of fire, that were very unwelcome to her. And the other lady, that was ſubject to convulſive, but not epileptic, fits, told me, ſhe divers times ſaw, as ſhe fancied, ſuch flaſhes of fire, as I had mentioned, paſs before her eyes, which at firſt did not a little frighten her.

OBSERVATION XI.

THE following obſervation is odd enough, to give riſe to ſome curious ſpeculations and diſputes; and therefore I choſe to ſet it down as I found it among my *adverſaria*, though I ſuſpect part of it to have been loſt, that the relation may be the more unbiaſſed, though, if I had another opportunity to diſcourſe with the patient, I ſhould, upon ſecond thoughts, have aſked ſome queſtions, and written down ſome circumſtances, that I now wiſh had not been omitted.

THE gentlewoman, I ſaw to-day, ſeems to be about eighteen or twenty years old, and is of a fine complexion, accompanied with good features. Looking into her eyes, which are grey, I could not diſcern any thing, that was unuſual or amiſs; though her eye-lids were ſomewhat red, whether from heat, or, which ſeemed more likely, from her precedent weeping. During the very little time, that the company allowed me to ſpeak with her, the queſtions I propoſed to her were anſwered to this effect:

THAT about five years ago, having been, upon a certain occaſion, immoderately tormented with bliſters, applied to her neck and other parts, ſhe was quite deprived of her ſight.

THAT ſome time after ſhe began to perceive the light, but nothing by the help of it: that then ſhe could ſee a window, without diſcerning the panes or the bars: that afterwards ſhe grew able to diſtinguiſh the ſhapes of bodies, and ſome of their colours: and at laſt ſhe came to be able to ſee the minuteſt object; which when I ſeemed to doubt of, and preſented her a book, ſhe not only without heſitancy read in it a line or two, (for her eyes are quickly weary) but having pointed with my finger at a part of the margin, near which there was the part of a very little ſpeck, that might almoſt be covered with the point of a pin, ſhe not only readily enough found it out, but ſhewed me, at ſome diſtance off, another ſpeck, that was yet more minute, and required a ſharp ſight to diſcern it. And yet, whereas this was done about noon, ſhe told me, that ſhe could ſee much better in the evening, than in any lighter time of the day.

WHILE ſhe was looking upon the printed paper I ſhewed her, I aſked her, whether it did not appear white to her, and the letters black? to which ſhe anſwered, that they did ſo; but that ſhe ſaw, as it were, a white glaſs laid over both the objects. But the things, that were moſt particular and odd in this woman's caſe, were theſe two. The firſt is, that ſhe is not unfrequently troubled with flaſhes of lightning, that ſeem to iſſue out like flames about the external angle of her eye, which often make her ſtart, and put her into frights and melancholy thoughts. But the other, which is more ſtrange and ſingular, is this, that ſhe can diſtinguiſh ſome colours, as

as black and white; but is not able to diſtinguiſh others, eſpecially red and green; and when I brought her a bag of a fine and gloſſy red, with tufts of ſky-coloured ſilk, ſhe looked attentively upon it, but told me, that to her it did not ſeem red, but of another colour, which one would gueſs by her deſcription to be a dark or dirty one: and the tufts of ſilk, that were finely coloured, ſhe took in her hand, and told me they ſeemed to be a light colour, but could not tell me which; only ſhe compared it to the colour of the ſilken ſtuff of the laced petticoat of a lady, that brought her to me; and indeed the blues were very much alike. And when I aſked her, whether in the evenings, when ſhe went abroad to walk in the fields, which ſhe much delighted to do, the meadows did not appear to her cloathed in green? ſhe told me they did not, but ſeemed to be of an odd darkiſh colour; and added, that when ſhe had a mind to gather violets, though ſhe kneeled in that place where they grew, ſhe was not able to diſtinguiſh them by the colour from the neighbouring graſs, but only by the ſhape, or by feeling them. And the lady, that was with her, took thence occaſion to tell me, that when ſhe looks upon a Turky carpet, ſhe cannot diſtinguiſh the colours, unleſs of thoſe parts that are white or black. I aſked the lady, whether ſhe were not troubled with female obſtructions? to which ſhe anſwered me, ſhe was not now, but that formerly ſhe had been much ſubject to them, having been obſtinately troubled with the green-ſickneſs.

OBSERVATION XII.

I SHALL add on this occaſion ſomething, that, though not ſo odd as it, has yet an affinity with the newly recited caſe, and ſo may make it the more credible. And it is, that I lately converſed with a mathematician, eminent for his ſkill in optics, and therefore a very competent relater of phænomena belonging to that ſcience, whoſe organs of viſion are ſo conſtituted, that though in his eyes I could diſcern nothing amiſs, and though he makes much and excellent uſe of them in aſtronomical obſervations and optical experiments, yet he confeſſes to me, that there are ſome colours, that he conſtantly ſees amiſs, and particularly inſtanced in one, which in a clear day (for ſo it was when we diſcourſed together of this matter) ſeemed to him to be the ſame with that of a darkiſh ſort of cloth, that he then wore, whilſt to me and other men it appeared of a quite differing colour.

OBSERVATION XIII.

DISCOURSING with a lady, who had been very long troubled with a very unuſual indiſpoſition in her head, and, though ſhe looks well, is never without pain in it; though, looking into her eyes, I perceived nothing amiſs, yet, conjecturing that ſo obſtinate a diſtemper muſt have had ſome unuſual influence upon her ſight, I learned by inquiry, that, after the violent fits of pain and diſorder ſhe had from time to time in her head, if ſhe did but caſt her eyes, or turn them ſuddenly, from one ſide to the other, there would preſently enſue a convulſive motion in one of them, whereby it would not only be drawn away, but, which was very ſtrange, all white things, and moſt other objects, that ſhe looked on with that eye, appeared green to her: and yet this was not a tranſient diſcompoſure, that would go quickly off, but would moleſt her for a good while, and frequently returned upon her for a whole year; ſo that ſhe deſpaired of recovering the uſe of that eye, wherewith yet ſhe now ſees very well, though her cephalic diſtempers were rather mitigated than quite cured. And when I aſked her, whether, whilſt the convulſion of her eye laſted, ſhe did not ſee

objects double? ſhe anſwered, that, whilſt that diſtemper was upon her, if ſhe went to read in a book, the letters were ſo apt to appear double, that, when ſhe was bent upon reading, ſhe was fain to ſhut the diſtempered eye, and employ only the other.

OBSERVATION XIV.

SOME may think, that a man has rather an excellent (than a vitiated) ſight, who can ſee objects with a far leſs degree of light, than other men have need of to diſcern them. But though an extraordinary tenderneſs may be a kind of perfection in the eyes of bats and owls, whoſe uſual food may be more eaſily purchaſed by twilight; yet as to man, the main part of whoſe actions is to be performed by the light of the day, or ſome other almoſt equivalent, it may argue the provident goodneſs of the Author of nature, to have given him eyes conſtituted as thoſe of men generally are: ſince that a very great tenderneſs of the *retina*, or principal part of the organ of ſight, would be, if not an imperfection, at leaſt a great inconvenience, may appear by the memorable ſtory I am going to relate.

IN the army of the late King, of happy memory, (*Charles* the firſt) there was a gentleman of great courage and good parts, that was major to one of the regiments; who being afterwards by the prevailing Uſurpers forced to ſeek his fortune abroad, ventured to do his King a piece of ſervice at *Madrid*, which was of an extraordinary nature and conſequence, and there judged very irregular. Upon this he was committed to an uncommon priſon, which, though otherwiſe tolerable enough, had no window at all belonging to it, but a hole in the thickneſs of the wall, at which the keeper once or twice a day put in liberal proviſion of victuals and wine, and preſently cloſed the window, if it may be ſo called, on the outſide, but not perhaps very ſolicitouſly. For ſome weeks this poor gentleman continued in the dark, very diſconſolate: but afterwards he began to think he ſaw ſome little glimmering of light, which from time to time increaſed; inſomuch, that he could not only diſcover the parts of his bed, and other ſuch large objects, but at length came to diſcover things ſo minute, that he could perceive the mice, that frequented his chamber, to eat the crumbs of bread, that fell upon the ground, and diſcern their motions very well. Several other effects of his ſight in that dark place he related. And that, which confirms, that this proceeded mainly from the great tenderneſs the viſive organ had acquired by ſo long a ſtay in ſo obſcure a place, was, that when after ſome months, the face of affairs abroad being ſomewhat changed, his liberty was reſtored him, he durſt not leave his priſon abruptly, for fear of loſing his ſight by the dazzling light of the day; and therefore was fain to accuſtom his eyes by ſlow degrees to the light. This ſtrange (as well as once famous) ſtory, I the leſs ſcruple to ſet down in this place, becauſe I had the curioſity to learn it from the gentleman's own mouth, who acquainted me with other particulars about it, that, for want of the notes I then took, I ſhall not now venture to ſpeak of.

MEDICINA HYDROSTATICA:

OR,

HYDROSTATICS

APPLIED TO THE

MATERIA MEDICA.

SHEWING

How, by the weight that divers Bodies uſed in Phyſic have in Water, one may diſcover, whether they be genuine or adulterate.

To which is ſubjoined,

A previous hydroſtatical Way of eſtimating ORES.

The PREFACE.

I Am far from being fond of their practice, that affect to give pompous and promiſing titles to their books; inſomuch that my friends have ſeveral times reproached me with inclining too much to the oppoſite extreme. But yet I am not averſe from prefixing to the enſuing paper the title of *Medicina Hydroſtatica*; not only for the conveniency of citations, (which are uſually troubleſome to make in tracts that have long titles) but becauſe too I am invited, if not authoriſed to do it, by the example of the famous and judicious Sanctorius, who ſcrupled not to prefix the name of *Medicina Statica* to a writing almoſt as ſmall, as it is ingenious, which applies the balance to ſome uſes relating to the medicinal art, perhaps not more than will be here found propoſed of the ſame inſtrument, improved by ſome additions. And it is ſcarce to be doubted, but that, in this inquiſitive age, the ſagacity of the curious will make, both of what he has diſcovered, and of what I have delivered, uſeful applications, that neither he, nor I, ever thought of.

IF the chief thing I aimed at in writing, had been to gain applauſe, I would have taken a more likely way to obtain it, than by treating of a ſubject, wherein few will think themſelves concerned, (though many in reality be ſo) and whoſe importance does not at firſt view appear. And this ſubject too the nature of it has obliged me to treat of in ſuch a way, that it will be almoſt as unpleaſant to the reader to peruſe ſo unadorned a piece, as it was troubleſome to the author to write ſo toilſome an one. And indeed, when I came to take notice of the number of particulars, that I had brought together into this little book, I did myſelf ſomewhat wonder, how I came to be prevailed with to lay out ſo much pains upon ſo uninviting a ſubject. But knowledge and health are two ſuch valuable things, that I durſt not refuſe to undergo even a toilſome taſk, whilſt I was encouraged by the hope, that was given me, that this kind of labour may conduce ſomewhat to thoſe deſirable ends; if not otherways,

yet at leaſt by exciting the more curious among phyſicians, chemiſts, and others, to enlarge their inquiries; and by helping them to remark divers things relating to medicinal bodies, that they are wont to overlook.

I HAD probably better conſulted my reputation, as well as my eaſe, if, having contented myſelf with thoſe few uncommon notions, that the reſt of the book was built upon, I had left the application made of them to particular bodies, to the induſtry of others. I ſhall not ſolicitouſly excuſe myſelf, for not having beſtowed more ornaments upon the following eſſay; ſince the nature of the ſubject, and drift of the writer, are ſufficient to juſtify the plainneſs of my ſtile to the judicious. I may have ſomewhat more cauſe to apologize for this, that I have not caſt a treatiſe, about a ſubject wherein mechanics are ſo much employed, into the form of propoſitions, and given it a more mathematical dreſs. But I was unwilling by that means to diſcourage thoſe many, who, when they meet with a book, or writing, wherein the titles of theorem, problem, and other terms of art, are conſpicuouſly placed, uſe to be frighted at them; and, thinking them to be written only for mathematical readers, deſpair of underſtanding it; and therefore lay it aſide, as not meant for the uſe of ſuch as they.

BUT there is another thing, upon whoſe ſcore, I confeſs, I ought to wiſh for indulgent readers. For the papers compiled into this eſſay having been written in looſe ſheets, and at ſuch diſtinct times, that divers accidents intervened between them; the loſs of ſome of thoſe papers, as well as others of different natures, and my want of health and leiſure, obliged me to change more than once my propoſed deſign, and to employ ſometimes the ſtile of a private letter, and ſometimes again that of a diſcourſe intended for the public; by which means ſome things, and ſome expreſſions, that were ſuitable to the deſign I had, when I committed them to paper, became incongruous, when the ſcope and ſcheme of my diſcourſe were altered; eſpecially ſome parts of the copy being out of my hands, when I ſhould have adjuſted the others to them. But though theſe irregularities may keep the parts of this eſſay from being ſo coherent as they ſhould be, yet they will not prove very prejudicial to an intelligent reader, who, finding the matters of fact, and the notions to be true, may, notwithſtanding the want of an uniform contexture, make good uſe of them.

THOUGH divers little memoirs and other things, that occurred to me from time to time, whilſt I was bringing together the following papers, have inſenſibly ſwelled them into a book; yet the eſſay itſelf was, in my firſt intention, but a large fragment of a greater work: whereof an account is given in the letter to a friend, (that is premiſed to a paper annexed to the following eſſay) which (letter) having been intended for a kind of preface to the laſt ſcheme of the whole larger ſcheme, if the reader pleaſe to peruſe it, he will there find the riſe and ſcope of this little tract, as well as of the other parts of that deſigned book; and ſome other things, that may make it needleſs to lengthen this preamble by any thing more than two advertiſements. Of theſe, one is, that (being reduced, by divers unexpected and unwelcome accidents, to forego my firſt deſign, and give only two or three ſpecimens of what was intended, and more than begun) I made choice of the title of the chemical changes of bodies by coloration, as a ſample of the chemical part of the treatiſe; and I pitched upon the ſubject of this preſent eſſay, as a ſpecimen of the mechanical part of the ſame treatiſe: the other advertiſement is, that the reader may not be ſtartled, to find ſome little variations of ſpecific gravity among ſome of the memoirs laid together in this eſſay, becauſe he will in due place be told, why ſuch things ought to be expected. And in the mean time, it may, I hope, ſuffice to ſay, that ſuch variations are neither new, nor eaſily avoidable things, in making hydroſtatical experiments,

Some experiments.

or

or others of affinity to them. For proof of which, to readers that, for want of having made trials themſelves, may diſtruſt what we have ſaid, I ſhall produce a couple of notable teſtimonies. The firſt is given by ſo induſtrious and diligent a mathematician as *Merſennus* * himſelf. For he candidly acknowledges, when he has occaſion to mention ſome trials of the learned *Ghetaldus*, and of the accurate French engineer monſieur *Petit*, and of his own, that the variety of weighing, which often happens to amount to ſome grains, is but like the variety of aſtronomical obſervations, which do almoſt always differ in ſome minutes or ſeconds. To which he ſoon after adds an intimation, that ſhews, that he expected not an exact uniformity between the obſervations of *Ghetaldus*, &c. already made, and the trials of an experimenter, that would examine them by making the like again.

To this firſt teſtimony we ſhall ſubjoin the ſecond; which is, that our famous experimenter, the lord *Verulam* himſelf, writing of a ſubject, that in ſeveral things has much affinity to ours, confeſſes, that it is not to be doubted, but that many of the bodies, which † he has ſet down in his table of their dimenſions and weights, differ in the ſame ſpecies or denomination, ſome being heavier than others; and that therefore there is ſome contingency in this affair, ſo that it is not neceſſary, that the individuals he made his trials with ſhould be exact ſtandards of the nature of their reſpective ſpecies, or ſhould (which makes directly to my preſent purpoſe) agree altogether to a tittle with experiments of other men.

But this ſcarce evitable imperfection of hydroſtatical and the like experiments does not hinder, but that by their help we may make good eſtimates of the weights, and bulks, of very many bodies; and among them of not a few, that belong to two ſorts of the three, that our illuſtrious author acknowledges to be reducible to his way of menſuration. And theſe eſtimates will (if I miſtake not) be found, not only preferable to thoſe, that can be of the ſame bodies by geometrical inſtruments, but (which is more conſiderable for the reader) accurate enough to be very uſeful on a great number and variety of occaſions. Which laſt clauſe I purpoſely add to inſinuate, that the hydroſtatical way of menſuration may be uſefully applied to ſeveral bodies and caſes, that do not at all ſeem to relate to the Materia Medica; as would appear by inſerting here what is delivered about metrical and about exploratory obſervations in other papers; if that were not too foreign to the enſuing eſſay, as not belonging to the ſubject, or to the deſign of it.

MEDICINA HYDROSTATICA:

AN

ESSAY.

CHAP. I.

I Have, in a former tract, endeavoured (and, as I am told in print and otherwiſe, not altogether unſucceſsfully) to make it probable, that divers (if not moſt) of the real virtues (for many fabulous ones have been aſcribed to them) of gems or

* *Varietas ponderandi, quæ ſæpius in quibuſdam granis contingit, ſimilis eſt varietati aſtronomicarum obſervationum, quæ ſemper ferè quibuſdem minutis, ſive primis, ſive ſecundis differunt.* Merſennus in Phænomenis Hydraulicis.

† *Hiſt. denſit. & rarit. P. M.* 12. *Editionis Londinen. in Octavo.*

precious

precious ſtones may in great part proceed from the qualities of metalline and mineral ſubſtances, that, whilſt the matter was either fluid or ſoft, were (more or leſs plentifully) incorporated with the ſtony matter, which hardened afterwards into a gem. The ſame phænomena and reflections, that led me to the opinion newly recited, induced me to think it alſo very probable, that divers boles, clays, and other earths, and much more that ſeveral minerals, which, though not looked upon as metalline ores, and ſeveral ſtones or ſtony ſubſtances, that, by reaſon of their bigneſs or opacity, or perhaps unpleaſant colours, have been judged unworthy to be numbered among gems or precious ſtones, may yet be endowed with conſiderable medical virtues; and perhaps with greater than the finer gems themſelves, becauſe in theſe deſpiſed ſtones and minerals there is often found a greater ſtore of metallic and mineral parts, which, while they were in *ſolutis principiis*, as chemiſts ſpeak, might with eaſe plentifully inſinuate themſelves into theſe more open bodies, where being ſettled, they were not locked up ſo faſt and ſtrongly, as in the nobler gems; ſuch as diamonds, rubies, ſapphires, *&c.* which are of ſo compact (and as it were glaſs-like) a nature, that divers corroſive liquors, and aqua fortis itſelf, are unable to penetrate and diſſolve them; though, as hereafter will appear, theſe inferior medical ſtones, and other minerals, may be opened by the like menſtruums.

UPON theſe grounds, I thought it might be a thing of uſe to phyſicians, as well as to divers mineraliſts and mine-workers, if I imparted to them a way of exploring many foſſils, that I do not remember I had met with, either among phyſicians or chemiſts: and though this way of exploration pretends not to diſcover directly more than one quality of the body examined by it; yet that quality, being its ſpecific gravity, is ſo radical and conſiderable a one, that it may lead a ſagacious enquirer further than at firſt ſight one would think.

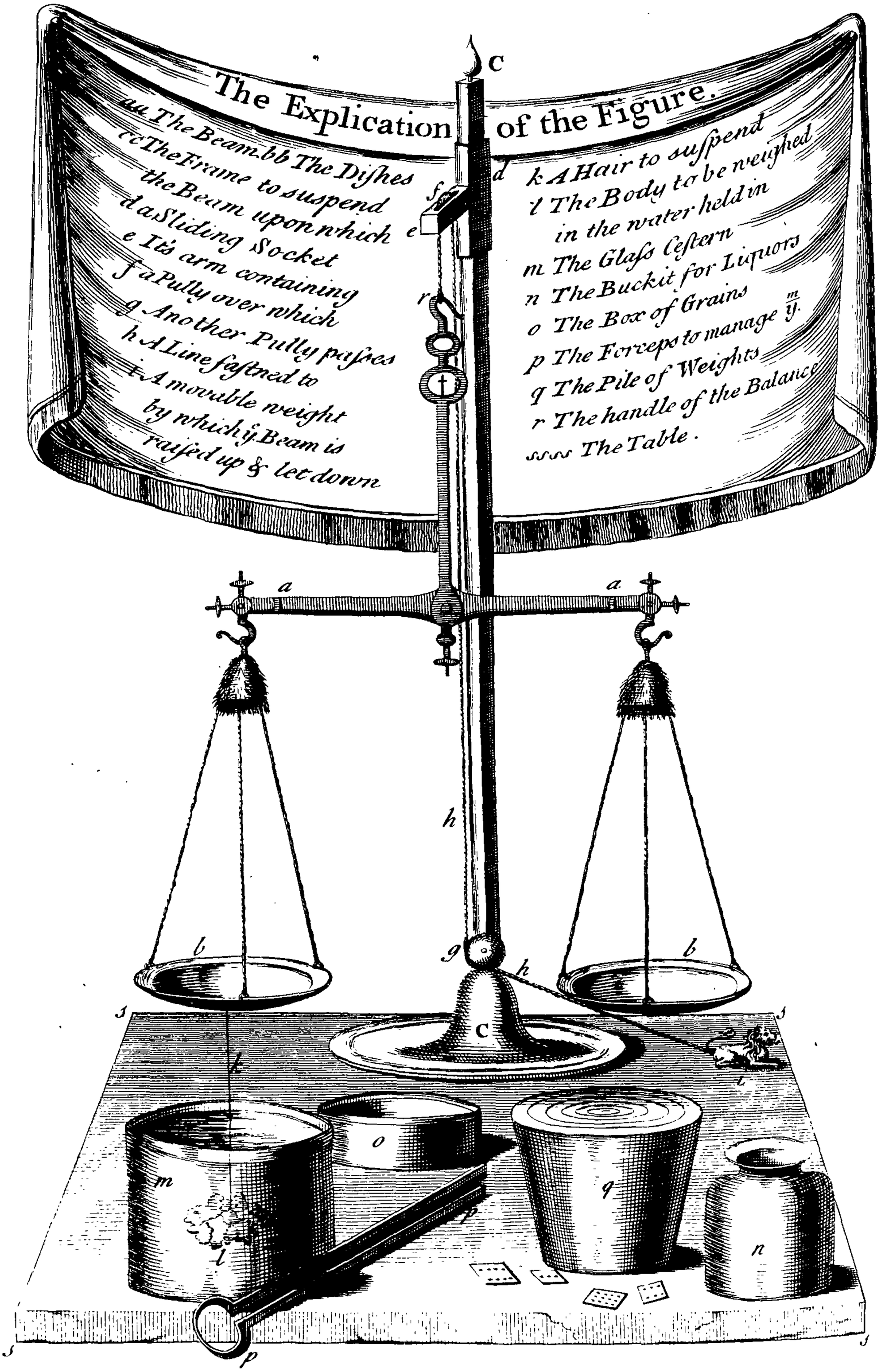
I CONSIDERED then, that the moſt pure and homogeneous kind of ſtones that we know of, and that ſeems the freeſt from all adventitious mixtures, and even * TR's, is rock-cryſtal: and therefore I pitched upon this, as the ſtandard I would employ, to make eſtimates of the greater or leſſer receſs from ſimplicity or homogeneity of the ſtones, or other ſtone-like ſubſtances, whoſe ſpecific gravity I ſhould examine.

* Tinctures.

WE took then ſome pieces of native cryſtal, clear and colourleſs; and having carefully weighed them, firſt in the air, and then in water, we found, by computation, that pure cryſtal was to clear water of the ſame bulk as two and an half, or thereabouts, are to one: ſo that, to clear the matter by an inſtance, if we ſuppoſe an hollow cube, of braſs or other metal, to be filled as carefully as may be (for the upper ſurface will ſcarce be exactly level) with ℥j. of water, and if afterwards the cavity of the emptied veſſel be exactly filled with a cubical piece of rock-cryſtal, this ſtone will weigh ℥ij and about an half. Some of my trials, indeed, made with tender balances, repreſented the proportion of theſe two bodies with ſome petty variation. But beſides, that it is not improbable, that differing pieces of rock-cryſtal itſelf, though of equal bulk, may not be preciſely equal in ponderoſity; beſides this, I ſay, the variation I found from the newly aſſigned proportion was ſo ſmall, that having juſt intimated, that for the moſt part it rather favoured a little the ſpecific gravity of the cryſtal, than fell ſhort of it; we may neglect it without any prejudice, worth taking notice of, to the uſe that is to be made of this proportion in this paper. And foraſmuch as there may be ſome ſcruple, though groundleſs, made about the origin and nature of cryſtal; I ſhall add, by way of confirmation of what has been delivered, that I procured ſome ſtrong icicles, that had been faſtened to vaults, *&c.* as bodies that would be acknowledged to be true ſtones, and yet to have been in a liquid form; and having hydroſtatically examined theſe concretions, the ſpecific gravity, though

The Explication of the Figure.

a a The Beam
b b The Dishes
c The Frame to suspend
the Beam upon
d a Sliding Socket
e It's arm containing
f a Pully over which
g Another Pully passes
h A Line fastned to
i A movable weight
by which the Beam is
raised up & let down
k A Hair to suspend
l The Body to be weighed
in the water held in
m The Glass Cestern
n The Buckit for Liquors
o The Box of Grains
p The Forceps to manage
q The Pile of Weights
r The handle of the Balance
s s s s The Table.



J. Mynde fc

though not exactly the same in all, appeared to be little differing from that of crystal; the solid body exceeding the weight of the fluid water, it was weighed in, about two times and an half (a little more or less.)

To apply this fundamental observation to uses designed in it; when I had a mind to make a probable discovery (for by this way I pretend to no more) whether in a stone, or stone-like body propounded, the merely stony matter were more or less commixed with some adventitious substance of a metalline nature, or that of some other mineral more ponderous than crystal, I carefully weighed it, first in the air, and then in the water, according to the method formerly declared; and if by virtue of its specifick gravity, its proportion to water of the same bulk exceeded the proportion of five to two (which, to avoid fractions, may be commodiously substituted to that often already mentioned of $2\frac{1}{2}$ to one) I concluded it probable, that the concretion had in it a portion of adventitious matter, heavier in specie than crystal or mere stone: by how much more or less the solid body exceeded the weight of water equal to it in bulk, by so much greater or lesser a portion of heterogeneous matter was guessed to be commixed with the stony in the propounded concrete. This may be illustrated, as well as proved, by the examples, that should presently follow, but that it will be fit, before I descend to particulars, to premise a paper, that concerns the whole design of this tract. Use 1.

CHAP. II.

THOUGH the way of weighing solids in water hath been delivered by the ingenious *Marinus Ghetaldus*, and, out of him, by some few other authors; and though therefore I might excusably dispense myself from delivering it distinctly; yet since their books are scarce, and the knowledge of this way is almost every where supposed in these papers, I hold it very fit, that it should once be proposed in this tract, not only for that reason, but for two others. One, that a dexterous way of finding out the weight of bodies in liquors may be of far more use than men seem to be yet aware of, being capable of being made, by a little variation and improvement, of good use to naturalists, and even to chymists. And the other, that perhaps you will find cause to think, that experience and reflections on it may have furnished me with some few expedients and cautions for the better practice of this art, and for the avoiding of some errors, that may be very easily, and perhaps have been, run into, for want of the cautions here given.

The way of weighing sinking bodies in water.

THE solid body, given to be examined, is to be tied about with an horse-hair of a competent length, which hair at its other end is to be fastened to one of the scales of a tender and exactly equilibrated balance; so that the proposed body being exactly weighed in the air, and then immersed in a glass or other fit vessel, almost full of fair water, may hang freely in that liquor, being on every side encompassed by it. This done, you must put into the opposite scale as many weights as serve to bring the body hanging in the water to an exact æquilibrium with the counterpoise, and consequently the beam of the balance to an horizontal situation. Then take out the weights newly employed, which give you the weight of the body in the water, and deducting it from the weight formerly taken of the same body in the air, and by the remainder, which will be the difference of these two, divide the whole weight of the given body in the air, and the quotient (whether consisting of

whole numbers, or a fraction, or both) will ſhew the proportion, in ſpecific gravity, between the examined ſolid, and as much water as is juſt equal to it in bulk. To make this more eaſily intelligible by an example; we took a fine piece of white marble (that ſtone ſeeming the moſt pure, and moſt free from mineral tinctures of any common opacous ſtones:) this being put into a good balance, whoſe ſcales were well equilibrated, was found to weigh in the air, ℥ii. ʒiii. ℈i, grains ix. which, for conveniency of ſupputation, we reduce to 1169 grains; then an horſe-hair was tied about this piece of marble, and the other end of the ſame hair was faſtened to one of the ſcales, under which, at a convenient diſtance, was placed a ſomewhat deep glaſs, almoſt full of fair water: in this liquor the ſtone was made to hang freely beneath the ſurface, and in the oppoſite ſcale there were put weights enough to bring it to an æquilibrium with the other; theſe weights were found, being reduced to the former denomination, to amount to 738 grains, which gave us the weight of the marble in water (which was much leſs weight than the former, becauſe the ſtone was partly ſuſtained by the water:) this being ſubſtracted from the weight of the ſame ſtone in the air, there remained 431 grains, which gave us the weight of as much as was equal to the ſtone in bulk. By this remainder the weight of the marble in the air, *viz.* 1169, being divided, the quotient was found to be 2 and $\frac{7}{10}$, or near enough $\frac{7}{10}$ for the proportion in ſpecific gravity of white marble to water. The demonſtration of this practice is founded on what I have elſewhere given; and it may, in another way, be found in ſome of the commentators on *Archimedes de inſidentibus humido*.

Hydroſtatical paradoxes.

FOR underſtanding of the ſummary direction newly given, it may be uſeful to ſubjoin the following notes: 1. It is manifeſt by the nature of the thing, that the body, propoſed to be weighed, ought to be heavy enough to ſink in water, ſince otherwiſe its weight in that liquor being none at all, cannot be ſignificantly deducted from its weight in the air. But if there be occaſion to weigh in water a body lighter in ſpecie than it, as bees-wax, a piece of fir-wood, *&c.* it may be done, though not without ſome trouble, by joining to it a body, heavy enough to make the wax ſink with it: but this caſe belongs not to this place.

2. AN horſe-hair is made choice of for hydroſtatical operations, becauſe it is ſaid to be equiponderant to ſo much water; and though I have not found that to be ſtrictly true, yet an horſe-hair is fitter to be employed in theſe trials, than any other ſtring I know of; and its ſpecific weight uſually differs ſo little from that of water, that the difference may be ſafely enough neglected; and if the ſolid propoſed be too heavy to be ſuſtained by a ſingle horſe-hair, one may twiſt two, or (if need be) more of them, to make the ſtring ſtrong enough to ſuſtain the ſolid.

3. I SHALL add, that I have met with bodies, about which, by reaſon of their roundneſs, as in bullets, or of ſome other inconvenient figure, we could not well faſten an hair, or other ſtring, wherewith to tie it to the balance. Now, on ſuch occaſions, I cauſed ſome hairs to be ſo contexed, as to make a kind of a little hoop-net, whoſe meaſhes were not great enough to let the body ſlip through them. In this ſmall veſſel, whether you call it a net or a baſket, which was tied by an horſe-hair (ſingle or twiſted) to one of the ſcales, we put the ſolid body to be weighed, and proceeded in the operation, as if the body were tied but with a ſtring.

4. BUT here it muſt be carefully noted once for all, that whenſoever any hydroſtatical trial is made with an horſe-hair, there muſt be put into the ſcale, that holds the counterpoiſe, as much of the ſame hair, as can be gueſſed to be of the ſame weight with that part of the ſtring, that ſuſtains the body in the water, which appears to be above the ſurface of the water; for this liquor takes off the weight only of as much

much of the hair as is immerſed in it, ſo that the unimmerſed part of the ſtring adds to the weight of the ſolid hanging in water, and therefore ought to be compenſated by an equal weight put into the oppoſite ſcale.

5. WHEN I kept a balance only or chiefly for hydroſtatical trials, I found it expedient, on divers occaſions, to take off one of the ſcales, with the ſtrings belonging to it, and ſubſtitute in its room a piece of lead, or other metal, of a conical, or ſome other convenient ſhape, exactly equiponderant to the oppoſite ſcale, and at the ſame end of the ſtring to faſten one end of the horſe-hair, that tied the body to be weighed in water. And ſometimes alſo, when I did not take off one of the ſcales, I cauſed it to be perforated in the middle (yet without leſſening its weight) that ſo the body to be immerſed might hang very perpendicularly from the midſt of the ſcale. The motives, that induced me to theſe practices, cannot be ſo well ſet down in few words; and therefore ſhall be now left unmentioned, eſpecially becauſe the practices themſelves, though on ſome occaſions convenient, are not neceſſary.

6. THERE remain yet a couple of remarks, which muſt leſs than any be pretermitted, if men would avoid ſome errors, that are but too often ſlipt into by the makers of hydroſtatical trials. We are then (firſt) to take notice, that the body to be examined hang freely in the water, ſo that no part of it any where touch the bottom or the ſides of the veſſel, or reach above the upper ſurface of the water contained in it; for, if any of theſe circumſtances be not taken care of (as it happens, when we are not heedful enough) the true weight of the ſolid is ſomewhat altered; and if any corner, or other part of the body (and the like may be ſaid of the horſe-hair it is tied with) though but a ſmall one, appear above the ſurface of the water; that extant portion, being not at all ſuſtained by the liquor, adds (more or leſs) to the weight, that the immerſed body ſhould have. Care alſo muſt be had, that as nothing but the water do touch the hanging body, ſo no part of the water may touch the ſcale whence it hangs. I have ſeveral times obſerved, that immerſed bodies have been concluded to weigh more in the water than really they did; becauſe, through ſuch a want of heedfulneſs, as is not uncommon, the experimenters did not take notice, that if the ſtring were too ſhort, or the veſſel too full, the vibrating motions of the balance would, at one time or other, carry down the ſcale the ſuſpended body was tied to ſo low, as to make one part or other of it touch the ſurface of the water; ſome drops of which liquor would readily ſtick to it, and, becauſe they adhered to the nether part of it, would lie concealed from an eye that was not prying, and by conſequence would ſenſibly add to the weight of the ſcale, and make the body be thought heavier than indeed it was; which overſight muſt needs be very prejudicial, when one makes experiments, that require exactneſs.

7. BUT the moſt uſual cauſe of miſtakes in hydroſtatical trials (eſpecially ſuch as are made on ſmall bodies) wherein a little error may be greatly conſiderable, is this; that men are wont to think it ſufficient (in theſe trials) that the body to be examined be totally immerſed in the water; whereas it does not only often, but moſt commonly happen, that the given ſolid, and the ſtring that is tied about it, carry down with them divers particles of air; and perhaps too it may find and extricate others, that lay concealed in the pores of the liquor itſelf; which aerial particles faſten themſelves to the little aſperities, that they meet with on the ſurface of the immerſed bodies, in the form of bubbles, which, like ſo many little bladders full of air, endeavour to buoy up the body they adhere to; and on that account do, in proportion to their number and bigneſs, leſſen the weight, which the immerſed body would otherwiſe have in water. And therefore great care is to be had, eſpecially in nice experiments, that, by ſhaking the ſtring, and warily knocking the body againſt the ſides

of the glaſs, the adhering bubbles may be diſplaced, and emerge to the top of the water. And I ſhall add a deſire, that on ſome occaſions this caution be made uſe of more than once in the ſame trials; becauſe I have ſeveral times obſerved, that now and then after the immerſed body was freed from the firſt bubbles, that appeared about it, others did ſucceed, before an end was made of weighing the body; out of ſome of whoſe unperceived cavities or pores (whether ſuperficial or lying deeper) perhaps the latent air could not eaſily on a ſudden be driven by the water. I have been the more circumſtantial in explaining the ſummarily propoſed method of weighing bodies in water, becauſe experience hath ſhewn, that it is not near ſo eaſy as upon the firſt reading of it one would preſume, to be exact in the practice of it.

HAVING obtained the weight of a body propoſed, firſt in the air, and then in water, according to the method plainly delivered; it will not be difficult to diſcover practically the proportion in weight between the ſolid and the liquor. I ſay practically, becauſe the rule is eaſy enough, though the demonſtration is not ſo readily to be underſtood by them, that are not acquainted with the principles of the hydroſtaticks. The theorem, upon which our practice is grounded, was firſt, that we know of, delivered by the moſt ſagacious *Archimedes*, whoſe commentators have buſied themſelves in demonſtrating it in a mathematical way, as I have ſince endeavoured to do in a phyſical way, and more eaſy to naturaliſts in the hydroſtatical paradoxes. *Archimedes*'s propoſition is this, *that a body heavier than water weighs leſs in water than in the air, by the weight of as much water as is equal to it in bulk or magnitude:* whence it is not difficult to deduce a rule ſufficing for our preſent purpoſe. For if you ſubſtract the weight of the body propoſed, whilſt it is every way environed with water, from the weight of the ſame body, which it was found to have in the air; the reſidual number or difference gives you the weight (taken in the air) of as much water, as is equal in magnitude to the ſolid propoſed; ſo that having now two bodies, one firm, and the other liquid, together with the weight of each of them apart; to find their proportion you need but divide the greater by the leſſer, and the quotient compared to one, that is, to an unit, will be the antecedent of the proportion deſired between the ſolid body and the water, which is mentioned but as it is the liquor, that is generally employed in theſe experiments, for otherwiſe the rule will hold, *mutatis mutandis*, in other liquors, as well as in water.

CHAP. III.

AND now having premiſed theſe remarks, and thereby made way for the clearer underſtanding of the ſubſequent part of this paper, we ſhall proceed to the examples, that this not unneceſſary digreſſion has diverted us from propounding.

THERE is a deeply red and opacous mineral, that commonly paſſes in the ſhops under the name of lapis hæmatites, though it ſeems to have more affinity to that, which divers authors call ſchyſtos. But whatever be the moſt proper name that belongs to it, it is an hard foſſil, which, though little uſed by our Engliſh phyſicians, is in ſeveral places abroad in great requeſt; and that not without cauſe, as far as I can judge, by what I yet know of it; and eſpecially for that ſomniferous quality, that may be obſerved in ſome of its preparations. But it is not here, though it is elſewhere, my purpoſe to deliver its medicinal virtues; but only to examine, whether, according to our method, it ought to be concluded to abound with metallick particles (perhaps but embrionated) to whoſe intermixture ſome of its virtues may probably be aſcribed. Therefore, in a very good balance, having weighed a piece

piece of Engliſh hæmatites, that chanced to amount to about ℥iii. ℥ii¼, firſt in the air, and then in water, we found its proportion to this liquor, as $4\frac{15}{16}$ to 1. At which ponderoſity, if I had not formerly made the like experiments, I ſhould have been ſurpriſed, as you probably will be, when you conſider, that this metalline ſtone did not very much want of almoſt twice the weight of a mere ſtone of the ſame bulk. This great weight much confirmed me in the conjecture I had made, that in this lump was contained a good deal of metalline ſubſtance. And this induced me (to add that upon the by) to examine my gueſs, by ſubliming it, when finely powdered, and diligently mixt with an equal or double weight of ſal armoniac. For then having taſted with the tip of my tongue, of this ſaffron-coloured ſublimate, I found it, as I expected, very aſtringent or ſtyptick, as divers preparations of *Mars* are wont to be; and, for further proof, having put leſs than a grain of it into a ſpoonful or two of good infuſion of galls, there was immediately produced a black, and as it were inky mixture.

LAPIS lazuli is ſometimes made uſe of by European phyſicians, but more frequently by Arabian and other Eaſtern ones, for divers purpoſes, but eſpecially to make evacuations by vomit. This emetic faculty ſeemed likely enough to belong to it upon the ſcore of a metalline ingredient; and accordingly, having examined hydroſtatically a piece, that was judged moderately rich, we found the proportion of it to an equal bulk of water, to be as 3 to 1; which argues, that, notwithſtanding its briſkneſs in operation, it contained a much leſſer proportion of metalline ſubſtance, than lapis hæmatites, or divers leſs operative minerals.

I ELSEWHERE ſhew, that the loadſtone may be applied to medicinal uſes; and that it emits effluvia, that are not magnetical, and may have ſenſible operations upon the body of man. On which account it was not improper to examine it hydroſtatically; by which means I found, that the weight of a lump of loadſtone, that I judged to be either Engliſh or Norwegian, was in proportion to water of the ſame magnitude, as $4\frac{23}{100}$ to 1. But of the ſpecific gravities of loadſtones much more may be met with in another paper.

Obſervation about the loadſtone, as it is a mineral.

LAPIS calaminaris is often enough uſed in phyſick, eſpecially by chymiſts, to dry, and to imbibe acidities; for which uſes, I prefer it before divers more famous drugs. But, though it is wont to be employed only as an external remedy, yet ſome things, that I found in ſome uncommon chemical preparations of it, made me think, it may deſerve to be further examined and tried. A famous and not unlearned empiric, to whom I willingly communicated ſome proceſſes, that he deſired of me, when I aſked him about a medicine, whoſe ſucceſs [illegible]ought him a great number of patients, for griping fluxes, and ſome dyſenterical [illegible]es, candidly diſcovered his medicine to me, and ſolemnly aſſured me, it was nothing but pure and well-ground lapis calaminaris, ſeaſonably given in a juſt doſe; as in a fitter place I have more fully declared. This made it obvious for me to conjecture, that lapis calaminaris participates of a metallic nature, as may be argued from its operation upon copper, which is thereby turned into braſs. Wherefore weighing a piece of this foſſil, firſt in air, and then in water, it appeared to be to this liquor as $4\frac{6}{10}$ to 1.

IF I had not among ſome other papers loſt ſome, wherein I had regiſtered a good number of trials of this kind made upon differing foſſils, it would be eaſy for me to add to the four already recited, others manifeſtly conducing to the ſame purpoſe. But preſuming, that thoſe already delivered may at preſent ſuffice, I ſhall now ſubjoin a few obſervations, whereof the firſt may become the candor and impartiality of

of a lover of truth, and the reſt intimate ſome further uſes of the hydroſtatical way of exploring hard and ponderous concretions, hitherto treated of.

I MUST not therefore forbear to admoniſh you, that, though when an hard foſſil propounded, is found to be much heavier than cryſtal of the ſame bulk; it is a very probable token, that in the ſolid concretion, there is a notable portion, greater or leſſer, of ſome metalline or other ponderous mineral body, whence its good or evil qualities, in reference to human bodies, may probably be deduced. Yet, this hinders not, but that it is very poſſible for a foſſil to be endowed with medicinal virtues, or to have noxious qualities, on the account of a portion of extraneous matter; though its ſpecific gravity doth but little exceed that of cryſtal, or the advantage ſeem but inconſiderable. For (to paſs by other reflections) a very ſmall proportion of adventitious, metalline, or mineral ſubſtance, if it be of an operative nature, may, in ſome caſes, ſuffice to diffuſe its ſelf through the reſt of the maſs, and impregnate it with active qualities. Which may be partly illuſtrated, and partly proved, by ſome experiments, that will be hereafter met with in one of the chapters.

CHAP. IV.

CHAP. IV. TO hint ſomewhat about the further utility of our hydroſtatical way of enquiry, I ſhall take notice in the firſt place, that it may aſſiſt us to gueſs with probability, whether a mineral body propounded, as likely to be a ſtone, or of a ſtony nature, be ſo indeed. Thus coral, for inſtance, is by ſome thought to be a plant; by others, a lithodendron; but by the greater number it is reckoned among precious ſtones. In this diſſent of opinions, the ſpecific gravity may be of conſiderable uſe. Wherefore, we thought fit to weigh a piece of choice and well coloured red coral, firſt in the air, and then in the water, and found its proportion to the weight of as much of that liquor, to be as $2\frac{68}{100}$ to 1. So that its ſpecific gravity much favours their opinion, who take it to be a ſtone, ſince it not only equals that of cryſtal, but ſomewhat exceeds it.

THERE are ſome, that will have pearls, becauſe of their hardneſs, and their being treated of by jewellers, and others that write of gems, to be of a ſtony nature. Wherefore I thought fit to examine their ponderoſity alſo. But not having now with me any trial of that kind, I ſhall ſubſtitute one that I made upon a monſtrous pearl, that was preſented me by a perſon, that took it out of the oiſter. I call it monſtrous, becauſe though it be well enough coloured, yet its ſhape is irregular, and its bigneſs extraordinary, as is alſo its weight, amounting to full 206 grains. This being weighed in water its proportion in gravity to an equal bulk of the liquor was found to be as $2\frac{51}{70}$ to 1. So that its ſpecific weight was much about the ſame with that of cryſtal.

THERE are many, that take the ſtones formed in mens bladders for as true and genuine ſtones, as thoſe that nature forms in the greater world; and ſpeak much, and ſometimes not without ground, of the great hardneſs of divers of them. But, though I deny not, that, in a laxer ſenſe, they may well enough paſs for ſtones, yet I ſhould rather call them animal ſtones, than ſimply ſtones; this name having been conſtantly and generally uſed to ſignify mineral or foſſil ſtones: which by our way of exploration, may be eaſily diſtinguiſhed from human calculi, and other like hard concretions, found in the bodies of ſome animals. For, having examined a good number of theſe ſtones, I found, that not only the chemical analyſes I made

of them, of which I elſewhere give an account, manifeſted them, how hard ſoever they were, to be concretions belonging to the animal kingdom, not the mineral; but, by an hydroſtatical examen of divers of them, I found them to differ much in ſpecific gravity from true foſſil ſtones. Of this you will, in its proper place, meet with ſeveral inſtances; ſo that it may here ſuffice to mention two, that now chance to come to hand; namely, that a calculus humanus weighing above ʒviß was found to be in proportion to an equal bulk of water, as $1\frac{76}{100}$ to 1. And another that weighed ʒiv and above an half in the air, being alſo weighed in water, appeared to be to this liquor, as $1\frac{69}{100}$ to 1.

I MENTION theſe ſtones as belonging to the *Materia Medica*, though they are looked upon rather as diſeaſes, of which, indeed, they are very ſad productions, becauſe a famous and experienced phyſician, that practiſed long in the *Eaſt-Indies*, and had better opportunity than almoſt any European had before him to try the virtues of bezoar, does either equal or prefer the calculi we are ſpeaking of even to oriental bezoar.

AND to ſhew, that men are not the only animals, wherein ſtone-like concretions differ in ſpecific gravity, (and ſo may be diſtinguiſhed by that difference) from cryſtal and ſuch like true ſtones; we ſhall ſubjoin two or three experiments, made upon choice bezoar ſtones, not exceeding a middle ſize, ſuch being the likelieſt not to be adulterated. The firſt of theſe weighing in the air ʒiij, and odd grains, was found to be in proportion to water of the ſame bulk, as $1\frac{47}{100}$ to 1. Another weighing ſomewhat leſs than ʒiij, was to the weight of an equal bulk of water, as $1\frac{53}{100}$ to 1. I might add divers other inſtances of the like import; and though I think them not neceſſary, yet I ſhall ſubjoin one more, becauſe it is afforded by a bezoar ſtone, taken out of another of the ſame kind: this kernel ſtone, if I may ſo call it, being weighed in the air, wanted nine grains of ʒiij, and its proportion to water of the ſame magnitude, was found to be as that of $1\frac{55}{100}$ to 1. In all which inſtances we may obſerve, that theſe animal ſtones, not amounting to twice the weight of water, equal to them in bulk, have leſs of ſpecific gravity by above a fifth part, than a true foſſil ſtone (ſuch as cryſtal) is wont to be endowed with.

CHAP. V.

THE uſe lately propoſed of our hydroſtatical way of exploration ſuggeſts to me another, which may be deduced from it as a kind of corollary. Uſe III.

THIS comprehends two ſomewhat differing ways of applying the obſervations we have lately mentioned. For firſt, we may by the hydroſtatics be aſſiſted to diſcover, with probability, the reſemblance, or the difference, that may be between bodies of the ſame denomination, ſo that ſome ſubordinate ſpecies of them may perhaps be diſtinguiſhed, as well as ſeveral individuals of the ſame, or lowermoſt ſpecies. Since, for inſtance, we have found a notable difference between the ſpecific weights of ſeveral loadſtones that were dug up in ſeveral countries or mines; if greater number and variety of experiments of this kind were made, we ſhould poſſibly find that, *cæteris paribus*, the loadſtones of one country, or of one mine, are conſiderably heavier than thoſe of another; as, if I miſtake not, I uſually obſerved, the Norwegian and the Engliſh loadſtones to be heavier in ſpecie, than thoſe that are ſaid to come out of a warmer region, *Italy*; whoſe iſland of *Ilva* abounds with mines, whereof I ſaw one entire maſs, that I judged to weigh a great many hundred of pounds. And this difference of weight between foſſils of the ſame kind, when it is conſiderable, may be of good uſe to help us to diſtinguiſh between the ſtones of the

ſame

ſame loweſt ſpecies, that are proper to differing countries or mines. But, in caſe the unequal weight proceeds, as it often does, from an adventitious matter, that inſinuated itſelf into the more genuine matter of the foſſil, whilſt it was fluid or ſoft, it may much aſſiſt us to gueſs at the greater or leſſer purity of the homogeneouſneſs of the foſſil propoſed; which diſcovery may, on divers occaſions, be of no ſmall uſe to the phyſician, the jeweller, or the naturaliſt.

CHAP. VI.

Uſe IV. BUT the ſecond thing compriſed in our corollary may in divers caſes be of much greater utility and importance, as being very proper to help us to diſcern genuine ſtones, whether animal or mineral, from counterfeit ones; which too often paſs for true, to the great prejudice of phyſicians and patients, and the great loſs of lapidaries, and their cuſtomers. For as there are few qualities appertaining to ponderable bodies here below, that are ſo radicated (if I may ſo ſpeak) as their ponderoſity is; ſo there is ſcarce any quality, wherein 'tis ſo difficult for impoſtors to make a notable alteration unperceivedly, as the ſpecific gravity. I ſaid, for impoſtors; becauſe, though in ſeveral caſes, it is not ſo very difficult, to alter the ſpecific weight belonging to this, or that kind of bodies; yet in thoſe very caſes, it may be exceeding difficult, and perhaps impracticable, to make a conſiderable change in that quality, but by ſuch additions, or operations, as will make a ſenſible change in ſome other qualities too, and thereby expoſe the fallacy to be diſcovered. And this will eſpecially prove difficult in many caſes to vulgar cheats, and counterfeits, or adulterators of gems, and other valuable minerals; becauſe the little knowledge they have of the numerouſneſs and variety of natural and artificial productions, confines them to a ſmall number and diverſity of means, to accompliſh their fraudulent deſigns. And whilſt they are intent but upon counterfeiting the more obvious qualities of things, and perhaps of eluding the known and vulgar trials men are wont to acquieſce in, they are not like to take care to maintain the ſpecific gravity, and ſecure their adulterated wares, againſt an hydroſtatical way of examen, which, probably, they never ſo much as heard of. By this means, ſeveral pearls for inſtance, may be diſcovered to be counterfeit, without in the leaſt injuring them. And, I remember, that ſome fictitious corals, that, for divertiſement, I made, to ſhew what might be done in that kind, were, notwithſtanding their fine colour, ſhape, and gloſſineſs, eaſily diſcoverable, by their having a ſpecific weight manifeſtly exceeding that, which belongs to natural corals.

BEFORE I knew better ways, I have ſometimes for recreation, by the help of minium, made paſtes, or fictitious gems, which, though tranſparent, and finely enough coloured, yet, becauſe they contained ſome vitrified lead, added to the other ingredients, to promote the fuſion, were liable to be detected by an eaſy hydroſtatical trial of their ponderoſity. I have likewiſe ſeen a fair bezoar-ſtone, that ſo reſembled a genuine ſtone, that a great price was ſet upon it. But being brought me to be judged of, I made little doubt of its being counterfeit, by reaſon of its appearing to me as heavy as a mineral ſtone of that bulk; though the poſſeſſor being loth to expoſe it to an uncommon trial, I could not ſo cogently evince, that I had a clear reaſon to diſadviſe the purchaſe of it.

CHAP. VII.

Uſe V. AFTER theſe inſtances, (which are not the only, that might be alledged of this kind) the affinity of the ſubjects invites me to take notice of another uſe, or

or, at leaſt, a variation of the former, which may be made of our hydroſtatical way of examining ſolids. For it may, on divers occaſions, aſſiſt us to make probable eſtimates of the genuineneſs (or the degree of purity) of ſeveral bodies, that are, or may, uſefully be employed in phyſic, though they be not ſtones or minerals, provided they be heavy enough to ſink in water. For when we have once found the ſpecific gravity of a concretion of this ſort, that we know to be genuine, and well conditioned in its kind; this degree of ponderouſneſs may ſerve us for a kind of ſtandard, whereby to judge of others of the ſame denomination, or that are ſaid to be of a like nature.

To illuſtrate a remark, that has no more of difficulty in it than this, fewer inſtances will ſuffice (if any be neceſſary) than you will meet with in the following part of this tract, wherein they will opportunely occur. And therefore, inſtead of ſetting them down in this place, I chuſe to give you an advertiſement, that would ſurpriſe you, if I had not formerly hinted ſomewhat applicable to the ſame purpoſe, by no great variation. For that which I am about to ſerve you, is, that I think there ſhould be made a great difference between the eſtimate, that men make of ſome ſtones, to which the ſhops give the name of gems, according as the eſtimate is to be made by jewellers and goldſmiths, or by phyſicians and chemiſts. For the tradeſmen, who uſually aim but at the beauty and luſtre of the gems they would ſell, may juſtly eſteem thoſe, *cæteris paribus*, the beſt, that are in ſpecie the lighteſt, becauſe ſuch are generally more uniform as to ſenſe, and more tranſparent; and alſo receive their colour from pigments of finer parts. But, on the contrary, thoſe, that in gems ſeek mainly, if not only, for the medicinal virtues, may juſtly value thoſe moſt, that are moſt ponderous; as having more plentiful portions of the metallic or mineral ſubſtances, whence the greateſt part of their virtues is, as has been formerly noted, in probability to be derived. And this difference in ſpecific weight, in ſtones that have the ſame name given them, I ſometimes found to be far greater than one, that has not tried it, would imagine; as may appear by ſome inſtances applicable to this argument, that will hereafter be met with. But yet, I would not hence infer, that even ſuch ſtones, whether tranſparent or not, as appear fine, and are but light in their kind, muſt be devoid of particles, whether metalline, or of kin to them, whence they may be endowed with conſiderable medicinal virtues. For there are mineral pigments of ſo ſubtile a nature, that ſo ſmall a quantity as will ſcarce make them ſenſibly heavier than gems that are leſs (or perhaps not at all) coloured, may be diffuſed through the whole matter, and at leaſt impregnate every ſenſible part of it. This I ſhall illuſtrate by the following experiment, deviſed for that purpoſe.

Five grains of powdered zaphora, being mixed with ℥j. ʒß. of finely powdered Venice glaſs, and kept a full hour in fuſion in a furnace, that gives an exceeding violent fire, afforded a tranſparent maſs, that was throughout of a fine blue colour, and that deep enough; ſo that one part of the pigment ſufficed to tinge by fuſion above an hundred parts of the glaſs: and when for curioſity we made the proportion of the zaphora a little greater, taking eight grains of the pigment to ℥j. of glaſs, that is, one to ſixty; the mixture having been kept for the like time in ſtrong fuſion, the maſs was ſo deeply coloured, that the proportion of the tinging ſtuff to the reſt of the water appeared too great to make a handſome gem.

And further to manifeſt, that a quantity of metalline matter, though it be but very ſmall, may ſuffice to give a tincture (and ſo to impart a virtue) to a glaſſy body, and even to gems; I ſhall add an experiment, that perhaps you will think ſomewhat ſtrange. I had long conjectured, that there was in granates, eſpecially in ſome that were deeply coloured, pretty ſtore of metalline corpuſcles of a martial nature; and

that thoſe corpuſcles are more than ſufficient for the granate itſelf, into whoſe compoſition they enter, though not viſibly, becauſe of their extreme minuteneſs. Upon this ſuppoſition, I took a Bohemian, or rather German, granate, (for I never ſaw any Bohemian ſo large) that I had kept by me for a rarity, becauſe of its bigneſs and deep colour, though it was not a fine ſtone to look on, notwithſtanding its being tranſparent in thoſe edges that were thin. This being reduced to very fine powder, (but not in an iron mortar, leſt it ſhould take ſomething from the metal) we exactly mixed eight grains with an ounce of finely pulveriſed cryſtalline glaſs; afterwards the mixture was kept two hours in a furnace, that gives a ſtronger fire than ordinary wind-furnaces, by which means we obtained, as I expected, a pretty uniform maſs, tinged of a ſufficiently green colour, ſuch as prepared iron or ſteel gives to pure glaſs.

CHAP. VIII.

WHAT has been hitherto delivered, may ſerve to ſhew, in ſome meaſure, the uſes of our hydroſtatical way of examining drugs, upon a ſuppoſition, that they are ſolid, and neither very minute, nor too light to ſink in water. But I muſt not forbear to confeſs, and even give notice, that there are many ſimples, and other ponderable ſubſtances, that may, upon good grounds, be ſaid to belong to the *Materia Medica*; which yet want one, or more, of the newly expreſſed conditions. Wherefore I muſt not conceal, that there are three things, which, though not neceſſary to the underſtanding of the uſefulneſs of the foregoing part of this diſcourſe, may, if they can be performed, much conduce to facilitate (for I dare not ſay to compleat) the hydroſtatical way of examining bodies heavier in ſpecie than water. And therefore, though I confeſs it no eaſy taſk to ſurmount the difficulties to be met with in this attempt, yet I ſhall endeavour to leſſen them as much as I can, by offering to you the expedients, that I was wont formerly to make uſe of in the three caſes I am about to mention: namely, firſt, when the body to be examined was liquid, and conſequently could not be immediately taken hold of by an horſe-hair, or any other ſlender ſtring. Secondly, when the body propoſed was either in the form of powder, or conſiſted of fragments, that were ſo ſmall, that it was not poſſible, or at leaſt not fit, to faſten each of them to an hair, and ſuſpend it after the manner of a body of a greater bulk. And thirdly, when the ſolid, to be hydroſtatically examined, though great enough in bulk to be tied about, was diſſoluble in water, and conſequently unfit to be weighed in that medium; ſince therein its gravity muſt continually decreaſe, whilſt the operation was performing.

As to the firſt of the three difficulties lately mentioned, I ſuppoſe I need not ſolicitouſly premiſe, that the liquid ſubſtance, to be hydroſtatically examined, ought to be heavier in ſpecie than the water (or other fluid) it is to be weighed in, and of ſuch a nature, as not to be apt (at leaſt ſpeedily) to mingle itſelf with it; ſince otherwiſe the propoſed liquor will either emerge in that it ſhould be weighed in, or elſe be confounded with it, and ſo retain no diſtinct maſs or gravity.

SUPPOSING then, that the liquor, to be examined, has belonging to it the two newly recited conditions, we made uſe of this expedient to explore its ſpecific weight. We took a ſmall jar, or wide-mouthed glaſs, capable of containing an ounce or two of common water, and weighing, in the air, about three or four drams (more or leſs, as occaſion requires.) This glaſs, which, for brevity's ſake, we are wont to call hydroſtatical, or elſe glaſs-bucket, we weigh very carefully once for all, firſt in the air, and then in the water, and by the difference of the weights we find, according

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to the known hydroſtatical method, a weight equivalent to that of the ſubſtance of the glaſs in water; ſo that ſuch a weight being put into the oppoſite ſcale of the balance, the veſſel hanging under the ſurface of the water may be conſidered as having no weight at all, that is, no preponderancy. And conſequently, the weight of a body contained in this bucket may be looked upon as that of the body itſelf in water, without being increaſed by that of the veſſel; ſo that, in our inſtance, the bucket makes a maſs of quickſilver, though fluid, as ponderable as if it were coagulated into a ſolid body.

THE glaſs-bucket being thus provided once for all, we put the propoſed mercury into it, and weigh them together in the air; whence deducting the already known weight of the veſſel itſelf in the air, the reſidue gives the weight of the quickſilver alone in the air. This done, by the help of an horſe-hair we tie the bucket to one of the ſcales, (or to either end of the beam) and letting it, with the quickſilver in it, ſlowly ſink into a glaſs, or other veſſel, competently full of fair water, and hang ſo, that the bucket may not any where touch, either the bottom, or the ſides of the larger veſſel; we reduce, by weights put into the oppoſite ſcale, and added to the formerly mentioned counterpoiſe of the bucket in the water, the balance to an exact equilibrium, without raiſing the bucket quite to the ſurface of the water: this newly obtained weight of the immerſed quickſilver being deducted from its weight in the air, it is eaſy, by the known hydroſtatical method, to obtain the proportion in gravity between the given mercury and an equal bulk of water.

To expedite this operation, it may be convenient to have in readineſs (as I was wont to do) a couple of weights of lead or tin; the greater exactly equal to the weight of the glaſs-bucket in the air, and the other equal to the weight of the ſame bucket in water. For, by keeping theſe two weights conſtantly in readineſs, one has at hand a counterpoiſe of the veſſel, in which ſoever of the two mediums it is employed in, which ſaves them, that have frequent occaſion to uſe the balance, much of the time, that muſt otherwiſe be ſpent to adjuſt it.

THIS advertiſement being premiſed, the lately propounded operation will be beſt underſtood by an example. We took a ſmall glaſs jar, capable of holding about ℥ß of water, and put it into one ſcale of a tender balance, whoſe other ſcale we furniſhed with a counterpoiſe, or weight equal to the glaſs. Into this little veſſel we then put ℥j, that is, four hundred and eighty grains of mercury, (affirmed to be Spaniſh, which is counted the richeſt) and the glaſs, with this mercury in it, was, by an horſe-hair, made to hang from one end of the ſcales into a deep glaſs veſſel of water. Whilſt it was in that ſtate, there was in the oppoſite ſcale a counterpoiſe to the glaſs itſelf in the water, ſo that the drachms and grains, that it was requiſite to add, gave us the weight of the quickſilver only, the weight of the glaſs being already accounted for. But care was firſt taken, that the open-mouthed veſſel ſhould be every where environed with water, and diligently freed from adherent bubbles; and that a piece of horſe-hair ſhould be added to the counterpoiſe, to compenſate that part of the ſtring or hair tied about the bucket that was in the air, intercepted between the ſcale it was faſtened to and the ſurface of the water. By this means we found the weight of the quickſilver in that liquor to amount to 446 grains, which being ſubſtracted from the weight of the quickſilver in the air, the difference was 34 grains, by which the greater number being divided, the quotient was 14 and about $\frac{1}{10}$. So that the mercury, employed in this operation, appeared to be in gravity to water of the ſame bulk, as $14\frac{1}{10}$ to 1. I ſaid the mercury employed in this operation, becauſe in former trials I ſcarce found common quickſilver, that was bought in ſhops, to weigh full fourteen times, and ſometimes ſcarce thirteen and a half, as much as a bulk of

water equal to it. Whether the ponderouſneſs of our laſt uſed mercury proceeded from hence, that as ſome chemiſts extol Spaniſh mercury, as participating more than others of a golden nature, which opinion, a trial, that I purpoſely made of that employed about the late experiment, did not disfavour;) ſo there was in this of ours ſomewhat of unfixed gold, that ſomewhat increaſed its weight, I leave to further inquiry.

If you can command, as I cannot, the learned *Ghetaldus*'s *Archimedes promotus*, ſince, as I am informed, he there ſets down the intenſive weight of quickſilver hydroſtatically found, it may be worth your while to conſult that ſcarce book, and compare the things you may meet with there, relating to quick-ſilver, with what I have now delivered. To which I ſhall add, that this I may here give you notice of in general; that having, on chemical and other accounts, had more occaſion than moſt men, to make trials of this ſort, I did not find all running mercuries, though they did not appear adulterated, to be preciſely of the ſame weight: nay, even diſtilled mercuries, if once combined with metalline bodies, and particularly, if they were animated, and drawn from fine gold, I found to differ more from common mercuries ſold in ſhops, than theſe did from one another; and even between common mercuries, notwithſtanding their having been diſtilled, we found a notable diſparity. But to enlarge on this ſubject were improper in this place, where I mentioned the weight of mercury; but to give ſo clear (though but ſingle) an inſtance of the way of meaſuring the weight of ponderous liquid bodies in water, as may warrant me to ſay, that, by this method, though not always with the ſame eaſe, we may explore the ſpecific weight of other liquors, that are in equal bulk heavier than water, and yet are indiſpoſed to mingle with it; ſuch as are the chemical oils of cinnamon, cloves, guaiacum, *&c.* But the chief thing, that has made me the more circumſtantial in delivering the foregoing experiment, was, that this practical direction, for weighing one liquor in another, will hereafter appear to be applicable to uſeful purpoſes; eſpecially when we come to mention, in the following chapters, ſeveral caſes, wherein liquors of a nature very different from water, may be ſubſtituted in its ſtead.

CHAP. IX.

AS for the way of examining hydroſtatically the powders of ſinking bodies, ſuch as minium, putty, *&c.* or ſuch ſmall ſolids, or fragments of greater ones, as by reaſon of their littleneſs or inconvenient ſhape, are ſingly unfit to be tied with an horſe-hair to the balance, as the fragments of rubies, and other precious ſtones, wont to be ſold by weight at the drugſters or apothecaries ſhops; the way of diſcovering the weight of theſe in water differs not much from that lately delivered of weighing quickſilver in that liquor. For, on theſe occaſions alſo, we employ ſuch a glaſs bucket, as was lately deſcribed; and having made it very dry, as well within, as without, we put into it the metalline calx, or other heavy powder, or a convenient quantity of the fragments of gems, or a competent number of ſmall (though entire) bodies, as pieces of native cinnabar, ſeed-pearl, *&c.* and proceed with theſe as we did with quick-ſilver. Only this caution is to be heedfully taken along, that we warily, and little by little, put into the bucket, whilſt it is yet kept in the air, and hath the already weighed powder, or fragments in it, a convenient quantity of the ſame water it is to be weighed in; that the liquor may have time to inſinuate itſelf between the dry bodies, and even the corpuſcles of the powders, and expel thence the air, that was harboured in the intervals betwixt them; which little aerial portions, if not thus ſeaſonably expelled, would, upon the immerſion of the veſſel,

veſſel, produce in the water ſtore of bubbles, that would buoy up, or faſten themſelves to the fragments, or other ſmall bodies, and make the experiment uncertain, or fallacious. And if it be a powder, that is to be weighed, unleſs it be beforehand throughly wetted, and thereby freed from aerial particles, and reduced to a kind of mud, there is danger, that ſome dry corpuſcles of the powder will, when the veſſel is under water, be buoyed up, and get out of it, and, floating on the ſurface of the incumbent water, take off from the true weight, that the immerſed powder ſhould have in that liquor.

If this way of examining bodies be carefully employed by a dexterous man, furniſhed with a tender balance, it may be of conſiderable uſe, not only to phyſicians, druggiſts, and apothecaries, that are converſant with the more precious kinds of ſinking bodies, that belong to the *Materia Medica*, but alſo to lapidaries, and goldſmiths, whom it much concerns not to be impoſed upon by counterfeit gems, or by other ſtones of price, that are not duly conditioned, in their kind. Thus the fragments of the five precious ſtones, that (upon what grounds I now enquire not) are made ingredients of ſome noble compoſitions, as *confectio hyacinthi*, *&c.* theſe fragments, I ſay, may each ſort of them apart be uſefully examined by their weight in water, by him, that knows the true ſpecific gravity of a parcel of the fineſt, or elſe of ſuch as he judges to be fitteſt for his purpoſe. And, to add that upon the by, whereas granates are reckoned among the five medicinal precious ſtones, and in ſome pharmacopœas are preferred to the firſt place, as the beſt; I have found ſo great a difference, in point of ponderoſity, between European granates and American ones, whereof ſome were ſent me as a preſent from *New England*, and others I myſelf picked plentifully enough out of an odd American mineral, which I ſuſpected to contain them, that it was very obvious to think their virtues might be very different, if not as to kind, yet, at leaſt, as to degrees. And not only ſuch factitious pearls as have deluded many, and ſometimes even famous jewellers, (as one of themſelves, that was lapidary to a great monarch, confeſſed to me) may oftentimes by this expedient be diſcovered, eſpecially if mercury (though diſguiſed) be employed in making them; but we may probably by the ſame method diſcriminate the natural pearls of ſeveral countries and ſorts, whereof I have ſeen a far greater difference than one would expect; and I have ſomewhere yet by me natural pearls of ſuch various colours, as well as ſhapes, as have ſomewhat ſurpriſed even the curious. But becauſe it more concerns phyſicians and patients, to be able to make eſtimates of ſeed-pearl, that are on many occaſions of good uſe to health, than to know the genuineneſs of thoſe bigger ones, that are ſeldom made uſe of, but for ornament; I ſhall here mention the reſult of an experiment, which I find among my old notes to have been made by me, when I was furniſhed with very fine oriental ſeed pearls. For having examined theſe, by the way we are now diſcourſing of, as judging them orient enough to be fit to be patterns, wherewith to compare others, we found theſe to water of the ſame bulk, $2\frac{75}{100}$ (*i. e.* $\frac{3}{4}$) to 1.

But in this, and in thoſe other trials, whoſe difficulty, or importance, require, that we make them as exactly as we are able, I muſt advertiſe you, that it is not fit to truſt to the ſteadineſs of your hand in holding the balance, but that you make uſe of a gibbet as they call it, or ſome other ſtable prop to ſupport it. For the hand often ſhakes, and makes the inſtrument, that it holds, to do ſo, and oftner grows weary before the ſcales have had time to play up and down, and at length ſettle in a determinate ſituation; wherein if you miſs of a true æquilibrium, the hand muſt undergo a new penance: whereas, when the balance hangs on a ſtable fulcrum, you have both your hands to help you, and need not be tempted by wearineſs to deſiſt, before

water equal to it. Whether the ponderouſneſs of our laſt uſed mercury proceeded from hence, that as ſome chemiſts extol Spaniſh mercury, as participating more than others of a golden nature, which opinion, a trial, that I purpoſely made of that employed about the late experiment, did not diſfavour;) ſo there was in this of ours ſomewhat of unfixed gold, that ſomewhat increaſed its weight, I leave to further inquiry.

IF you can command, as I cannot, the learned *Ghetaldus*'s *Archimedes promotus*, ſince, as I am informed, he there ſets down the intenſive weight of quickſilver hydroſtatically found, it may be worth your while to conſult that ſcarce book, and compare the things you may meet with there, relating to quick-ſilver, with what I have now delivered. To which I ſhall add, that this I may here give you notice of in general; that having, on chemical and other accounts, had more occaſion than moſt men, to make trials of this ſort, I did not find all running mercuries, though they did not appear adulterated, to be preciſely of the ſame weight: nay, even diſtilled mercuries, if once combined with metalline bodies, and particularly, if they were animated, and drawn from fine gold, I found to differ more from common mercuries ſold in ſhops, than theſe did from one another; and even between common mercuries, notwithſtanding their having been diſtilled, we found a notable diſparity. But to enlarge on this ſubject were improper in this place, where I mentioned the weight of mercury; but to give ſo clear (though but ſingle) an inſtance of the way of meaſuring the weight of ponderous liquid bodies in water, as may warrant me to ſay, that, by this method, though not always with the ſame eaſe, we may explore the ſpecific weight of other liquors, that are in equal bulk heavier than water, and yet are indiſpoſed to mingle with it; ſuch as are the chemical oils of cinnamon, cloves, guaiacum, *&c.* But the chief thing, that has made me the more circumſtantial in delivering the foregoing experiment, was, that this practical direction, for weighing one liquor in another, will hereafter appear to be applicable to uſeful purpoſes; eſpecially when we come to mention, in the following chapters, ſeveral caſes, wherein liquors of a nature very different from water, may be ſubſtituted in its ſtead.

CHAP. IX.

AS for the way of examining hydroſtatically the powders of ſinking bodies, ſuch as minium, putty, *&c.* or ſuch ſmall ſolids, or fragments of greater ones, as by reaſon of their littleneſs or inconvenient ſhape, are ſingly unfit to be tied with an horſe-hair to the balance, as the fragments of rubies, and other precious ſtones, wont to be ſold by weight at the drugſters or apothecaries ſhops; the way of diſcovering the weight of theſe in water differs not much from that lately delivered of weighing quickſilver in that liquor. For, on theſe occaſions alſo, we employ ſuch a glaſs bucket, as was lately deſcribed; and having made it very dry, as well within, as without, we put into it the metalline calx, or other heavy powder, or a convenient quantity of the fragments of gems, or a competent number of ſmall (though entire) bodies, as pieces of native cinnabar, ſeed-pearl, *&c.* and proceed with theſe as we did with quick-ſilver. Only this caution is to be heedfully taken along, that we warily, and little by little, put into the bucket, whilſt it is yet kept in the air, and hath the already weighed powder, or fragments in it, a convenient quantity of the ſame water it is to be weighed in; that the liquor may have time to inſinuate itſelf between the dry bodies, and even the corpuſcles of the powders, and expel thence the air, that was harboured in the intervals betwixt them; which little aerial portions, if not thus ſeaſonably expelled, would, upon the immerſion of the veſſel,

veſſel, produce in the water ſtore of bubbles, that would buoy up, or faſten themſelves to the fragments, or other ſmall bodies, and make the experiment uncertain, or fallacious. And if it be a powder, that is to be weighed, unleſs it be beforehand throughly wetted, and thereby freed from aerial particles, and reduced to a kind of mud, there is danger, that ſome dry corpuſcles of the powder will, when the veſſel is under water, be buoyed up, and get out of it, and, floating on the ſurface of the incumbent water, take off from the true weight, that the immerſed powder ſhould have in that liquor.

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But in this, and in thoſe other trials, whoſe difficulty, or importance, require, that we make them as exactly as we are able, I muſt advertiſe you, that it is not fit to truſt to the ſteadineſs of your hand in holding the balance, but that you make uſe of a gibbet as they call it, or ſome other ſtable prop to ſupport it. For the hand often ſhakes, and makes the inſtrument, that it holds, to do ſo, and oftner grows weary before the ſcales have had time to play up and down, and at length ſettle in a determinate ſituation; wherein if you miſs of a true æquilibrium, the hand muſt undergo a new penance: whereas, when the balance hangs on a ſtable fulcrum, you have both your hands to help you, and need not be tempted by wearineſs to deſiſt, before

before the balance be brought to reſt in a perfect æquilibrium. The neglect or omiſſion of this practice I take to be one main reaſon (for the want of good balances, or of ſkill to uſe them, is oftentimes another) why ſo many of the experiments, that require weighing, are erroneous; as they that cautiouſly examine them (as I have ſometimes had occaſion to do) may eaſily find. And therefore (to add that, upon the by) I hope you will not make haſte to cenſure the accounts I give of hydroſtatical trials, becauſe they do nor always agree with thoſe of other men; ſince perhaps they did not employ either more diligence, or better inſtruments, than I.

CHAP. X.

THE laſt of the three caſes, formerly mentioned, namely, 'What is to be done, 'when the body to be hydroſtatically examined will diſſolve in water, or eaſily 'mingle with it?' imports a queſtion difficult and troubleſome enough to be reſolved. Nor can this examen be performed by a ſingle operation, which yet ſufficed in each of the two foregoing caſes. And having ſeriouſly conſidered the matter, the beſt expedient I could then think of was that, which divers years ago I propounded in an aſſembly of the Royal Society, and grounded on this reflection, that though the body propoſed could not be immediately weighed in water, yet we may ſubſtitute another liquor, that will not diſſolve it, and thereby inveſtigate the ſpecific gravity, in reference to that medium; and then, by comparing the difference of thoſe two liquors in point of gravity, one may come to diſcover, what the body propoſed would have weighed in water, in caſe it could have been kept there a competent time, without having any part of it diſſolved. Conſidering then, that, except quick-ſilver, the viſible fluids we can command, are either of an aqueous or of an oily nature; and that moſt bodies, whereof we can make ſolutions in liquors of the former, will not (at leaſt ſenſibly) ſuffer themſelves to be diſſolved by thoſe of the latter kind, whilſt a propoſed ſolid is weighing in them; we preſumed, that the moſt ſaline bodies, ſuch as alum, vitriol, ſal gem, to which may be added borax, ſublimate, &c. might be commodiouſly weighed in oleous liquors. Among theſe I made choice of oil of turpentine, rather than olive-oil, or any chemical eſſential oil; partly, becauſe, being of common uſe, it is to be procured in ſufficient quantity, and, being very cheap, is ſeldom adulterated, as chemical oils are too often found to be; and, partly, becauſe, being a diſtilled body, it may be preſumed to be free from aqueous parts, of which experience has ſhewn me, that common expreſſed oil is far from being deſtitute. But becauſe two liquors, that are indeed both of them oils, are wont to have diſtinct names given them in the ſhops, I ſhall here intimate, that I do not, when I have my choice, make uſe of that which many call the oil of turpentine, but of that which firſt comes over, which thoſe, that diſtinguiſh them, call the ſpirit of turpentine: I prefer this (I ſay) becauſe it is clear, almoſt like fair water; whereas, that which is called the oil, beſides that it is leſs fluid, is commonly of a yellow colour, which does leſſen its tranſparency, and may be compounded with ſome of the coloured bodies to be weighed in it.

THERE are many perſons, that would find it very difficult, and to whom, on moſt occaſions, it will not be neceſſary, to know the determinate proportion in gravity between oil of turpentine, and the ſolid that is weighed in it; and to diſcover, by the help of that gravity, what the body propoſed would weigh in water, in caſe it could be kept for a competent time in that medium, without having any part of it diſſolved therein. And therefore, though, if you deſire it, I ſhall, God permitting, annex the method of performing this taſk (which, you know, requires more calculation,

lation, than every common reader is able to go through with) to the end of this tract; yet, for the preſent it may perhaps be ſufficient, as well as fit, that I give you notice, that thoſe, that have not ſkill enough to determine, by the hydroſtatics, the proportion between ſinking ſolids, and the liquor they are weighed in, may yet be aſſiſted, by what we have delivered about oil of turpentine, to make a not unuſeful eſtimate, what is the ſpecific gravity of divers bodies, in reference to others of the ſame (or a differing) ſpecies; and by that means, to make a probable gueſs, whether or no it be rightly conditioned; if he be but provided with one piece of the body, which he knows to be genuine or well qualified. For this may ſerve him as a ſtandard, whereby to examine other bodies of the ſame denomination, that he may have occaſion to purchaſe, or to ſell, or to employ. As, ſuppoſe a tradeſman be to buy a parcel of ſublimate, he may take an ounce, for inſtance, or half an ounce of ſome of that he knows to be good, or rightly made; then having carefully weighed it in oil of turpentine, and ſet down how much it weighs therein; if he takes an ounce, or half an ounce, of the ſublimate he would make trial of, he may weigh that, as he did the other, in the ſame liquor, wherein if it give the ſame weight with the ſtandard, it is a good ſign; but if it weighs not ſo much, it is a ſign, that it has not its full or due proportion of mercury, and too great a proportion of ſalts, whence its comparative lightneſs proceeds. The ſame way of trying may be made uſe of for the examen of *mercurius dulcis*, and divers other bodies, totally or partly diſſoluble in water, as of alum, which is often ſophiſticated with ſome baſer ſalt, and of Roman vitriol, which is ſometimes either counterfeited, or adulterated by the help of roch alum, and a tincture of copper. And according as the weight in oil of the body propoſed recedes more or leſs from the weight of the ſtandard, ſo the adulteration may be probably concluded to be leſſer or greater.

CHAP. XI.

BEFORE I go off from this ſubject, it is fit, that I give you notice, that the hydroſtatics may ſupply us with another way of eſtimating the intenſive gravity of bodies, ſolid or fluid, that may on ſome occaſions be of good uſe. The way I mean is this: we take a ſolid body, more than heavy enough to ſink in water, and carefully obſerve, once for all, its weight in the air; then we weigh the ſelf-ſame ſolid, firſt in one of the liquors we would examine, and then in another; and ſo onwards, if there be more than two: and having noted the difference between the ſolid, and each of the liquors, it is eaſy to find, according to the practice elſewhere delivered, the ſpecific weight of each, and the proportions betwixt them. And in regard it is but one and the ſame ſolid, that is compared to the differing liquors; whatſoever their number be, it will not be difficult to compare the ſpecific gravities of thoſe liquors betwixt themſelves, and to diſcover, by the weight of the firſt, that of any of the others, that one pleaſes.

THE propoſed way having been but ſummarily delivered, it will not be amiſs to ſubjoin ſome remarks relating to it.

AND firſt, if you intend to employ but one ſolid in your examen of liquors, it will be neceſſary you make choice of ſuch an one, as hath a much greater ſpecific gravity, than is neceſſary to make it ſink in water. For there are ſome liquors, that are far, perhaps twice, more ponderous than this newly named. Secondly, the body ought to be heavy enough to ſink in all liquors but quickſilver (for in that none but gold is ponderous enough to ſink.) But if your trials are to be made upon liquors, that belong to the vegetable or animal kingdom, the body you employ need not be near

near ſo ponderous; though it ought to be more ſo than water; becauſe (as I found by trials purpoſely made) ſome liquors, that are very ſpiritous and volatile, are yet much heavier in ſpecie than water. It is not very eaſy to pitch upon ſuch a ſingle ſolid, as may have all the qualities, in reference to our purpoſes, that may be deſired in it, if it be to be made uſe of for a long time. For thirdly, beſides that, it ought not to loſe of its weight (and conſequently to change it) by the inſenſible avolation of effluvia, and that it muſt be, as was freſhly noted, of a conſiderable ſpecific gravity. Fourthly, it ought not to be too big, or too intenſely heavy, leſt it be too heavy for a tender balance, or require too much liquor to environ it. Fifthly, it ought to be of ſuch a texture as not to be diſſolved, or corroded, by any of the ſeveral liquors, ſome of which may be ſharp and piercing menſtruums, that it is to be weighed in, and thoſe too of differing natures. Sixthly, it ſhould alſo be of ſuch a make, as is not eaſily liable to be broken, or otherwiſe ſpoiled, that it may laſt till all the deſigned experiments, though many, be made with it. Seventhly and laſtly, it is deſirable, that it ſhould be of a natural and uniform, as to ſenſe, and procurable ſubſtance; that the experiments made with it may be eaſily enough communicated to others, and, if they think fit, tried over again by them; and that, if any be judged worthy, they may be tranſmitted to poſterity.

SEVERAL bodies there are, that I looked upon as more fit than moſt others to be employed about the trials we are treating of. The chief of theſe were brimſtone, hard wax, ivory, and white marble. But though each of theſe, eſpecially if fitly ſhaped, may be of uſe on ſome particular occaſions; yet every one wanted ſome of the deſirable qualifications lately mentioned. And therefore, I made much more uſe of three other bodies, not becauſe they were ſuch as I could wiſh, but becauſe they were the leaſt remote from being ſuch, among thoſe I could procure. The firſt of theſe was a piece of amber between three and four drachms in weight, of an high yellow colour, but very tranſparent, and of an uniform texture and convenient ſhape. This was judged fit to be employed, when we were to examine the lighter ſorts of liquors, ſuch as common water, rain-water, *&c.* wine, brandy, rectified ſpirit of wine-vinegar, and the liquors drawn from it, cyder, beer, ale, urine, many waters and ſpirits diſtilled from bodies belonging to the vegetable and to the animal kingdoms. But it is not proper for the more ponderous kind of liquors, ſince it will not ſink to the bottom, but float at the top, not only of ſome liquors of the mineral kingdom (as will ere long appear) but in ſeveral liquors afforded us by the ſaline parts of bodies belonging to the vegetable kingdom; as you will find within a few pages.

THE ſecond body I employed was a globular glaſs, which I cauſed to be blown at a lamp, and to be hermetically ſealed at the neck, which was purpoſely made very ſhort, after there had been lodged in it as much quickſilver, and no more, as we gueſſed would ſerve to ſink it in any liquor, except quickſilver. This, by reaſon of its great bulk, in reference to its weight, was fit to diſcover differences in weight minute enough between the liquors it was weighed in; and it was out of danger of being corroded, even by ſharp menſtruums; and therefore, on divers other occaſions, I preferred this inſtrument to any of the other two: but it is diſadvantaged by theſe inconveniencies, that it is difficult to be made, or procured; that it is hard to be preſerved, being very eaſy to be broken; and that partly on this account, and partly on others, it can ſcarce be a fit ſtandard in reference to ſuch obſervations, as are to be communicated to others, and tranſmitted to poſterity.

WHEREFORE for experiments, that are to be imparted and recorded, I made uſe of a ſolid, which, though heavier in ſpecie than was neceſſary to enable one to compare

pare together the lighter ſorts of liquors, and to diſcover their minuter diſparities in point of weight, is yet a natural ſtandard, not ſubject to be broken without groſs negligence, nor to be diſſolved or corroded by the liquors it was to be immerſed in, however of various kinds, and very ſharp, and ponderous enough to ſink in all of them, except quickſilver, and yet not near ſo ponderous, as the lighteſt metals, or many metalline bodies. This ſolid I ſpeak of is rock-cryſtal, which I formerly repreſented, as for its purity, homogeneity, &c. fit to afford a meaſure, to which other bodies may be compared in weight, and by that means among themſelves. And of this pure concrete we employed an almoſt complete globe (weighing in the air ℥ii. ʒß. grains 3.) ſave that it had in one part of it two ſmall holes near one another, and eaſily ſtopt up with hard wax, after there had been put through them an horſe-hair, by whoſe means the ball was eaſily faſtened to the ſcale, from whence it was to hang in the water. The bigneſs of this globular body made it the more fit to diſcover the leſſer differences between liquors in point of intenſive gravity. But becauſe we may have oftentimes occaſion to know the weight of liquors, of which, by reaſon of their preciouſneſs, or rarity, we can command but ſmall quantities, as it frequently happens, if we be to try the weight of chemical oils, tinctures, eſſences, &c. we thought fit, for ſuch liquors, to provide a piece of cryſtal, ſuch as nature had framed it, *viz.* an hexagonal priſm, with a kind of pyramid at the end, which is oppoſite to the extreme, at which it was broken off from the body it grew on. For this clear and finely ſhaped cryſtal (or what is very near of kin to it, white amethiſt) by reaſon of its oblong figure, might be commodiouſly weighed in ſo ſlender a cylindrical glaſs, as required but a ſmall quantity of liquor to cover and ſurround a conveniently ſhaped body, that weighed, in the air, but half an ounce and ſixteen grains. And to render the obſervations, made with theſe two bodies of medicinal and other liquors (for there are ſeveral of theſe trials, that belong not to this tract) the more uſeful to experimenters, I ſhall here deſire you to take notice, once for all, that the ball of cryſtal was to water of the ſame bulk, as $2\frac{5}{10}\frac{7}{0}$ to 1, or thereabouts; and the priſmatical oblong piece of cryſtal was, to a quantity of the ſame liquor, equal to it in magnitude, as $2\frac{5}{10}\frac{6}{0}$ to 1.

I HAVE the more particularly delivered the way of exploring the gravity of ſeveral liquors with one ſolid, becauſe there may be made of it a couple of applications, that may, on ſeveral occaſions, be of uſe, not only to chemiſts, phyſicians, and apothecaries, but to divers other experimenters, that are not of either of their profeſſions.

THESE applications do, I confeſs, belong to another paper, (*viz.* an eſſay about ſome uſes of chemiſtry improved) that was written divers years ago. But ſince, by reaſon of the loſs of divers leaves of it, I know not whether, much leſs when, it will come abroad, I ſhall at preſent borrow ſome few things of it to accommodate my preſent deſign.

FIRST then, the piece of clear amber formerly mentioned, or ſome ſuch convenient body, that is not too little, nor *in ſpecie* too heavy, may ſerve the chemiſt, apothecary, and others, to make probable gueſſes of the degree of ſpirituoſity, or of thinneſs, that is to be found in many liquors belonging to the vegetable or the animal kingdom, which may be done with far leſs error by this way, than by thoſe uncertain ſigns, on which the common ways of gueſſing are wont to be grounded. For having once provided a liquor, by compariſon whereto one may ſafely make eſtimates of others of the ſame kind, or denomination, it will be eaſy, by obſerving the differing weights of the amber in ſeveral liquors to judge of the fineneſs of any of them in its kind; for, *cæteris paribus*, that is the thinneſt, or abounds moſt in

ſpirituous parts, where the ſolid weighs more than in the other, as for inſtance, the amber we employed, that in water weighed $6\frac{3}{4}$ grains, in common red French wine weighed $8\frac{1}{2}$ grains, in common brandy of a pretty good ſort, ſuch as that of *Nantz*, $17\frac{1}{8}$ grains, and in vinous ſpirits highly rectified $34\frac{1}{8}$ grains. The ſame way one may employ to judge of the ſtrength of ſpirits of vinegar, *acetum radicatum*, &c. but with a great difference in the application. For it may paſs for a general rule, that it is probable, that of liquors diſtilled from wine, cyder, ale, and other fermented liquors, the hydroſtatical body (if I may ſo call it) weighs more or leſs, according as the liquor it is weighed in is more or leſs ſpirituous; but, on the contrary, in acid ſpirits and liquors; the leſs the ſolid weighs, the ſtronger one may repute that liquor to be: that greater decrement of weight proceeding uſually from the greater proportion it contains of ſalts, that are not volatile.

I MUST not here pretermit one convenience of the way newly propoſed, that may, in tract of time, ſave you ſome money, and, at leaſt, will enable you to huſband better, than in the vulgar method you can, liquors, that you may have but ſmall quantities of, or that are worthy to be preſerved. For, you know, it is uſual with many chemiſts, and eſpecially thoſe, that are more circumſpect than others, to try the goodneſs of their ſpirit of wine, or brandy, or other ſpirits drawn from fermented liquors, by ſetting fire to a ſpoonful of the ſpirit to be examined, in order to ſee how much of it is totally inflammable, and how great, or little a portion of phlegm will be left behind. But, not here to mention the ſcruples I propoſe in another paper, about this way of trying ardent ſpirits, I ſhall now only take notice, that, by the newly recited way you loſe or ſpoil all that you try, and the better the ſpirit is, the greater is your loſs; whereas by the hydroſtatical way, the liquor is examined without being deſtroyed.

IT is now fit to add, that by the help of the foregoing obſervations, one may alſo make eſtimates of liquors of the ſame kind not diſtilled, whether fermented or not fermented, as ſeveral ſorts of beer, or of ale, or of cyder, or of juices of apples, or of pears newly preſſed out. And the ſame hydroſtatical ſolid may be employed, to compare with one another, in point of intenſive weight, liquors of differing kinds, as wine, beer, ale, mead, cyder, perry, verjuice, expreſſed oils, eſſential oils of different bodies, &c.

BUT, in caſe the liquors to be employed be very ponderous, amber will not be a fit ſolid to be examined about them; for I have found by trial, (what one would ſcarce ſuſpect) not only that it would ſwim or float in divers liquors made by ſolution of ſalts, whether in the moiſt air, or even in water, ſuch as oil of tartar per deliquium, ſolution of ſalt of tartar in as little water as may be, and ſolution of the ſalt of pot-aſhes, &c. But ſome diſtilled liquors would not ſuffer my pellucid amber to ſink to the bottom, as I found by trial made with oil of vitriol, with ſpirit of nitre, and even with good ſpirit of ſalt.

BESIDES, there may be another uſe made of our hydroſtatical ſolid, which may, on divers occaſions, be as ſerviceable to experiments in general, by aſſiſting them to proportion to their purpoſes, the ſtrength of the menſtruums, and other liquors they are to employ, as the former uſe is to diſtillers and apothecaries, for diſcovering the ſtrength of the already prepared liquors, that they would examine. For there are divers experiments, that either do not ſucceed, or at leaſt do not ſucceed ſo well, unleſs the menſtruums, or other liquors employed in making them, be of a determinate degree of ſtrength, (which is uſually knowable by a certain degree of intenſive weight.) This will be the more eaſily granted, if (as I have elſewhere ſhewn) the ſtrength and ſpirituoſity even of ſome liquors, whoſe chief virtue and uſe

uſe is to be good ſolvents, may yet be unfit to diſſolve, as well becauſe their ſtrength exceeds a certain meaſure, as becauſe by their weakneſs they fall ſhort of it. Of this, I remember, I gave an inſtance in aqua fortis, whoſe ſtrength, as its name intimates, is reckoned the beſt quality it can have; for I found that if it were ratified ſo much as to make it as ſtrong as we could, or but ſomewhat leſs ſtrong than that, it would not diſſolve ſilver, but required to be weakened by an addition of water; and I found that the menſtruum, though it were not much rectified, would not near ſo well diſſolve the filings or raſpings of crude lead, when it was moderately ſtrong and fit to diſſolve ſilver, as when it was allayed with a conſiderable quantity of water, eſpecially if afforded by rain, or by diſtillation. I ſhall add, that in making extractions from many vegetable ſubſtances for medicinal uſes, chemiſts themſelves may fall into a miſtake, when they affect to employ their moſt rectified ſpirit of wine, as the beſt menſtruum for their purpoſe: for the medicinal virtue of not a few ſuch bodies does not reſide only in what chemiſts call their ſulphur, and might perhaps more properly be called the reſinous part, which indeed is beſt diſſolved by ſuch ſpirit of wine as is carefully dephlegmed; but alſo in a more gummous, and partly perhaps almoſt mucilaginous ſubſtance, for whoſe extraction a moderately phlegmatic ſpirit is more proper, becauſe of the aqueous portion, that is mingled with the inflammable one; ſince we ſee, that ſome gummous bodies, as gum arabick, gum tragacanth, *&c.* are not diſpoſed to be diſſolved by the beſt rectified ſpirit of wine, as they are by aqueous liquors, as water, weak ſpirit of wine, *&c.* and ſome, though diſſoluble in both kinds of menſtruums, are yet leſs eaſily ſo in ſtrong ſpirit of wine, than in wateriſh menſtruums, as may be obſerved particularly in myrrh; for other inſtances applicable to theſe advertiſements belong to another paper.

And what has been now ſaid may ſerve to perſuade you, that it may be of good uſe, on divers occaſions, to take notice of the degree of ſtrength of the menſtruum, or other liquor, we employ about this or that nice experiment; that when we have occaſion to reiterate it to the ſame purpoſe only, we may be able to bring the liquor we make uſe of to the ſame degree of ſtrength with that which we formerly employed, and by which the deſigned effect was produced. But in experiments, that ſhould be very critically made, it will not be amiſs to bear in mind this caution, that if the liquor be very ponderous in ſpecie, as oil of vitriol, or oil of tartar per deliquium, it will be fit to put ſomething into the ſcale, from which the ſolid hangs, to make compenſation for that part of the hair, that is immerſed, ſince horſe-hair not being of the ſame ſpecific gravity with this liquor, (though it be preſumed to be ſo with common water) is to be conſidered as a ſomewhat lighter body, capable of buoying up the ſolid a little, and therefore its comparative levity ſhould be compenſated.

CHAP. XII.

Besides the way we come from diſcourſing of, there is indeed another way, which we have, on divers occaſions, found uſeful to compare different liquors, that are of the ſame magnitude in point of weight. This is done by ſucceſſively filling a vial greater or ſmaller, furniſhed with a pretty long and ſlender cylindrical ſtem, to a certain ſtable mark made near the top, with the ſeveral liquors to be compared together in point of gravity.

But this way I muſt here do no more than name, not ſo much becauſe I ſpeak of it in a convenient place of another paper, as becauſe it is not hydroſtatical. But

there is alſo another way to diſcover, whether or no two or more liquors propoſed differ in ſpecific weight, and to make ſome not groundleſs eſtimate of their differences. This is done by a hollow cylinder of braſs, or other metal, made ſomewhat heavy at bottom to make it ſwim upright, that ſinks more or leſs in ſeveral liquors, as they are lighter or heavier, one than another. But the diligent *Merſennus* himſelf, who propoſes this way, confeſſes it to be very difficult to make ſure obſervations by it. To which I ſhall therefore add but this, that being a metal, it may be corroded by acid menſtruums; and if it be of braſs or copper it may be wrought upon or injured by urinous menſtruums too.

WHAT *Merſennus* ſaid of this inſtrument, may be applied to another, though differing from it both in ſhape and matter. For it is made of two glaſs bubbles, and a very ſlender ſtem, which is hermetically ſealed with a ballaſt in the lowermoſt of quickſilver to keep it ſteady, when partly immerſed in liquors, in which this inſtrument, like the metalline cylinder, ſinks deeper in lighter liquors, than in heavier, in a meaſure ſomewhat anſwerable to their differences in gravity. But, though I have, on ſeveral occaſions, employed theſe inſtruments, and found them not unuſeful, when I did not confine myſelf to one or two, but made uſe of ſeveral different ſizes, according to the various liquors I was to examine; yet what you may elſewhere find about this inſtrument, diſpenſes me from ſaying any more of it in this place, than that for ſome of the ends aimed at in this chapter, it is inferior to the way of examining liquors by the help of the balance.

THERE is alſo another way, that is hydroſtatical, propoſed by *Merſennus*, of weighing of liquids in water, and it is this: he bids you take a glaſs vial, to which, being firſt weighed in air, and then in water, you are to adjuſt a ſtopple of wax, or cork, that will fit it exactly. This done, you are to fill the vial with the liquor you would examine, ſo that no air be left between it and the ſtopple. The veſſel thus filled you are to weigh in water, and ſubſtract from its weight there, the formerly noted weight of the glaſs itſelf in water, and alſo that of the ſtopple; which done, the remains will give the weight of the liquor propoſed in water. This method I lately chanced to find propounded by (the writer newly named) the induſtrious *Merſennus* in his *Hydraulicks*; but I remember not, that he affirms himſelf to have made uſe of it; and though it may be ſerviceable on ſome occaſions, yet I fear it will be troubleſome in practice. For (to omit ſome inconvenient circumſtances) ordinary vials, capable of containing a competent quantity of liquor, are uſually too heavy to be employed with tender balances; and common ſtopples (ſuch as *Merſennus* may be well ſuppoſed to have employed) will be ſubject to divers inconveniencies, as that they may be penetrated by ſome liquors, and corroded by others; and if they be made of cork, or of common wax, or any other ſubſtance lighter in ſpecie than water, it will not be eaſy to find its ſpecific gravity, eſpecially ſince evaporation and other accidents make this itſelf vary; and whatever matter vegetable or animal, it be made of, the veſſel will coſt you two operations, one to diſcover the weight of the veſſel in water, and the other that of the ſtopple, (at that time) which is troubleſome. Wherefore, when I met with this way in the ingenious *Merſennus*, it ſeemed to me more inconvenient than one, that I remember I had formerly thought of, and which I have ſometimes put in practice, by chuſing a vial not too large, and of a round figure, that being the moſt capacious under ſuch a ſuperficies, and inſtead of other ſtopples, fitting it with one of (the like) glaſs, carefully ground to the neck of it. For by this means the inconveniencies of a ſtopple lighter than water were avoided, nor would the ſtopple alter its ſpecific gravity, either by imbibition, or evaporation; nor would it be penetrated by the moſt ſubtile ſpirits, nor corroded by the

the moſt fretting ones. To which may be added, becauſe in ſome caſes it may be conſiderable, that a glaſs ſtopple, as it will not be wrought on by the liquor contained in the vial, ſo it will not communicate any tincture, or extraneous quality, to the liquor; which cannot be affirmed of a ſtopple of cork or wax, in reference to ſome ſubtil and very corroſive, or other very penetrating liquors: this hydroſtatical bottle (as for diſtinction ſake I call it) being together with its ſtopple carefully weighed, firſt in air, and then in water, (that the gravity of the whole inſtrument in that liquor may be ſettled once for all) we filled it exactly with the liquor to be examined, and ſo proceeded, as if we were to weigh quickſilver according to the manner formerly declared in the eighth chapter. The weight of the given liquor in water being thus obtained, its proportion in weight to water of the ſame bulk may be eaſily diſcovered by the way formerly delivered in the ſecond chapter (or the tenth chapter.) This way of examining liquors may, on ſome occaſions, do good ſervice; and I did the rather now and then make uſe of it, becauſe it is applicable to all kind of liquors, whether heavier in ſpecie than water, or lighter.

If you lay aſide the ſtopple, the round ball itſelf may be made uſe of on ſeveral occaſions, inſtead of that hydroſtatical bucket formerly mentioned; for the weighing of quickſilver, and divers heavy powders, eſpecially if they be coarſe ones. But if the inſtrument be fitly ſhaped, and not too heavy, there may belong to it a greater conveniency than this. For when you have, and are willing to ſpare liquor enough to environ the little bottle, it may be uſefully ſubſtituted to the hydroſtatical bubble, with quickſilver encloſed, that I formerly recommended. For by reaſon of its exact ſtopple, it has no need of an hermetic ſeal, (which is not eaſy to be made or procured) and it is far leſs ſubject to be broken than a bubble. And yet that which I moſt made uſe of (and which weighed about ℥i. ʒiiiſs. grains xix. or 709 grains) being well ſtopt with only air in it, would ſink by its own weight in water, and in liquors lighter than this, as wine, brandy, *&c.* And if it were to be employed in liquors much more ponderous than water, as aqua fortis, oil of tartar per deliquium, *&c.* it was eaſy to make it fit to be weighed in them alſo, by putting into it a quantity of quickſilver (or ſome other fit body) of a determinate weight, as two, three, or four drachms, before we ſtopped it: which ballaſt, when the operation is over, may, if it be quickſilver, be eaſily taken totally out, and kept apart for the like uſes: and the empty bottle and ſtopple may thereby become fit again, to be weighed in water and lighter liquors.

But notwithſtanding all this, becauſe glaſſes, for ſize, ſhape, and weight, fit for balances, tender enough, and furniſhed with glaſs ſtopples exactly fitted to them, are very difficult to procure; and the way itſelf is ſubject to ſome of the inconveniencies that we imputed to other ways, not long ſince mentioned: it ſeems, that generally ſpeaking, this way of finding the weight of liquors in water, is inferior for common uſe to thoſe more ſimple ones that we formerly recommended. See the chapter.

CHAP. XIII.

HAVING now laid down the method of weighing one liquor in another, it is allowable, and may be fit, that we ſubjoin ſome application of it; eſpecially becauſe it will become me to make good, in ſome meaſure, what I remember I formerly hinted to you, *viz.* that in the ſubſequent part of this paper, there would be delivered a further uſe, which may be counted the ſixth of the hydroſtaticks in examining medicinal bodies. And though by the inſtances we lately had occaſion to propoſe in ſome of the chapters preceding this, divers things referable to this uſe are

ſet down already; yet I ſhould not content myſelf (as I now muſt do) to point at the chief heads or kinds of things referable to it, if on a ſubject that is more fertile than it ſeems, want of leiſure did not reſtrain me from deſcending to treat of the particular inſtances that belong to them.

AMONG the ſervices then that the hydroſtaticks may do a ſagacious phyſician, I muſt not omit one, though it has not hitherto, that I know of, been propounded by any author. And, I hope, you will not think it improper to be taken notice of here, though it do not regard only the *Materia Medica*, but is applicable (as I may elſewhere relate that I made it) to divers ſubjects that are referable to other parts of phyſiology: ſince divers bodies that ſeem not ſo directly to regard the *Materia Medica*, as it is uſually repoſited in the ſhops of drugſters, have been in ſome times and places, and may deſervedly be now made to afford matter for remedies to a free and ingenious phyſician.

I CONSIDER then, that there are many liquors, whoſe ſpecific gravity it may be uſeful to know, not only as it may help to diſtinguiſh genuine or well-conditioned ones from them that are not ſo, but for other good purpoſes too.

INSTANCES of this kind may be afforded by the juices of herbs and fruits; where (according to the direction given in the laſt chapter) we firſt weigh a determinate quantity, as an ounce, or ſo many drachms in our hydroſtatical jar, or bucket; and putting ſome oil of turpentine on it, we ſink it warily into that liquor, whoſe ſpecific gravity, in reference to refined ſilver, clear rock cryſtal, (or ſome other body, if we know it to be as pure) has been carefully found out and regiſtered: for by this means (as we have lately manifeſted) ſubſtituting this oil for common water, we may diſcover the ſpecific gravity of liquors, not to be weighed in water, becauſe they mingle with it. And thus we may find, not only the difference in ponderoſity between the juices of plants of different kinds, as of wormwood and roſes, and ſometimes of the ſubordinate ſpecies of the ſame genus, as abſynthium vulgare, ponticum, romanum, *&c.* and roſes, white, red, damaſk, yellow, *&c.* but we may on ſome occaſions obſerve, whether, and if at all, how far the keeping of a juice for ſome time, more or leſs, or the fermentation of it, or the putrefaction, will alter its ſpecific gravity. There are alſo other liquids uſed by phyſicians, and not ponderable in water, that may be by this way examined, as honey, vinegar, verjuice, *&c.* And by the ſame way may be alſo diſcovered and compared, the ſpecific weight of the juices of fruits of different kinds, as of grapes, apples, pears, quinces, *&c.* and of ſubordinate ſpecies belonging to the ſame genus, as the newly expreſſed juices that make ſacks, French-wines, rheniſh-wines, *&c.* and thoſe liquors that are preſſed out of ſeveral ſorts of apples, as pippins, pearmains, John-apples, queen-apples, *&c.* And in divers of theſe, a perſon that is curious enough, may probably, by the method we have been propoſing, be enabled to take notice of the differences produced in the ſpecific gravity, (whoſe changes are uſually accompanied with thoſe of conſiſtence, *&c.*) in the ſeveral ſucceſſive ſtates, wherein the liquors may be found at different times, as (not to mention the juice of unripe grapes, *viz.* verjuice) the juice of ripe grapes is in very differing ſtates when it is newly preſſed out, when it begins to ferment, when it is yet but new wine, when it has attained its full maturity and perfection, when it begins to degenerate into ropy pricked wine, *&c.* and when it is abſolutely changed into vinegar, or elſe into vappa.

BUT here it ought not to be concealed from you, that in this kind of experiments, to make uſe ſucceſsfully of the hydroſtatical bucket, is a taſk difficult enough, for reaſons that a few trials will eaſily diſcover. And therefore, though I would not diſcourage the ſkilful, yet for thoſe that do not find themſelves dextrous at making experiments,

experiments, I think it adviſeable to employ, inſtead of the bucket, amber, or ſome other convenient hydroſtatical ſolid, or rather (which is better) a glaſs bottle and ſtopple, ſuch as we formerly deſcribed, but as large as may well be employed without overloading or injuring the balance.

CHAP. XIV.

AS I thought it was fit to give the foregoing advertiſement by way of caution in the caſes that occaſioned it; ſo having conſidered the nature and ſcope of the hydroſtatical experiments in general that belong to this eſſay, I ſhall venture to add for the encouragement of thoſe that are better furniſhed with inquiſitive minds, than with nice balances; that though in divers trials, eſpecially thoſe that are made about precious things, as gold, pearls, diamonds, and other gems, there is no relying upon any but very good and tender balances; yet, on many other occaſions, it is not neceſſary, though it be deſireable, that the ſcales we employ ſhould be extraordinary good. And this for two reaſons: firſt, becauſe many hydroſtatical experiments are ſuch, that a little variation from the exact proportion of the ſolid to the liquor, or between bodies of the ſame denomination, can lead us into no conſiderable error, or at leaſt not defeat the experimenter's main deſign; as with a balance that is not nice, one may ſufficiently diſtinguiſh between an human calculus and a pebble, or other ordinary ſtone, and between coarſe and fine native cinnabar: and between a true guinea, or other piece of coined gold that is not very ſmall, and a counterfeit one of braſs, or any ſuch mixture, though never ſo finely gilt.

AND ſecondly, becauſe as there are few phyſical experiments, wherein mathematical preciſeneſs is neceſſary, and fewer wherein it is to be expected; ſo in many hydroſtatical trials, it is very probable, that the difference of bodies of the ſame kind, or denomination, flowing from their compoſitions and internal textures, will make a diſcernable, though but ſmall difference in their ſpecific gravity: as in rock-cryſtal itſelf, we have found ſome pieces to be to water, as $2\frac{5}{100}$, or a little more to one: and others to be to the ſame liquor as two to ſix, or between ſix and ſeven tenths to one. And therefore, how exact ſoever the balance be, there muſt be ſome allowance made for the diverſity that may be found in the bodies themſelves that are examined, which diverſity may perhaps produce, at leaſt, as great difference in the proportions we ſeek for, as needs to be expected from a ſmall difference of tenderneſs in the ballances we employ. And indeed, neither one of thoſe differences, nor the other, (nor perhaps both together) is wont to be ſo conſiderable, as to challenge much regard in phyſical experiments; or at leaſt, as to hinder it to be true, that on moſt occaſions, the hydroſtatical way of examining the ſpecific weight of bodies, is preferable by far to any other way of doing it that has been practiſed.

BEFORE I proceed to the remaining part of this eſſay, it will be worth while to obviate an objection, that I foreſee may be made by critical naturaliſts againſt the method hitherto delivered, of finding the proportion in weight betwixt a ſinking body, and water of the ſame bulk. For it ſpecioufly may, and probably will be objected, that by this method we cannot diſcover the proportion between a ſolid body, and water in general, but only betwixt the propoſed body, and the particular water it is weighed in; becauſe there may be a great diſparity betwixt liquors that are called, and that deſervedly, common water. And ſome travellers tell us from the preſs, that the water of an eaſtern river, which if I miſtake not is *Ganges*, is by a fifth part lighter than our water.

BUT to this plauſible objection, I have two things to anſwer.

AND

AND firſt, having had upon ſeveral occaſions the opportunity, as well as curioſity, to examine the weight of divers waters, ſome of them taken up in places very diſtant from one another, I found the difference between their ſpecific gravities far leſs than almoſt any body would expect. And if I be not much deceived by my memory, (which I muſt have recourſe to, becauſe I have not by me the notes I took of thoſe trials) the difference between waters, where one would expect a notable diſparity, was but about the thouſandth part (and ſometimes perchance very far leſs) of the weight of either. Nor did I find any difference conſiderable in reference to our queſtion, between the weight of divers waters of different kinds, as ſpring-water, river-water, rain-water, and ſnow-water, though this laſt were ſomewhat lighter than any of the reſt. And having had the curioſity to procure ſome water brought into *England*, if I much miſremember not, from the river *Ganges* itſelf; I found it very little, if at all lighter than ſome of our common waters.

AND now I ſhall repreſent in the ſecond place, that I do not pretend, (and indeed it is not neceſſary) that the proportion, obtainable by our method, ſhould have a mathematical preciſeneſs. For in experiments where we are to deal with groſs matter, and to employ about it material inſtruments, it is ſufficient to have a phyſical, and almoſt impoſſible to obtain (unleſs ſometimes by accident) a mathematical exactneſs, as they will ſcarce deny, that have, as I have done, conſidered and made trial of the difficulties that oppoſe the attainment of ſuch a preciſeneſs.

CHAP. XV.

Hydroſtatical Stereometry applied to the Materia Medica.

SECT. I.

THERE is an uſe of hydroſtatics, which though it do not directly tend to the examen of drugs, or ſimples received into the *Materia Medica*, yet may be ſerviceable both to the phyſician and the naturaliſts, in delivering their deſcriptions; and ſo it may indirectly conduce to the knowledge of them, and help, on ſome occaſions, to diſtinguiſh between genuine ſimple (eſpecially fruits) and thoſe that are not ſo; it is known that the writers of the *Materia Medica* are wont to ſet down the bigneſs of the bodies they deſcribe by very uncertain gueſſes; and thoſe that to be more accurate, aſſign them determinate meaſures, are wont to do it, by ſaying, that ſuch a fruit, or other body is, for example, an inch, or two inches, or half a foot long; and half an inch, or a whole inch, or two inches and an half in breadth. But it is obvious to thoſe, that are not great ſtrangers to the mathematics, that according to this way of deſcribing bodies, there may be, by reaſon of the great variety of figures they are capable of, eſpecially irregular ones, a very great diſparity of magnitude, or bulk in bodies, to each of which the ſame length and breadth may belong or be applied.

I SHOULD here be able to preſent you an hydroſtatical way of determining the bulk of bodies, both much nearer the truth than that newly recited, and grounded as well on experiments as mathematics; if among other papers, I had not unfortunately loſt one, that I wrote many years ago, about the meaſuring of ſolids, by the help of liquors. But though I cannot, out of my memory, recover the theoretical part of that writing, (whoſe loſs I regret, becauſe it had been examined by one of the exacteſt, as well as famouſeſt mathematicians of our age, whom I invited to be preſent

preſent at the chief experiments) yet I think I can call to mind as much of the practical applications of it, as may ſuffice for my preſent purpoſe.

THE ground of the way, I am about to propoſe to you, will be eaſily underſtood by the following (though but ſhort) account. I cauſed to be carefully made, by ſkilful artificers, ſeveral cubes, both of different ſizes and different materials, as marble and metal; whoſe ſides were each of them, as near as the artiſt could make them, either an exact inch, or preciſely more inches than one, according to our *Engliſh* meaſure, which is ſaid to differ very little from the correſpondent one of the old *Romans*. Theſe cubes were carefully weighed in truſty balances: firſt, in the air, and then in common water. And though I found ſome little (and but little) difference, between the products of the trials; yet that difference being no more than might reaſonably be expected from the ſcarce avoidable imperfection, even of good artiſts, and their tools; we concluded that one might, without any conſiderable error, take a medium (as they ſpeak) between theſe products, and allow, even to this medium, a latitude of ſome grains; ſince that latitude will not amount to the ſixtieth part of the weight of a cubical inch of water. Since therefore ſome of our trials inclined us to judge, that about two hundred and ſixty; and ſome others to think, that two hundred fifty two; and others again, that about two hundred fifty ſix came neareſt to the true weight of a cubical inch of water; we thought ourſelves at liberty to make uſe of that number, that ſhould appear moſt commodious for practice, by reaſon of its diviſions and ſubdiviſions into aliquot parts, eſpecially if the body to be examined were not great; ſince in that caſe, two or three grains, more or leſs, would not be conſiderable, eſpecially in a phyſical experiment, where geometrical exactneſs is not to be expected nor indeed required, and a far leſs accurate eſtimate will be leſs unaccurate, than can with any certainty be made by the formerly mentioned way of judging by the length, breadth, and depth (or thickneſs) of the body propoſed.

I MADE the leſs ſcruple to pitch upon the laſt of the three forementioned numbers of grains, not only becauſe it affords many aliquot parts for a number that is no greater, ſince barely by a ſucceſſive bipartition it affords ſeven ſuch parts, *viz.* 128. 64. 32. 16. 8. 4. and 2. but becauſe I was encouraged by an experiment differing from thoſe already mentioned. For having cauſed to be purpoſely made by a good artiſt, an hollow cube of braſs, whoſe cavity was fitted to contain a juſt cubical inch of matter, (either ſolid or liquid) we put it into one ſcale of a tender balance, with a juſt counterpoiſe in the other, and placed it there as horizontally as we could. Then we warily put into it, little by little, as much common water as it would contain, without either overflowing, or having its ſurface manifeſtly turgid; putting alſo, from time to time, in the oppoſite ſcale, ſmall weights, to keep it from ſwerving too much at once from an æquilibrium. And though it is extremely difficult in practice, to diſcern with certainty, when the veſſel is ſo exactly filled, that a drop, or even two or three drops, more or leſs, cannot be added, or taken away, without being obſervable by the eye; yet, for this very reaſon, we thought our experiment agreeable enough to our ſuppoſition, when we found, that, by ſo light an alteration, the weight of the water, when the ſcales were heedfully counterpoiſed, amounted to near about two hundred fifty ſix grains, which number we ſhall therefore hereafter employ, as expreſſing the weight of a cubical inch of water.

AND now to apply the paſt diſcourſe to our preſent purpoſe.

SUPPOSE, for example, that a ſolid, heavier in ſpecie than water, having been weighed firſt in the air, be found to loſe of its weight in the water ℥ß. ſixteen grains, that is two hundred fifty ſix grains, I ſay, that the dimenſions of this ſolid, if it were of a cubical ſhape, would make it equal to a cubical inch: ſo that (to expreſs the

thing yet more clearly) if the given body be ſuppoſed to be an eaſily fuſible metal, as tin, or lead; and, being melted, to be warily poured into the hollow cube formerly mentioned, and ſuffered to cool, it would juſt fill it and no more, and conſequently be a cube of metal, whoſe length, breadth, and depth, are equal to one another, and each of them to an inch. For as it is a fundamental theorem in hydroſtatics, demonſtrated mathematically by *Archimedes*, and elſewhere phyſically by me; that *a ſinking ſolid weighs leſs in water than in air, by the weight of as much water as is equal to the ſolid in bulk*; and ſince we have lately ſhewn by experiments, that a cubical inch of water weighs ℥ß. 16 grains, that is, 256 grains; it will follow, that when the decrement of a body's weight in water is found to be 256 grains, the ſolid content of that body is a cubical inch: ſince an aqueous body, weighing 256 grains, is equal in magnitude, as well to the ſolid propounded, as to a cubic inch of water. And here it may prevent a ſcruple, to obſerve, that to make bodies equal in magnitude, it is not at all neceſſary, that they ſhould be of the ſame weight, or of the ſame matter, as is evident in bullets of copper, tin, and gold, caſt ſeparately and dextrouſly in the ſame mould. For though they be equal in bulk, yet the bullet of copper will be much heavier than that of tin; and the bullet of pure gold will be more than twice as heavy as that of copper. Whenſoever therefore you meet with a ſolid, ponderous enough to ſink in water, that, being weighed in that liquor, loſes 256 grains of the weight it had in the air; you may conclude the magnitude or bulk of that body to be equal to a cubical inch, of whatever matter it conſiſts, or of what ſhape ſoever, regular or irregular, it be. And in caſe the ſolid propoſed do (as it will very often happen) loſe of its weight in the water leſs than 256 grains, you may conclude its bulk to be proportionably leſs than a cubical inch. And ſuch is the conveniency of the number we have pitched upon, which abounds in aliquot parts; that every 32 grains, that the ſolid loſes of its weight in the water, anſwers to an eighth (that is, half a quarter) of an inch in the bulk of the body: as if the decrement be 128 grains, the ſolid will be half a cubic inch; and if it be but 64 grains, it will be but a quarter of a cubic inch; and ſo if it be 160 grains, it will be $\frac{5}{8}$, that is, half and half a quarter of an inch cube: and on the other ſide, if the decrement of the given body exceed the ſtandard, *viz.* 256 grains, twice, thrice, *&c.* then that decrement being reduced to grains, as ſuppoſe it weigh ℥j. + grains 32 (amounting to 512 grains) or ℥j. ß. + grains 48 (amounting to 768 grains) the body will be equal to two or three (ſingle) cubical inches. And, if after the diviſion there remains a fraction, it will not be difficult to eſtimate it to him that conſiders what has been newly delivered.

SECT. II.

TO diſcover hydroſtatically the ſolid contents of a body heavier in ſpecie than water; to him that knows how to make uſe of the method newly delivered, it will not be very difficult. But to meaſure, by the help of water, the ſolidity of a body lighter in ſpecie than that liquor, is a work not ſo eaſily performed. It may ſomewhat leſſen the difficulty, to premiſe, that there are two ſorts of bodies, that will naturally not ſink in water. For ſome are of a cloſer texture, and will not be eaſily invaded by that liquor; at leaſt, in ſo ſhort a time, as they are of neceſſity to be kept in it: and others abound with pores, that diſpoſe them to imbibe the water they muſt be kept immerſed in till the experiment be diſpatched.

To begin with the firſt ſort of bodies: it is known to hydroſtaticians, that, according to a theorem of *Archimedes*, the weight of a body, belonging to that kind, may be

be gathered from the weight of the water, that is equal in magnitude to that part of the body that is immerſed in that liquor, when the ſolid floats freely upon it; as, if a parallelipipedon, or a cylinder, of wood, twelve inches long, being placed upon water, ſhould reſt there, when a twelfth part of it lies beneath the ſurface of the liquor; in this caſe, the weight of the water, equal in bulk to that immerſed twelfth part, would be equal to the weight of the whole wooden body. But becauſe the bodies, whoſe bulk phyſicians and chemiſts may have occaſion to examine, will very ſeldom happen to have ſhapes ſo near thoſe of regular ones; it will ſcarce be worth our while to enlarge upon this way of eſtimating light bodies; which will be ſo troubleſome to make fit for moſt mens practice, that, unleſs it be deſired, I ſhall not trouble you with it; but forthwith proceed to what will conduce far more to our preſent deſign, which being to meaſure the ſolid contents of bodies, not ſo heavy (intenſively) as water, and for the moſt part irregularly ſhaped; it will be neceſſary that we employ a method differing from what we have hitherto made uſe of. In the firſt ſtep of this, though not in the ſecond, we may be helped by the induſtrious *Merſennus*, who probably borrowed his way of *Ghetaldus*, from whoſe *promotus Archimedes* he profeſſedly borrows many things.

But becauſe that, on this occaſion, *Merſennus*, affecting brevity, hath made himſelf obſcure; ſo that what he writes can ſcarce be underſtood, but by mathematical peruſers; I ſhall, for the ſake of another ſort of readers, deliver the propounded method, though not in ſo few words, yet more clearly and orderly. Firſt then, you ſhall weigh in the air the body (lighter than water) to be examined. Secondly, you ſhall take a plate of lead capable of making this body ſink with itſelf in water, and of ſome weight, not incumbred with fractions, as juſt a dram, half an ounce, an ounce, *&c.* Thirdly, you muſt weigh this plate in water, and, by ſubſtracting its weight in this liquor from what it weighed in the air, you muſt obtain a difference, which will give the weight of as much water as is equal in bulk to the immerſed lead. This, for diſtinction's ſake, may be called the ſpecific weight of the lead in water. Fourthly, you muſt tie together (which you may beſt do by one or more horſehairs) the plate of lead, and the lighter body, and note the weight of the aggregate, which, as you know, is nothing but the ſum of the reſpective weights of the lighter and of the heavier body. Fifthly, you muſt weigh this aggregate in the water, and ſubſtract its weight in that liquor, from the weight that the ſame aggregate had in the air, and the difference will be the ſpecific weight of the ſaid aggregate in water. Sixthly, from this difference ſubſtract the formerly found ſpecific weight of the plate alone in water, and the remains will give you the weight of the lighter body in the ſame liquor.

Thus far our author; without whoſe help we may eaſily diſpatch the reſt of our work, by the method employed already of meaſuring ſolids heavier than water. For the lately obtained weight of the light body in water, being (according to the method formerly propoſed) divided by 256 grains, will give you the ſolid content of that naturally floating body.

But becauſe a method, that is difficult enough to be put in practice by thoſe that are not more than ordinarily well verſed in hydroſtatics, requires to be illuſtrated by an example, I ſhall ſubjoin an experiment, that may ſerve not only to clear up this practice, but in good meaſure to confirm it too; we took then a piece of oak conveniently ſhaped, and that weighed in air $193\frac{1}{2}$ grains. To this we tied with an horſe-hair a plate of lead, weighing juſt half an ounce, *i. e.* 240 grains. But before we tied them together, the lead was weighed in water, where it loſt of its former weight 20 grains, which, being deducted out of the 240 grains lately men-

tioned, left a difference or reſidue of 20 grains, for the ſpecific weight of this piece of lead (for I have ſeldom found lead quite ſo heavy) in the water. Then the aggregate of the wood and lead was weighed, firſt in the air, and found to be 433½ grains, and then in water, where it amounted but to 162 grains; which being ſubſtracted from the aggregate of the ſame bodies in the air, the reſidue, or difference, was found to be 271½ grains: from which difference the other difference of 20 grains (which had been lately found) of the leaden plate alone in the water being deducted, there remained 251½ grains for the weight of water equal in bulk to the given piece of wood. If this number had amounted to 256 grains, of which it fell ſhort but 4½ grains, we might have concluded the ſolidity of it to be a cubic inch, ſince 256 grains of water, which we formerly found equal to a bulk of water of a cubic inch, was alſo now found equal to the bulk of the given piece of wood. And indeed, intending (as I formerly intimated) to give an example, that ſhould not only illuſtrate (but confirm) the propoſed practice, I cauſed the wood I employed to be formed into as exact a cube of an inch every way as I could procure from a joiner, that bragged of the pains he had taken about it: ſo that the difference of its weight in water from 256 grains, the weight of a full cubic inch of that liquor, may probably be imputed to ſome little imperfection in the figure of the wood, or ſome other light circumſtance, not conſiderable enough to be much regarded.

Of this experiment one of my notes gives the following account.

I. THE oaken cube in air weighs (ʒiii. grains xiii½.) ——	193½
II. THE weight of the lead in air, (ʒiv.) ——	240
III. THE weight of the lead in water (ʒiiiß. grains x.) ——	220
Which, being ſubtracted from its weight in air, leaves for its ſpecific weight in water ——	020
IV. THE aggregate of the two in air is ——	433½
V. THE weight of both together in water is ——	162
Which, being ſubſtracted from its weight in air, gives the difference of both the aggregates ——	271½
VI. THE difference between the weight of lead alone in air and in water, or, which is all one, the ſpecific weight of the plate alone, *viz.* — being ſubſtracted from the difference of the weights of the aggregates in air, and in water, gives [for the weight of the cube propoſed]	20 / 251½

THE way of meaſuring bodies, that has been hitherto delivered, is appropriated to ſuch as will not at all (or, at leaſt, will not readily) be diſſolved in water. But becauſe there are divers other ſolids, as lumps of ſalt, alum, vitriol, ſugar, *&c.* whoſe magnitudes it may be fit for inquiſitive men, of more profeſſions than one, to know and to compare, I ſhall, to what has been already ſaid, ſubjoin this advertiſement; that the ſame way may be applied to meaſure the magnitudes of ſolids diſſoluble in water, if, inſtead of this liquor, we ſubſtitute oil of turpentine, whoſe proportion and ſpecific gravity to water we have found, or is otherwiſe known to us. When I firſt made this reflection, I had not ſuch conveniencies, as when I found the weight of a cubic inch of water, to determine the weight of a cubic inch of oil of turpentine. But, having yet lying by me the hollow veſſel of braſs, whoſe cavity was an exact inch, that I employed to find out the weight of a cubic inch of water, I made uſe of it on this occaſion too; and found, that when it was carefully filled with ſuch oil of turpentine as we were wont to employ about hydroſtatical experiments, the contained liquor amounted but to 221 grains, and an eighth (part of a grain)

grain) by which number the difference of the weight of a ſolid in the air, and in that oil, being divided, the quotient will give you the ſolid contents of the examined body.

AFTER ſo circumſtantial an account as we have given of the way of hydroſtatically examining ſuch floating ſolids as, like the wood we employed, are of a texture at leaſt moderately cloſe, it may be ſeaſonable, to proceed to the mention of the ſecond ſort of floating bodies, that I formerly told you might be propoſed to be weighed in water; namely, ſuch as, by their poroſity or laxneſs of texture, are ſubject to embibe too much of that liquor, even in as little time as is neceſſary for the diſpatch of the experiment.

MERSENNUS * (more briefly than clearly) propoſes an expedient in this caſe, which is, to cover over the body to be weighed in water with wax, pitch, or ſome other gluten, as he calls it, whoſe ſpecific weight in water muſt be firſt known. But I take bees-wax to be much preferable to the other two. For pitch is ſo apt to ſtick to one's hands or clothes, that it is troubleſome to apply it, and very difficult to get it off: and as for glues, moſt of them, eſpecially the more common, are diſſoluble in water, and therefore not ſo fit for the purpoſe as bees-wax (for that, I preſume, he means by wax) which has this conveniency in it, that its proportion to water being uſually conſtant enough, and the gravity of thoſe two bodies differing but little, one may more eaſily diſpatch a good part of the experiment; which is thus to be performed. Take the ſolid lighter than water, that you would examine hydroſtatically, and having weighed it in the air, over-lay it carefully with a thin coat of bees-wax, ſo that no part of it may remain uncovered, or acceſſible to the liquor. Then take alſo in the air the weight of the wax you have employed, and faſten to the body, thus coated, a plate of lead, or tin, heavy enough to make it ſink, and obſerve the weight of the aggregate in water. This done, ſubſtract the weight of as much water as is equal in bulk to the wax, and proceed with the reſt, as is before taught. *Merſennus* declares this practice by this inſtance, if the wax that inveſts the propoſed body be of ʒxxii. in the air, the bulk of water equal to it will be ʒxxi. and therefore a quantity of water of ʒxxi. muſt be firſt taken away, or ſubſtracted, that the remaining bulk, equal to the (immerſed) body, may, by its gravity, ſhew the gravity of the body (propoſed) as has before been ſaid.

BUT becauſe the way above delivered can help us but to the knowledge of the weight of the propoſed body in water, we muſt, to diſcover the ſolid content of it, proceed further than our *Merſennus* enables us to go; and therefore we muſt divide the weight of the ſolid in water, already found, by 256 grains, that by the help of the quotient we may obtain the ſolid contents of the propoſed body.

I HAVE ſometimes (to add that upon the by) thought of, and tried, another expedient, to hinder ſmaller ſolids, whether lighter or heavier in ſpecie than water, from imbibing the ambient liquor. In order to this, I firſt found the weight of a cubic inch of quickſilver (which is not difficult to diſcover by its proportion to water of the ſame bulk.) And then we brought the body to be meaſured into a veſſel, whoſe ſolid contents were known before: and thirdly, all that was not poſſeſſed by the firm body being filled with quickſilver, it was eaſy enough to know, by the difference in weight of that quickſilver from the weight of the quickſilver requiſite to fill the whole veſſel, to how much quickſilver the environed body was equal. And by this means, and the knowledge before gained of the weight of a cubical inch of mercury, the ſolid contents of the body propoſed was not difficult to be obtained. But I forbear to give more than this intimation of an expedient, which, beſides that

* In his *Phænomena Hydraulica*, p. 185.

it

it belongs properly to another eſſay, is rather mechanical than hydroſtatical. And, for the ſame reaſon, I forbear to ſet down one way of meaſuring the contents of irregular ſolids, delivered in ſome books of practical geometry; and another, but yet unpubliſhed, way, differing enough from the former, that tends to the ſame purpoſe.

CHAP. XVI.

BUT, I perceive, that it is now more than time, that I ſhould put an end to a labour, that has, I fear, tired you, becauſe I am ſure it has tired me And yet I dare not conclude this tract without briefly anſwering a couple of queſtions, that, I foreſee, may juſtly enough be aſked me by a peruſer of the foregoing eſſay.

AND firſt, I preſume it may be demanded, 'Whether I have propoſed the beſt 'ways that can be thought of to examine bodies hydroſtatically?' To which queſtion I anſwer, that, upon divers conſiderations, ſome of which have been mentioned here and there in the body of the foregoing eſſay, I did not think myſelf obliged ſolicitouſly to invent or propound new inſtruments for the hydroſtatical examen of bodies. For though I am not ignorant, that divers more curious and artificial ways of finding out their weight in water, or their ſolid contents by it, may be deviſed by perſons more ſkilful and ſagacious than I: and though alſo I think it not unlikely, that, when the utility of ſuch practices comes to be taken notice of, artificial inſtruments will be found out to facilitate, or otherwiſe improve them; yet I thought it became me at firſt to propound only the more ſimple ways of operating, as the moſt likely to invite the generality of thoſe, for whoſe ſake this eſſay is made public, and to require, for the main part of our experiments, only the uſe of the balance, as an inſtrument eaſily procurable, and already, for other purpoſes, in moſt mens hands, without mentioning, at this time, any more artificial inſtruments; though ſome of them are ſuch as I have long ſince not only had thoughts of, but for my own uſes practiſed; which intimation may be countenanced, if it were needful, by the mention of that little inſtrument, for diſtinguiſhing between true and counterfeit guineas, or the like pieces of coined gold, by the help of water; which was ſeveral years ago publiſhed in the philoſophical tranſactions, and has ſince (without ſtaying for my improvements of it) been made uſe of by ſome, and uſurped by others. But of ſuch things no more in this place.

HAVING anſwered the firſt queſtion, it remains that I conſider the ſecond, wherein, though I ſhall aim at brevity as much as in the former, yet I fear I ſhall not be able to diſcuſs it in as few lines as I did that. I preſume then it will be aſked, 'What 'credit may be given to the eſtimates of the weight and proportions of bodies, ob-'tained by hydroſtatical trials?' Since we ſee that though mathematicians, not knowing, or not applying, our obſervation about the ſpecific gravity of rock-cryſtal, and the nature of oil, eſpecially that of turpentine, have given us but the proportions of metals, and ſome very few other familiar bodies, as the loadſtone, wax, honey, oil, and wine; yet thoſe few that have not tranſcribed from one another differ, in the tables they have left us of the comparative weight of thoſe few bodies.

THIS queſtion is ſo comprehenſive, that I think it cannot well receive a ſingle anſwer; and therefore I ſhall offer two things to be conſidered about it.

AND firſt, I freely acknowledge, that there is no exact uniformity in the obſervations delivered about the weight of metals, and the other bodies newly named, among the few authors that have written of this ſubject; and there would probably have been yet more difference in their accounts, if ſome, even of thoſe writers, had not avowedly

avowedly made uſe, to their purpoſes, of as much as they thought fit of the tables of *Ghetaldus*.

NAY, I ſhall not think it very ſtrange, if I find that the experiments of the ſame man, made at diſtant times, and in other differing circumſtances, ſhould not all of them exactly agree. For I have already noted, and I think in more places than one, that there will ſcarce be found ſo great an uniformity in qualities, and particularly in ſpecific weight, among bodies of the ſame kind or denomination, as there is generally preſumed to be. There may be alſo ſome difference, though but little, betwixt the waters men employ, eſpecially if the air be at one time (as in *July*) intenſely hot, and at another (as in *January*) exceeding cold. The difference alſo of degrees of goodneſs of the balances, men employ about nice experiments, is not altogether inconſiderable. But there is a thing of greater moment than this towards the hindering hydroſtatical experiments, and even ſtatical ones themſelves, from being ſo accurate as thoſe that are not verſed in ſuch matters may require. The thing I mean is the difficulty of finding an exact uniformity in weights of the ſame denomination, which, for that reaſon, are vulgarly ſuppoſed to be exactly equal; but to know how far this ſuppoſition is to be relied on, it may at preſent ſuffice to ſet down ſome paſſages of a mathematician juſtly famous for his diligence, and who has made it his particular work to examine theſe matters ſcrupulouſly. The firſt paſſage that I ſhall alledge out of his writings ſhall be the ſhort account he gives of many trials he made of natural grains, whence all ſorts of weights have been deduced. * *Cum* (ſaith he) *omnia grana, vel ſemina, quæ reperiri ſolens in atriis venalibus Lutetiæ, ad ſtateram expendiſſem, vixque granum ullum inter ejuſdem ſpeciei grana grano alteri exactè reſpondiſſet, in incertis ludere nolui.* The ſame author informs us, that the Roman grains differ from the French grains, ſince, as he obſerves, 688 grains of the former ſort are equiponderant but to 576 grains of the latter ſort. And he ſubjoins, that, whilſt he was writing theſe things, there was found, by the more exact weights of the mint, an error in the former eſtimate of at leaſt half a grain in 36 grains.

AND elſewhere he † gives notice, that, by two relations ſent him from *Rome*, about the number of grains contained in a Roman ounce, it appeared, that even that number varied, ſince one of thoſe relations reckoned 612 grains in an ounce, whereas the other allowed it but 576 grains. And yet this I do not wonder at, becauſe I have myſelf found it ſo difficult in practice to get and keep weights (for, as little as this is wont to be ſuſpected, the very air may, in time, a little alter them) as exact as I deſired, that I left off the hopes of it. And one remark, though commonly overlooked, I think too conſiderable to be here omitted. For whereas the accurate *Ghetaldus*'s ‡ tables of the weight of metals, and ſome few other bodies, in reference to one another, are looked upon as the moſt authentic that have been publiſhed, and are accordingly made the moſt uſe of: it is certain, that the weights he employed are not divided, as ours are. For though indeed, according to him, as well as with us, the ounce conſiſts of 24 ſcruples, yet the ſcruple, which with us is divided but into 20 grains, he divides into 24. But to return to *Merſennus:* a while after he had told us of the difference between his repeated trials and thoſe of other men, in determining the weight of a certain body, he has this paſſage, which ſhews, that he was not over confident of the preciſeneſs of all his own determinations: *Cum autem* (ſaith he, pag. 37. lib. 16.) *dixi, Chelinum, undecim dici denariorum, credunt tamen alii decem duntaxat, nil aſſero.*

* *In præfatione ad librum de menſuris, ponderibus, & nummis.*
† *Merſennus*, in the paper entituled, *Pariſienſia pondera*, Coroll. 1, and 2.
‡ In the paper called *Galic. Nummis.*

HAVING

HAVING gone through the firſt part of my anſwer, to the ſecond query above propoſed, it remains, that I proceed to the other part, which perhaps will not need more than the following reflection.

I CONSIDER then, that though it be granted, that hydroſtatical experiments are not always either ſingly accurate, or exactly agreeable among themſelves, yet they may well be both accurate enough to be of very good uſe, eſpecially in practice, and leſs remote from being quite accurate, than any other ways that have been hitherto known to be practiſed of determining the proportions of bodies in point of weight and bulk, and of meaſuring the ſolid contents of ſtable bodies, whether heavier in ſpecie than water, or lighter.

THE firſt part of this reflection may be deduced as a corollary from, or at leaſt confirmed by, the greateſt part of the foregoing eſſay. And indeed, as little ſkill as I have in hydroſtatics, I would not be debarred from the uſe of them for a conſiderable ſum of money; it having already done me acceptable ſervice, and on far more occaſions than I myſelf at firſt expected, eſpecially in the examen of metals and mineral bodies, and of ſeveral chemical productions. And I have been able more than once or twice to undeceive artiſts and other experimenters, that, *bona fide*, believed they had made, or were poſſeſſors of, *luna fixa*, (as they call it) and other valuable things: and to make a good judgment of the genuineneſs or falſity, and the degrees of worth, or ſtrength in their kind, of divers richer or poorer metalline mixtures, and other bodies, (ſome ſolid, and ſome liquid) whoſe fair appearances might otherwiſe have much puzzled (if not deceived) me.

BUT of this more may be found in another paper. For I muſt haſten to the ſecond part of our deſigned reflection, by repreſenting, that our hydroſtatical methods of diſcovering the weights and bulks of bodies, though they may not be mathematically accurate, yet they are leſs remote from being ſo, than any way of menſuration of bodies, (eſpecially ſuch little ones as we uſually have need to examine on the account of the *Materia Medica*) by the geometrical inſtruments, that are hitherto known to be practiſed; or, by the way, whereby the *tabula coitionis & expanſionis materiæ per ſpatia in tangibilibus*, &c. was framed by the renowned Sir * *Francis Bacon*, whoſe judicious reflections upon the rarity and denſity of bodies, ſuch as their meaſures are delivered in that table, do ſufficiently manifeſt, as the philoſophical genius of the author, ſo the utility that may be derived from even ſuch determinations of the bulks and weights of bodies, as fall ſhort enough of being accurate.

I might here relate, that to convince ſome curious perſons, how much hydroſtratics may be made ſerviceable to as accurate a menſuration, as ought to be expected in phyſical experiments; I deſired a virtuoſo, firſt, to put together two lumps of metal, (*viz.* of tin, and of lead) in a certain proportion, that he was to conceal from me, but to ſet down in writing to prevent miſtakes. Then I deſired him to melt the metals (whoſe reſpective ſpecific gravities I knew before) into one maſs, and give me that maſs. And thirdly, I weighed it carefully in water, and did alſo algebraically examine it. Which being done, I told him, that the lead he had employed amounted to ſuch a weight, and the tin to ſuch another; which being compared with the quantities he had committed to paper, the difference was found to be little more than one grain, and this itſelf probably proceeded from ſome ſcarce avoidable imperfection in the melting, pouring out, &c. of the given bodies. But becauſe ſpecious arithmetic was employed in this work, (to which yet it was not abſolutely neceſſary) I ſhall lay no ſtreſs upon it; becauſe, if I miſtake not, the paſt diſcourſe may ſuffice to give the hydroſtatical ways of menſuration of bodies a pre-

* *Verulam in hiſtoriâ denſi & rari, p. m.* 8. &c.

ference

ference to their competitors, and may keep it from being preſumptuous, to ſay, that they may be received as the beſt for practice, till ſome other more accurate, and yet as firmly grounded, and as practicable ways of accompliſhing the ſame purpoſes, ſhall be propoſed.

A PREVIOUS

HYDROSTATICAL WAY

OF

ESTIMATING ORES.

Addreſſed to the Secretary of the Royal Society.

ADVERTISEMENT.

I KNOW there is a greater number of different kinds of foſſils, than thoſe that are yet known to belong to the *Materia Medica*. And, I confeſs, that the perſons, which the following paper is chiefly deſigned to aſſiſt, are thoſe that explore minerals with an aim not at health, but at profit. But yet I was content, that the enſuing diſcourſe ſhould accompany the foregoing eſſay, as a kind of appendix to it, becauſe many of the ſubjects, about which both tracts are converſant, are the ſame; and the fundamental obſervation, (*viz.* about the ſpecific gravity of cryſtal or marble) and the hydroſtatical way of applying it in explorations, is the ſame in both: and alſo (and indeed chiefly) becauſe I was made to believe, that it might, eſpecially at this ſeaſon, be grateful, and not unuſeful to divers ſearchers after profitable minerals.

THIS paper (as the inſcription intimates) was deſigned to be ſent to the learned ſecretary of the Royal Society, when it was expected, that he would begin again to publiſh monthly the philoſophical tranſactions, that had been long ſuſpended, and as long deſired by the curious. But ſince ſome accidents have occurred, that occaſion a further delay of their publication, it was not thought fit, this paper (after having been long already) ſhould be any longer confined to my cloſet. It is true, that this diſcourſe, containing but an application of an hydroſtatical experiment, I am far, as I ought to be, from propoſing it as a treatiſe of the docimaſtical art, whoſe grand inſtrument is, the fire ſkilfully managed. For which reaſon I have forborn to ſet down in this paper, any of the flux powders, or other ways of examining ores, or of reducing them, or other foſſils, to metals, or reguluſes; that either aſſay-maſters are wont to employ, or I have deviſed, or tried upon minerals. But this, notwithſtanding

our unpractiſed way of eſtimating ores, may not be uſeleſs; and for that reaſon, will not perhaps be unwelcome to ſome that love mineralogy, much better than they underſtand it: eſpecially coming forth at a time, when many induſtrious perſons of this nation are excited to look after profitable minerals, by the repeal (that has been made ſince our appendix was written) of a diſcouraging act of parliament made in the reign of *Henry* IV. And though our hydroſtatical way of eſtimating foſſils will not determine how rich or poor they are in this or that particular metal; yet (as is intimated at the beginning in the enſuing paper) it may, on many occaſions, ſerve to keep thoſe that are venturous, and not ſkilful, from being deluded by cheats, or from deluding themſelves with ill-grounded expectations, which the promiſing appearances of divers foſſils, eſpecially marchaſites, will temptingly invite, but never anſwer.

SECT. I.

SIR,

A way propoſed for the previous examen of ores.

AT a time wherein ſo many ingenious or induſtrious men appear very ſolicitous to diſcover and to work mines, both here and in *New England*, and others of his majeſty's *American* colonies; it will not probably be thought unſeaſonable, nor prove unwelcome to the ſeekers of ſubterraneal treaſures, if my deſire to do them a piece of ſervice, make me borrow of a paper, I long ſince wrote about ſome things relating to the *Materia Medica*, a few paragraphs that contain a way of exploration of minerals; which, though it reaches but to one of their qualities, will perhaps, by reaſon of the conſiderableneſs of this, keep, on certain occaſion, ſome ſearchers after mines from beginning chargeable works, or proſecuting them with too great expectations, which are uſually followed by proportionable diſappointments. And I make the leſs ſcruple to ſuffer this fragment to leave its company, and preſent itſelf to you; becauſe after the misfortune, I have formerly ſignified to you of the loſs and ſpoiling of ſeveral of my writings, I know not when, if ever, I may have opportunity of communicating to my friends the treatiſe that theſe paragraphs belong to.

THAT part of the forementioned treatiſe that concerns my preſent purpoſe, is founded on an experiment, whereof what you are about to read is one of the applications.

I SHALL then ſuccinctly inform you, that the obſervation, whereon my diſcourſe was grounded, is double, as will by and by appear; and that the riſe of it, which will help to underſtand the nature and influences of it, was this. I thought fit (for reaſons elſewhere given) to find out what was the ſpecific gravity of a pure ſtone, ſuch as I ſuppoſed cryſtal, or white marble, or a ſtony icicle, to be; and found it by the hydroſtatical way of trial, (doubtleſs not unknown to you) that is delivered in the eſſay called *Medicina Hydroſtatica*, whereof, when you pleaſe, you may command a ſight, to have to clear common water, equal to it in bulk or magnitude, pretty near the ratio, or proportion of two and an half to one; or, which is ſomewhat more obvious to conceive, as five to two. I ſaid pretty near, becauſe it is not always exact, nor need be for our preſent purpoſe, but uſually enough does ſomewhat rather exceed that proportion than fall ſhort of it; but that is ſo little, that it may, on all common occaſions, be ſafely enough neglected by a mineraliſt: though, if one pleaſes, one may make uſe of the proportion of $2\frac{3}{4}$ to 1, that is, of 11 to 4.

SECT.

SECT. II.

THE uſes that may be made to our preſent purpoſe of this fundamental obſervation, are either of a more general or of a more particular nature.

As to the firſt of theſe, when my intention is only to diſcover in general, whether a foſſil propounded, or perhaps caſually lighted on, may with probability be judged to contain any ſubſtance, either metalline, or belonging to ſome foſſil of affinity to a metalline nature; and alſo, whether in caſe the firſt queſtion be reſolved in the affirmative, the propoſed body does, indefinitely ſpeaking, contain much, or but little, of the metalline or other adventitious ſubſtance: when, I ſay, I would only make thoſe general inquiries, I weigh the body I would examine, firſt in air, and then in water, and obſerve the proportion in ſpecific gravity between them; and if I find it weigh either leſs, or but little more, than cryſtal or marble of the ſame bulk, I judge it unlikely to contain any metalline portion, conſiderable for its quantity. And if it weigh manifeſtly, or ſomewhat conſiderably more than marble or cryſtal, I gueſs, that in proportion to that exceſs, it abounds, more or leſs, with a metalline ingredient, or one or other of affinity to a metalline nature.

To explain myſelf a little by two or three examples; it is known, that the magnet is vulgarly reckoned among ſtones, and its great hardneſs confirms men in that opinion. But having obſerved, that loadſtones, eſpecially thoſe that come from ſome places, that I elſewhere take notice of, ſeem to be apparently more ponderous than common ſtones of the like bulk; we weighed them in air and water, and found their ſpecific gravity, eſpecially of ſome of them, ſo far to exceed that of cryſtal or marble, that it could not be difficult for us to conclude, that theſe foſſils contained a not inconſiderable proportion of metalline matter, which, by collateral experiments, delivered in another paper *, appeared to be of a martial or ferruginous nature.

EMERI is a foſſil well known to many tradeſmen, eſpecially armourers and gunſmiths, by whom it is commonly reputed a mere ſtone. But finding that its weight in water conſiderably exceeded that of cryſtal of the ſame bulk, ſince it was to that liquor very near as 4 to 1; I conjectured, that it contained a metalline ſubſtance, as afterwards by proper trials I found it to do. Upon the ſame ground (its weight in my hand) I concluded, that lapis hæmatites, that is commonly ſold in ſhops, and, as its name witneſſeth, paſſes for a ſtone, did not ſparingly participate of a metalline ingredient; in proſecution of which conjecture, I quickly thought on ways whereby I diſcovered, that iron or ſteel was the metal it contained.

AND not to accumulate inſtances in this place, I ſhall advertiſe you in general, (what perhaps may hereafter be found uſeful to ſeveral enquirers) that, upon the grounds hitherto mentioned, I was invited to gueſs, that divers bodies, that were little ſuſpected to be of a metalline or mineral nature, did really contain a portion of ſubſtance that was ſo. And I remember in particular, that having met with granates of ſeveral ſizes, that were not *Bohemian*, but were found in other parts of *Europe*, and ſome that I diſcovered in a kind of talc, that was brought me from *America*; which angularly figured ſtones, I ſuſpected by their weight to be metallic, and found, by hydroſtatics, to have a ſpecific gravity conſiderably ſurpaſſing that of cryſtal. Upon theſe grounds, I ſay, I ſuppoſed them to participate, and that not very ſparingly, of a metal, one or more; and, by other ways of exploring, found that I had gueſſed aright; ſince I was able, notwithſtanding the great compactneſs of ſuch ſeemingly

* The author means a paper containing experiments and obſervations about the loadſtone, as it is a mineral.

vitreous bodies, to diſcover there a decompoſition, and extract thence a metallic ſubſtance.

To theſe I might add other foſſils, and ſome that were not, even by men not unſkilful, ſuſpected to have any metallic ingredients. But I have not time to ſpeak of them, and therefore ſhall proceed in the lately begun diſcourſe.

SECT. III.

TO illuſtrate then the general obſervation formerly laid down, and make it more diſtinct, I ſhall ſubjoin the following remarks.

FIRST, I do not pretend by this way to make any more than probable conjectures and eſtimates about the contents of the bodies, I examine by it. But though the eſtimates grounded on it be not always true, yet they may be frequently uſeful, as may be gathered from ſome of the ſubſequent obſervations.

SECONDLY, if the foſſil propoſed be lighter, eſpecially if it be much lighter, than ſo much cryſtal, it is an almoſt certain token, that it is not a metalline ore. And this negative uſe, if I may ſo call it, of our hydroſtatics, may be more ſafely relied on, than the affirmative conſequences uſually can be. Thus when I find that jet, though a foſſil dug up in veins, eſpecially in the *Pyrenean* mountains, (as a learned man, whoſe brother has there a mine of jet, aſſured me) has far leſs of ſpecific gravity than cryſtal, I conclude it to be no metalline body. The like inference I make on the ſame ground, as to foſſil amber or ſuccinum, ſulphur vive, and the obſervation holds in common ſulphur, (clear or ſemidiaphanous) Engliſh talc, Venetian talc, and ſome other firm concretions, whether brittle or not, that are dug out of the earth. Among theſe, I think fit to mention particularly black lead, leſt the name it bears ſhould deceive men into a belief, that it is an ore of that metal. For having found its weight, in reference to water, to be but as $1\frac{86}{100}$ to 1. And gathering from the ſmallneſs of its ſpecific gravity, that it would prove to be very unlike our true common lead ores, I found, upon trial purpoſely made, that it was a mineral *ſui generis*, and ſeemed, upon the ſcore of more than one quality, to be of kin to a ſort of talc that I have met with.

THIRDLY, we ſhould diſtinguiſh between the ſeveral uſes that foſſils may be ſought for and examined by men of different profeſſions, or deſigns. And therefore, if a foſſil be found to be ſomewhat, and yet but very little, heavier in ſpecie than cryſtal or marble, it may poſſibly have a metalline or mineral portion, which, though very ſmall in quantity, may conſiſt of ſuch efficacious parts, as may make it deſerve the eſteem of a jeweller, a phyſician, or a chemiſt. But if the ſurplus of ſpecific gravity be inconſiderable, the foſſil itſelf will be ſo too to a mineraliſt, that ſeeks not to gratify his curioſity, or make a good medicine, but to fill his purſe. For the charge and trouble of working a foſſil, ſo poor in metalline ſubſtance, will probably either exceed the profit, or keep it from being conſiderable; whereas if the ſpecific gravity do much exceed that of marble or cryſtal, it may give good hopes of proving a ſubject profitable to be wrought on.

FOURTHLY, but here I muſt give notice, that though, for the moſt part, the great ponderoſity of a foſſil proceeds from a portion of ſome metalline ſubſtance, more ſtrictly ſo called, that is embodied with the other part of the concrete; yet this alone is indeed a certain ſign, that the foſſil is not a meer ſtone, but is not alone a ſure ſign, that the mineral portion is properly metalline; and therefore, where there is juſt cauſe of doubt, it is beſt to endeavour by ſome collateral ſigns to reſolve it. The reaſon, why I thought fit to give you this admonition, is, that, beſides metal-

line

line ores more properly ſo called, there are other foſſils, which ſome call ſemi-metals, others *media mineralia*, and others again give other appellations to; which foſſils, though of affinity to metals, are wont to be diſtinguiſhed from true metalline ores; ſuch (foſſils) as are (that I may here name the principal of them) antimony, biſmuth (uſually in our ſhops called tin-glaſs), *lapis calaminaris*, and pyrites (commonly called marcaſites, and vulgarly, in Engliſh, vitriol ſtones). But there will not perhaps occur many caſes, wherein it will be neceſſary to have recourſe to collateral ſigns, to diſcern whether the mineral portion of a foſſil be, in a ſtricter ſenſe, of a metalline nature, or not: for theſe ſemi-metals, that I ſpeak of, are moſt commonly found either in veins, or in maſſes, or great lumps of their reſpective kinds; and eaſily diſcover, to one that conſiders them with ſo much as a moderate meaſure of attention and ſkill, what ſpecies of foſſils they belong to. I have indeed from *Devonſhire* received a lump of matter, which the owner of the mine, not knowing what to make of, deſired my opinion of, wherein I found ſome antimony mixt with lead, which was the predominant body. But ſuch mixtures occur not often enough, at leaſt here in *England*, to keep our way of eſtimating ponderous foſſils from being, on moſt occaſions, uſeful.

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vitreous bodies, to diſcover there a decompoſition, and extract thence a metallic ſubſtance.

To theſe I might add other foſſils, and ſome that were not, even by men not unſkilful, ſuſpected to have any metallic ingredients. But I have not time to ſpeak of them, and therefore ſhall proceed in the lately begun diſcourſe.

SECT. III.

TO illuſtrate then the general obſervation formerly laid down, and make it more diſtinct, I ſhall ſubjoin the following remarks.

FIRST, I do not pretend by this way to make any more than probable conjectures and eſtimates about the contents of the bodies, I examine by it. But though the eſtimates grounded on it be not always true, yet they may be frequently uſeful, as may be gathered from ſome of the ſubſequent obſervations.

SECONDLY, if the foſſil propoſed be lighter, eſpecially if it be much lighter, than ſo much cryſtal, it is an almoſt certain token, that it is not a metalline ore. And this negative uſe, if I may ſo call it, of our hydroſtatics, may be more ſafely relied on, than the affirmative conſequences uſually can be. Thus when I find that jet, though a foſſil dug up in veins, eſpecially in the *Pyrenean* mountains, (as a learned man, whoſe brother has there a mine of jet, aſſured me) has far leſs of ſpecific gravity than cryſtal, I conclude it to be no metalline body. The like inference I make on the ſame ground, as to foſſil amber or ſuccinum, ſulphur vive, and the obſervation holds in common ſulphur, (clear or ſemidiaphanous) Engliſh talc, Venetian talc, and ſome other firm concretions, whether brittle or not, that are dug out of the earth. Among theſe, I think fit to mention particularly black lead, leſt the name it bears ſhould deceive men into a belief, that it is an ore of that metal. For having found its weight, in reference to water, to be but as $1\frac{86}{100}$ to 1. And gathering from the ſmallneſs of its ſpecific gravity, that it would prove to be very unlike our true common lead ores, I found, upon trial purpoſely made, that it was a mineral *ſui generis*, and ſeemed, upon the ſcore of more than one quality, to be of kin to a ſort of talc that I have met with.

THIRDLY, we ſhould diſtinguiſh between the ſeveral uſes that foſſils may be ſought for and examined by men of different profeſſions, or deſigns. And therefore, if a foſſil be found to be ſomewhat, and yet but very little, heavier in ſpecie than cryſtal or marble, it may poſſibly have a metalline or mineral portion, which, though very ſmall in quantity, may conſiſt of ſuch efficacious parts, as may make it deſerve the eſteem of a jeweller, a phyſician, or a chemiſt. But if the ſurplus of ſpecific gravity be inconſiderable, the foſſil itſelf will be ſo too to a mineraliſt, that ſeeks not to gratify his curioſity, or make a good medicine, but to fill his purſe. For the charge and trouble of working a foſſil, ſo poor in metalline ſubſtance, will probably either exceed the profit, or keep it from being conſiderable; whereas if the ſpecific gravity do much exceed that of marble or cryſtal, it may give good hopes of proving a ſubject profitable to be wrought on.

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SECT. V.

BUT there is one kind of minerals, that I have obſerved to impoſe on men ſo often, that I think it neceſſary to take a paticular notice of them in this place. For, not to mention examples, that I might draw out of the books of travellers and navigators, I have met with, I know not how many, that have built great hopes, and ſome (which is worſe) that have been at charges upon thoſe illuſory expectations of great matters from marcaſites. And, I remember, I have had ſent me, or brought me, not only from places nearer home, but from hotter and colder countries of the *Indies* themſelves, foſſils, whereof I was earneſtly deſired to give my opinion, that I found to be but marcaſites: and many of theſe foſſils having two qualities, that make them very fit to delude the vulgar and the unſkilful, namely, firſt a multitude of ſhining ſtreaks, or other gliſtering parts, uſually of a colour near enough to that of gold, and ſometimes to that of ſilver; and then, a ponderouſneſs uſually not inferior, at leaſt, to that of true metalline ores; marcaſites, I ſay, being thus fitted to delude the unſkilful, I have had much ado to undeceive ſome, that brought or ſent me them from *America*, of the pleaſing confidence they had entertained, that theſe promiſing foſſils were lumps of rich ore of gold, or ſilver. Wherefore ſince their ponderouſneſs (which is the criterion of minerals I am now treating of) is one of the two chief things that delude ſo many, I think it expedient to ſubjoin ſome few but various inſtances of the ſpecific gravity of marcaſites, whereby it may appear, that ſome of them are, bulk for bulk, far more ponderous than divers true metalline ores, that I have tried, have been found to be. And indeed this great ponderoſity has ſeveral times invited me, before I made any artificial trial of propounded foſſils, and ſometimes before I took them out of the bags or papers to look on them, to judge, tho' perhaps to the ſurprize of thoſe that brought them, that they were not true ores, but marcaſites. And, becauſe this miſtake is ſpeciouſly grounded, and has deceived many, whereof ſome have undertaken voyages betwixt *Europe* and the *Indies*, upon confidence of the value of theſe gliſtering ſtones; I ſhall decline a little the method of this paper, which confines me to the hydroſtatical way of exploring minerals, to advertiſe thoſe whom it may concern, that they may eaſily try almoſt any ſtone, that by its great weight and luſtre they ſuſpect to be a marcaſite, if they put it either within a crucible or without one, into a well kindled fire, and blow now and then upon it with a pair of bellows. For by this means the ſulphur, wherewith marcaſites are wont to abound, (ſo that I remember, that, even by diſtillation in a cloſe veſſel, I had ℥iv. of good brimſtone, like the vulgar, out of ℔iij. of the ſtones) will take fire, and burn with a flame for the moſt part blue like that of common ſulphur. And if, when it ceaſes to flame and ſmoke, you take it out of the fire and let it cool, you will find it deprived of all the gaudy appearance of rich metal it had before, and turned to a brittle blackiſh ſubſtance, differing enough from that of a metalline ore, more ſtrictly ſo called. Theſe laſt words I add, becauſe, in a lax ſenſe, it is eaſy to ſhew, that marcaſites, at leaſt thoſe that I have tried, may be looked upon as a kind of metalline bodies. For, beſides that I have found divers of them to contain particles of copper, I found all (that I purpoſely examined) to contain, and ſome of them plentifully enough, corpuſcles of iron or ſteel, as plainly appeared. when, after the newly mentioned calcination (for with crude marcaſites I found not the following trial to ſucceed) I applied to the pulveriſed remains a vigorous load-ſtone; to which great multitudes of martial corpuſcles quickly adhered. And, I remember, I found in a catalogue of the foſſils of *Aſiſnia*, publiſhed by the experienced *Kent-*

mannus,

mannus, that, under the head or title of pyrites, he brings in ſeveral marcaſites, whereof ſome contained copper, others ſilver, others gold, and others both the laſt named metals; which brings into my mind, that having preſented, among other Engliſh minerals, a curiouſly ſhaped and very fine marcaſite, to a virtuoſo, that is now overſeer of one of the emperor's beſt mines; he quickly examined it by a peculiar way not known to me, hoping to find in it ſome gold or ſilver; but, inſtead of that, obtained a portion of running mercury, which he was pleaſed to preſent me, and which I preſume I may have yet by me.

THOUGH I thought it needful to give the foregoing caution about marcaſites, for the reaſons before expreſſed, yet my deſign is only to keep the leſs ſkilful from being deluded by their promiſing appearance. For otherwiſe I do not deny, but that it is poſſible for a ſkilful artiſt to make (at leaſt of ſome ſorts) of them a gainful uſe, either by fixing the volatile gold or ſilver, that may be found in ſome of them; or by graduating ſilver by their means; or perhaps by ſome other ways that I can but gueſs at. But (to add that on this occaſion) that, for which I much more value marcaſites, is, that (NB) ſomewhat more than bare conjectures make me think, that being dexterouſly handled, and perhaps even without additions, they may afford very noble as well as uncommon medicines, and particularly in continual fevers, though their operation be uſually ſcarce ſenſible, but by their good effects.

SECT. VI.

ON this occaſion I muſt not forbear to give an advertiſement, that may be of good uſe to divers examiners of ores, eſpecially ſuch as are novices in the art of reducing them. And it is this, that as to many who make trials of ores, though they much value their own flux-powders, or thoſe that are cried up by others, yet they commonly act as if they expected nothing from thoſe that they prefer, but that they ſhould more than others facilitate the fuſion of the ores; as that which being once done, the metalline part will be ſeparated by its own weight, or as it were ſpontaneouſly. But yet, having purpoſely examined the matter more nicely, and compared the quantities of metal that we obtained from two portions of equal weight of the ſame ore, we found that thoſe proportions did very conſiderably differ, though that which yielded leaſt metal was fluxed down with a fondant (as the French compendiouſly call what our men, after the Germans, call a flux-powder) that is dear enough, and not undeſervedly eſteemed, when ſuch ores are to be handled. And I little doubt, but that, from other metalline ores, a greater portion of pure metal may be obtained by ſome, but little employed or known, fondants, and perhaps cheap ones too, than by others that are much more in uſe and famous; of which I may elſewhere give ſome inſtances: now one, that firſt occurs to my memory, was afforded me, by two equally heavy portions of the ſame lead ore devoid of ſpar; whereof one, being reduced with a due weight of nitre and tartar fulminated together, afforded much leſs of malleable lead, than was obtained by means of half or a quarter of the quantity of filings of *Mars*, which, for trial's ſake, I then employed on the other; to ſhew, how much better a reductive of that kind of ore that metalline flux was, than even a ſharp and fiery fixed ſalt.

AND yet (to give you an inſtance in a much more precious mineral than lead ore) I ſhall add, that having, for curioſity's ſake, tried ſome ounces of good native cinnabar finely pulveriſed, one half with a fixed alcali of tartar, and the other with a different flux-powder, we obtained from the firſt parcel twice as much mercury as

as we did from the other half, diſtilled with another fixed alcali, even though it were of a mineral nature.

SECT. VII.

Some Obſervations about Native Gold.

About the hydroſtatical examen of gold and its ore.

GOLD being by far the moſt noble and precious of metals, it may be ill taken, if I ſhould here leave the ore and mineral, that affords it, altogether unmentioned; and therefore, though I have but two or three obſervations, pertinent to my preſent ſubject, to offer about it, yet I think it may not be uſeleſs to ſay ſomewhat of that ore in this place.

I KNOW there are many learned men, and even chemiſts, that think there are no ſuch things as gold mines, properly ſo called. And I confeſs, that I myſelf was long kept from being confident of the affirmative. And I was induced to this diffidence by conſidering, that though, having had the honour for divers years to be a member of his majeſty's council for foreign plantations, I had the opportunity to converſe with a conſiderable number of navigators, and other great travellers, and with divers perſons that had ſettled themſelves in the *Indies*, I made it more than once my buſineſs to enquire, not whether they knew of any golden mines in the popular ſenſe of the word, for I knew that there are in *Hungary*, *Macedonia*, and ſome other countries, mines that afford gold enough to deſerve to be wrought for it; but whether there are any real mines, or veins, whereof gold is manifeſtly the predominant metal. Having, I ſay, propoſed to many this queſtion, I was anſwered, that ſome of them indeed had heard of ſuch mines, but none of them had ever ſeen any. But afterwards I ſaw ſome ore that I judged true, that was preſented to his majeſty *Charles* II. and I alſo received from an unknown virtuoſo, reſiding in the *Eaſt-Indies*, together with a very civil letter (which I wiſhed had been more hiſtorical and leſs complimental) among other leſs valuable pieces of ore, one in whoſe clefts, and a little beyond them, there appear ſome lumps, wherein by their colour, and other ſigns, it is ſo apparent, that gold is the predominant metal, that I little doubt, but that, if I would ſpoil the lump by breaking the ſpar, I ſhould find theſe metalline protuberances malleable, without the help of the fire.

BUT being unwilling to deſtroy the entireneſs of it, I ſhall make only a few and ſhort remarks about this ore.

THE biggeſt piece, and that which was beſt furniſhed with metalline parts, being about an ounce and a quarter in weight, contained ſo great a proportion of ſpar, in reference to the metal, that its weight to an equal bulk of water was but as $2\frac{91}{100}$ to 1.

BUT ſomewhat to compenſate this ſmallneſs of the metalline portion, that, that was of it, ſeemed to be all gold, there being no ſign of any other metal in that lump of ore, nor in ſome leſſer ones that I received with it.

THE ſpar (as our mine-men uſed to call that ſtony matter in which the true ore is immediately lodged) did not look like the ſpar of lead ore, or that of any other of our Engliſh metals that I have ſeen, but ſeemed at firſt view to be a kind of white marble with a daſh of yellow.

AND, upon trial, I found it to differ more from the ſpar of lead ore, which, with us, is uſually white, and almoſt ſemidiaphanous, than in the colour. For, whereas our ſpar of lead ore is oftentimes ſo ſoft or tender, that it may eaſily enough be cut with a knife, we found the ſparry portion of our gold ore to be a ſolid ſtone, and that ſo hard, that being ſtruck with a piece of ſteel, it would yield ſparks of fire.

WHEREAS alſo I found, that the ſpar of lead ore would be eaſily enough, and in a ſhort time (as about a quarter of an hour) calcined to a kind of lime; our golden ſpar, though kept ſome hours red hot in a crucible, did not appear to be at all calcined. And whereas I had formerly obſerved, that I could eaſily diſſolve the ſpar of lead ore in ſome acid menſtruums, and even in diſtilled vinegar itſelf, I did not find, that our golden ſpar, though kept divers hours in ſtronger menſtruums, as ſpirit of ſalt, aqua fortis, and aqua regis, was diſſolved or manifeſtly wrought upon by any of them, as if it were of a glaſſy nature, as well as of a very hard one.

A PIECE of ſpar, that had ſcarce any gold at all that could be diſcerned, being hydroſtatically examined, was in ſpecific gravity to water as $2\frac{65}{100}$ to 1. which ponderoſity does but very little exceed that of white marble, or that of ſome good ſpar of lead ore that was compared with it.

IF I had received a greater quantity of gold ore, I ſhould have given a leſs imperfect account of this ſubject. But theſe notes, ſuch as they are, may perchance not be unwelcome to ſome of thoſe many Engliſh and other ſearchers for mines, that have never ſeen true gold ore, or have not had liberty to make any trials upon it, and yet are in ſearch of gold mines, eſpecially in *Jamaica*, where, if I much miſremember not, the * inquiſitive gentleman that conquered it for the Engliſh, told me, at his return thence, that the Spaniſh governor of the iſland, when his priſoner, confeſſed to him, that there was mineral gold, though the Spaniards did not dig deep for it for want of workmen.

* General *Venables*.

SECT. VIII.

BUT by the mention I have made of the true ore of gold, I would not diſcourage any from ſeeking for that rich metal in the veins of ſome other metals; becauſe, in divers of theſe, I know it may ſometimes be found blended with predominant minerals. This may appear by thoſe Hungarian copper mines of *Cremnitz*, whence a conſiderable quantity of gold is yearly obtained. I have elſewhere alſo taken notice, that I have ſeen an Engliſh tin ore, part of which I preſented to the king, wherein there lay, in little cells, a good number of ſmall leaves or chips of gold, which I ſaw there with pleaſure. And though the tin-men, not being able to ſeparate them with profit, uſually melted both the metals together, and ſold the product for mere tin; yet an experienced gentleman, who was owner of the mine, aſſured me, that one of his workmen, who had many little children, employed them with good profit, to pick the gold with their ſmall fingers out of the ſkilfully broken ore. And though lead mines be looked upon as thoſe, which the matter whereof gold is made is ſeldomeſt found to be near, and does as it were avoid; yet there is a place in *Scotland*, (whoſe name I remember not) where over a lead mine, upon or near the ſurface of the ground, they oftentimes find grains or bigger pieces of native gold without ſpar; ſome of which, by the ingenious owner's favour, I was maſter of, and thought ſometimes worthy of being preſented to that curious examiner of ores, his highneſs prince *Rupert*. And ſtill I have one bit of native metal by me, which, if much I miſtake not, I had from the ſame place: which foſſil, though I found it hydroſtatically (becauſe being native I would not melt it) not to be, as the owner ſuppoſed, pure gold; yet gold is the predominant metal in it, and the piece weighs forty odd grains.

Memoirs for the natural hiſtory of tin.

SINCE I wrote the laſt foregoing lines, I have, in an old collection of my notes, found three, whereof the firſt is thus ſet down, a grain of *Scotch* gold, ſuch as nature had made it, without any adhering ſtone or ſpar, weighed ʒiij. + 21 grains:

the ſecond thus, another grain of the ſame gold, that had here and there ſome little ſtone or ſpar ſticking to it, and partly incloſed in it, weighed ʒiij. + 3 grains; ſo that the heterogeneous ſubſtance being, according to my eſtimate, abated, it weighed about ʒiij: and the third is ſubjoined in theſe terms, a grain of *Scotch* gold weighed in air 43 grains, in water 39 ½ grains, differ. 3 + ½ propor. 12 $\frac{2}{7}$ to 1.

THIS lightneſs of a yellow metal (heavier than braſs or ſilver) deſerves a reflection; but I cannot ſtay to make it.

IT ſeveral times happens, that among the leſſer grains of gold, that are more properly called ſand-gold, there are found pieces, ſome of which I have ſeen, that are ſingly big enough to be tied about with an horſe-hair, and ſo weighed in water, as lumps of ore of other metals are wont to be. And to ſuch bigger fragments of gold, it is manifeſt, by what has been already delivered, that our hydroſtatical way of exploring may be uſefully applied. For ſince, according to the famous and diligent *Merſennus*, and ſome eſteemed writers, pure gold is to water of the ſame bulk, as (about) 18 to 1; and by my examen of very fine gold, I found that it equals about nineteen times the weight of as much water (I ſay about, becauſe I unhappily loſt the exacteſt of my trials upon gold among thoſe made upon the other metals in a moſt exquiſite balance) as is equal to it in bulk; it will readily appear, whether the fragment propoſed be perfectly pure or not. For if its weight amount to near nineteen times as much water in quantity, we may conclude it to be unallayed; and as it wants leſs or more of this ponderoſity, we may conclude it to be more or leſs pure.

SECT. IX.

IT is known, that ſince we began effectually to cultivate the African trade, it frequently brings into theſe parts, beſides things of leſs value, conſiderable quantities of what, from the moſt uſual ſize of it, is by many called ſand-gold; but which, by reaſon of the very unequal bulks of the grains, may perhaps juſtly be called fragments of gold; ſince being brought from the maritime parts, where no mines of gold are yet found, they ſeem to have been broken off and waſhed away from hidden veins by the violence of waters, that having carried them as far as they were able, left them a prey to men. Now (becauſe that unleſs it be perhaps brought by, or for ſome virtuoſo) there is ſcarce any gold that comes into *Europe* in lumps, under the form of ore; but a great deal that is brought from *Guinea*, (and thoſe other parts of *Afric*, which for that reaſon are compriſed under the name of the golden coaſt) in the form chiefly of ſand or gravel, groſſer or ſmaller, and partly alſo of leſs minute pieces; it may conduce to the ſcope of theſe papers to take notice, that in making eſtimates of the genuineneſs and the degrees of purity of theſe native fragments of gold, our hydroſtatical way of exploring may be of no ſmall uſe.

FOR firſt, when we have once diſcovered the proportion between pure or exquiſitely refined gold, and water equal to it in bulk, (which proportion I have lately given exactly enough for our preſent purpoſe) it is eaſy, by our hydroſtatical method, to examine the fineneſs of any other gold propoſed; ſo at leaſt as to know, whether it be perfectly fine; and if it be not, whether it do conſiderably fall ſhort of perfect fineneſs. But ſince of this I elſewhere treat, I think it more proper to obſerve in this place, that when once a man has found the true ſpecific gravity of a parcel of ſand-gold, (ſmaller or coarſer) whoſe degree of fineneſs he knows by collateral trials, or ſome other means, (whatever they be) he may (as was formerly noted when I ſpoke of metalline ores) take this ſpecific gravity for a ſtandard, with relation

relation to which he may make his eſtimates of the fineneſs of other parcels of the like native gold, that he is concerned to buy or to examine. And, by this means, he may oftentimes prevent that chief fraud of the negroes, whereof ſeveral traders to the golden coaſt are not a little apprehenſive, as being in danger to be much damnified by it. For they complain, that though the blacks be, otherwiſe, for the moſt part, but a dull ſort of people; yet they have often made a ſhift to cheat the traders, by clandeſtinely mixing with the right ſand-gold, filings of copper, or rather of braſs, whoſe colour does ſo reſemble that of gold, that the fraud is not eaſily diſcerned. And in the account of a late voyage, made by the French to the coaſt of *Afric*, to trade eſpecially for gold, it is acknowledged, that the officers were egregiouſly cheated by the blacks, who, inſtead of paying them for the wares they brought with powder of true gold, gave them powder of braſs, or gilt copper, which thoſe that were not accuſtomed to make trial of ſuch wares, are, as the relater complains, in a ſcarce evitable danger to be cheated, as theſe Frenchmen confeſs they were in one day to the worth of a thouſand crowns. But in regard that, as trial has informed me, braſs is not quite half ſo heavy as fine gold of the ſame bulk, if there be any conſiderable quantity of filings of braſs with the gold; this mixture being put into ſuch an hydroſtatical bucket, or wide mouthed glaſs, as is mentioned in the eſſay, will manifeſtly weigh leſs in water, than if it were all gold. And by comparing its ſpecific gravity, with that formerly found to the grain gold pitched upon for a ſtandard, the greater or leſſer decrement of the ſuſpected gold will help to make an eſtimate of the quantity of braſs, mingled with the natural gold.

SECT. X.

BUT though my preſent undertaking do not oblige me to conſider ſand-gold, otherwiſe than hydroſtatically; and though it highly concerns merchants and others, that deal in ſo rich a commodity as gold, and that is by ſo many ſtudiouſly adulterated, to be furniſhed with nice and truſty balances; yet, becauſe divers perſons, eſpecially ſeamen, that trade to the gold coaſt and other parts, where ſand-gold is to be met with, do, (perhaps too often) without being furniſhed with good ſcales and ſufficient ſkill to uſe them, venture upon buying ſuch precious wares; it will not be to depart from my general and main deſign, which is to ſerve the public, if I deviate a little from my ſubject, and add to the hydroſtatical way, lately propoſed, of examining ſand-gold, two or three chemical ways to the ſame purpoſe. Firſt then, if he that would purchaſe ſand-gold, doubts that there are filings of braſs (or of copper) mixed with it; in caſe he have aqua fortis at hand, he may quickly diſcover the cheat, if there be any. For it is known to chemiſts, that aqua fortis will not work upon gold, and therefore if there be filings of braſs mixed with it, the operation of the menſtruum upon thoſe, together with the colour betwixt blue and green, it will thereby acquire, will diſcover the deceit. But, becauſe if nature hath mingled much ſilver with the gold, the proof by aqua fortis will require ſkill, and may puzzle thoſe that want it; I ſhall add, that good ſpirit of urine may be ſubſtituted in its ſtead. For I elſewhere ſhew, that it will readily work upon filings of copper or braſs in the gold, and gain from them a fine blue colour; and this being a menſtruum not corroſive, like the other, but harmleſs to moſt bodies, and a good medicine for human bodies in ſeveral diſeaſes, (as the jaundice, pleuriſies, ſome kind of fevers, coughs, and aſthmas) may be fit to be carried about in voyages, and to be preferred to aqua fortis. And to make the operation of this liquor on filings of braſs far more quick, than if the ſolution be attempted

an ordinary way, I thought upon the following expedient. I took filings of braſs, (and the like may be done with thoſe of copper) amounting to the weight but of eight or ten grains, or perhaps leſs; and having with my finger ſpread them ſomewhat thin upon a ſmall piece of white paper, I moiſtned them thoroughly with good ſpirit of fermented (or putrified) urine, (which will not diſſolve gold) that by this means the air might promote the diſſolutive action of the menſtruum; which accordingly it did ſo well, that, to the ſurpriſe of the beholders, there appeared in leſs than a quarter of an hour, and ſometimes in a few minutes, a manifeſt, if not alſo a deep and pleaſant blue colour upon the paper, or on ſome of the filings, or both. Thoſe that carry with them ſpirit of hartſhorn, or ſuch other volatile alcalies for medicinal uſes, (as ſome modern ſhip-chirurgeons do) may, for a need, employ that inſtead of ſpirit of urine. Nay, one may for the ſame purpoſe make uſe of urine itſelf never diſtilled, if it be ſtale and rank enough, (as it grows to be, ſooner in hot airs than in others:) ſince having for trial's ſake moiſtened with ſuch urine ſome filings of braſs, thinly ſpread on a piece of paper, there was a manifeſt blueneſs produced in about a quarter of an hour. But I thought alſo of another way, which I preſumed would be better liked by moſt traders, as more commodious; becauſe the agent being in a dry form, cannot, like ſpirituous liquors, be ſpilt; and though it be more eaſily procured, may ſerve the turn almoſt as well. This agent is common ſal armoniac, of which, when I have occaſion to uſe it, I reduce a greater quantity to powder, than I gueſs the quantity of water, I ſhall need, will diſſolve; that the liquor may be ſatiated with the ſalt. With this brine I thoroughly wet filings of braſs, (or copper) after the forementioned manner, thinly ſpreading them with my finger on a piece of paper, or ſome other fit and flat body; and in a ſhort time (as about a quarter of an hour or leſs) there will appear a greeniſh blue colour, drawn from the braſs by the liquor: which (liquor,) I ſuppoſe, I need not tell you, will not work on the gold, wherewith the braſs is mingled.

SECT. XI.

I HAVE obſerved ſuch a variety of appearances and diſguiſes of metalline bodies, and ſome other minerals, that I would adviſe thoſe that are given to the ſearch of mines, and other foſſils, to have their eyes always open when they paſs (eſpecially by land) from one place to another, that they may be ready to take notice of any unknown or uncommon foſſil, that they chance to ſee in their way; and that having taken it up, they do not neglect to poiſe it in their hands, (which after a little practice it will not be difficult to do, though not exactly, yet not unuſefully) and if they judge it to exceed the weight of cryſtal, or marble, to examine it hydroſtatically at their firſt conveniency. For there are in *England*, as well as in divers other countries, uſeful foſſils, that are wont to be overlooked by the unſkilful; and I have found in this kingdom, even upon, or very near the highways, eagle-ſtones, and ſome other minerals that were not ſuſpected to be of Engliſh growth.. And I remember, that having occaſion, in the country, to paſs by the work-houſe of an ingenious potter, that I ſometimes employed in his profeſſion; and having viewed the ground ſomewhat attentively, among ſome other uncommon foſſils that I took notice of, I made a diſcovery of manganeſe, or magneſia, whereof I gave the potter an advertiſement, which he afterwards thankfully made uſe of, having found the mineral very proper for the glazing and colouring of his veſſels.

NOR was this the only kindneſs, that ſkill in mineralogy, as little as mine was, enabled me then to do him. For he having invited me to view very privately, a place

place wherein there was great ſtore of a foſſil ſubſtance, that men knew not what to make of, becauſe they had not ſeen nor heard of the like in *England*: the knowledge I had of ſome Italian mines, made me quickly gueſs what it was that was taken for an unknown metal. For it is true, that this mineral was not divided into lumps of ſuch ſhapes and bigneſſes, as make glittering foſſils paſs for ſtones among the unſkilful, ſuch as are the marchaſites, whereof they make vitriol, and are found by the ſea ſhore in or near the *Iſle of Wight*, and (though not ſo plentifully) in other parts of *England* (where I have found them) but ran a great way (and I had not time or liberty to try how far) under ground, like a vein of metalline ore. But this notwithſtanding, I judged the mineral to be but a marchaſite, in a form unuſual indeed in *England*, but which is not without reſemblers in ſome parts of *Italy*; which conjecture I found true the ſame day, by ſome eaſy trials that manifeſted it to abound much more in vitriolate ſalt, than any marchaſite that I had examined in the form of ſtones. So that, though I had no opportunity to try, whether or no it contained any better metal than iron; yet I concluded, that, *cæteris paribus*, it might be employed to make ſtore of vitriol, in far leſs time, and with far leſs coſt, than the marchaſites made uſe of in the vitriol works at *Deptford*, or elſewhere in *England*.

I REMEMBER alſo, that a mineral of an odd, though pretty appearance, being ſent me, whoſe ſpecies was unknown to the mine-men that dug it up, I gueſſed that it was a foſſil, that I had not found in a good printed catalogue of our Engliſh minerals, namely, the ore of Biſmuth. And in this conjecture ſome trials, purpoſely made of that mineral, ſufficiently confirmed me, and gave me cauſe to be ſorry, that the vein, that afforded it, was ſo very ſmall, as the diggers found it, of an ore, that has properties enough; and is by ſome famous chemiſts affirmed to have ſome, that are not only rare, but wonderful.

BUT the chief thing, that invites me to recommend in this place, to thoſe that travel, an heedful eye on the ore-like, or ponderous ſubſtances, that may occur to them, is, that one of the applications of our general remark about the ſpecific gravity of foſſils may be extended to an uſe, that has not, that I know of, been made by mineraliſts, and which yet I thought fit not to overlook: becauſe I ſee no need we ſhould be confined to examine only thoſe foſſils, whereof we can obtain parcels big enough to be weighed in water in the entire body. For beſides other minerals, that may be found profitable to the phyſician, the drugſter, or the mineraliſt, the ores, or wombs of metal themſelves, may be divers times found diſguiſed in the form of earth, or of mud, eaſy to be dried: which foſſils, though (becauſe they chance not to be found in lumps) unfit to be kept immediately ſuſpended by an horſe-hair, may be conveniently enough examined by the help of a glaſs-jar, whoſe weights in air, and water, and their difference, (which gives the ſpecific weight of the veſſel) have been taken once for all, which I uſually call an hydroſtatical bucket. For this veſſel being almoſt filled with the propounded foſſil, and carefully counterpoiſed in the air, and then thoroughly wetted with water, and when it is ſo, warily let down into the water, and kept ſuſpended by an horſe-hair to a tender balance; when theſe things, I ſay, are done, the difference between the weight of the mineral and veſſel, when they are under water, and their former weight being obſerved; and the ſpecific weight already found of the veſſel itſelf in water being ſubſtracted from that difference, there will remain the weight of the foſſil only, (which we here ſuppoſe to be heavier in ſpecie than water, and not to be diſſoluble in it) or the mineral itſelf in that liquor; and conſequently the proportion between that body, and water of the ſame bulk, as is elſewhere ſufficiently declared.

SECT. XII.

TO manifeſt, that this expedient may be of uſe in divers caſes, I ſhall only here obſerve, that a late author, who hath publiſhed an account of *Swedeland*, declares, that one of the beſt ſorts of Swediſh iron (which, you know, is much eſteemed in its kind) is divers times found in the form of a red mud, at the bottom of lakes, or far leſſer ſtagnant waters; which I the more readily believe, becauſe I have found ſome Engliſh okers (that paſs but for red earth, or ſtone of that colour) to be richer in iron than I found ſome famous ores of that metal to be. And another experienced writer, who gives us an account of the gold and ſilver mines of *America*, among which he ſpent ſeveral years, takes notice, that gold itſelf is found, from time to time, diſguiſed into a reddiſh earth, or is (though unſuſpectedly) harboured in it. An Italian mineraliſt, of repute in the laſt age, doth alſo take notice, that a reddiſh ſort of earth doth ſometimes contain a portion of the richeſt metals. I have obſerved ſome European diamonds, as many call a ſort of clear and finely figured cryſtals, to grow in a red earth, whence I have taken up pretty ſtore of them. And an inquiſitive traveller, who has been in the *Indies*, preſented me with a certain earth, which he affirmed to be from the diamond mines, (I preſume in the kingdom of *Colchonda)* which I found to be alſo red, and which I made ſome trials of, that belong not to this place.

Vannochio.

SECT. XIII.

BUT the profitableſt uſe, that a mineraliſt may make of our hydroſtatical bucket, is to employ it much in weighing variety of coloured ſands and gravels, particularly ſome hereafter to be mentioned.

AND to let you ſee, by an eaſy inſtance, how apt we are to overlook ſands for want of trying them by weight, I ſhall not tell you, that I have ſometimes ſeen a ſort of ſand, that was ſlighted as common or worthleſs, which being waſhed and viewed in a microſcope, though none of the beſt, looked like an aggregate of ſmall granates, and perhaps was ſo; but ſhall here content myſelf to inſtance in that black ſand, that is commonly uſed in *London* and elſewhere, only to dry up the ink of words, that have been newly written. For having obſerved, when I had ſome quantity of this in my hand, that it was manifeſtly heavier than common ſand, I thought it worth the being examined by the hydroſtatical bucket; by which trial, that which we employed appeared to be to water of the ſame bulk, near about as $4\frac{6}{10}$ to 1. And having, for reaſons, that I cannot ſtay to mention, judged this ſand to be a mineral of a martial nature, I was confirmed in my conjecture, by melting it down with two or three parts of antimony, and caſting it into an iron cone. But I was more than confirmed in the ſame conjecture, when having tried it with a vigorous loadſtone, I found it to be far richer in metal than any of the Engliſh iron ores I had made trial of, and (except perhaps one) than any of the outlandiſh: for having taken, at adventures, ſome drachms out of a much larger quantity, and weighed it, I found, that at leaſt ſeven parts of eight would eaſily be taken up by the magnet. But ſuch obſervations as theſe are not the things, that chiefly move me to recommend the examen of ſands and gravels to the mineraliſt; particularly thoſe ſorts of them, that being ſomewhat ponderous, are reddiſh or yellow, eſpecially if they retain thoſe colours, after they have been made red hot, and quenched in cold water.

BUT therefore to proceed to the mention of richer ſands, it is known, that from the coaſt of *Guinea*, European traders, of ſeveral nations, do yearly bring gold to a great

value, which is waſhed or picked out of the ſand. And even in *Europe* there are rivers, whoſe ſand is enriched by grains of gold, for which the *Tagus*, that runs by *Liſbon*, and *Pactolus*, were famous among the ancients. I knew an induſtrious chemiſt, who owned to me, that he got gold with profit from the ſand, which he found in ſome places of the banks of the Rhine: and there is a little river in *Savoy* proceeding from the mountains there, on whoſe banks, after a land-flood, I ſaw poor people buſy themſelves in ſeeking for grains of gold. Some trial (alſo) that I cauſed purpoſely to be made, confirmed me in a conjecture, which poſſibly may hereafter prove beneficial to many, namely, that the ſands of divers places, if they be ſkilfully treated by a dextrous chemiſt, may afford much more gold than is picked or waſhed out of them in form of grains. For beſides, that there may be many atoms, or corpuſcles of gold, that are ſo very minute, and ſtick ſo cloſe to grains of ſand, that they are neither taken notice of by the eye, nor ſeparable by waſhing and picking; beſides this, I ſay, there may, as I conceive, be many particles of gold incorporated with the body of the ſand, which may be a kind of womb for matter of a golden nature, that a ſkilful artiſt, by the help of proper additaments, may ſeparate with profit, eſpecially if, with litharge or minium, he firſt reduce the ſand to a glaſs, and then take care to get the volatile gold, by giving it a pure body fit to retain and fix it, ſuch as is fine ſilver: out of which, I remember, we ſeparated by quartation, (though without profit, becauſe of the charges, and of the ſmall quantity we could work with at once) from as much vitrified ſand, and two or three fluxing additaments of ſmall price, as were contained in one crucible, (that broke too before the operation was near done) ſixteen grains of pure gold, that you may yet ſee, if you deſire it.

SECT. XIV.

IT need not ſtartle you, that in reciting this experiment, I made mention of volatile gold. For though I know, that divers learned men, and ſome able chemiſts themſelves, look upon it as a fictitious thing, and that ſeems to bear a kind of contradiction in its very name, in regard of the perfect fixity they preſume to be an eſſential property of gold; yet I do not ſcruple to diſſent from them, being warranted ſo to do by my own experience. For I have more than once made uſe of a way, wherein, by the help of an additament, inconſiderable as to bulk, and leſs as to weight, one may, without a naked fire, and in a glaſs retort, ſublime gold, (not prepared by previous calcination) ſometimes in the form of a yellow or golden coloured ſalt; and ſometimes, when the operation ſucceeded better, in the form of thin cryſtals prettily ſhaped, gloſſy, and as red as rubies. But this upon the by; it may perhaps be more uſeful to ſearchers of rich foſſils not found in lumps, if I take this occaſion to obſerve, that when they meet with ſands, earths, mineral fragments, *&c.* that conſiderably exceed cryſtal in ſpecific gravity; and by the place, wherein they are found, or by other tokens, give hopes of their containing corpuſcles of a golden nature: when this, I ſay, happens, it will not be adviſable, haſtily to reject ſuch bodies, but rather carefully to try, whether they do not deſerve a better uſage. For having ſometimes had the opportunity to diſcover corpuſcles of *Mars*, as chemiſts call iron and ſteel, in a far greater variety of foſſils and of diſguiſes, than even many noted chemiſts would have imagined, or ſome of them could, upon heedful trial, diſcover; I was much confirmed in my ſuſpicion, that corpuſcles of a golden nature may be concealed in divers bodies, which are thought not to contain any metal; and that in more of thoſe minerals, that are looked upon as ores of ſome other metal, becauſe of its being manifeſtly predominant, there may be mingled pretty ſtore of particles of gold or ſilver; which (becauſe of the

the greater quantity of that other metal, or mineral, that doth, as it were, cover or diſguiſe them) lie unperceived, and uſually unſuſpected, by perſons not very well acquainted with ſuch matters; and yet may, by one that is very ſkilful, be ſeparated even with profit.

SECT. XV.

BUT the grounds of the forementioned ſuſpicion being as yet but conjectural, I ſhall decline the particular mention of them in this place; and ſhall rather adviſe, with reference to ores in general, that thoſe, that would apply the hydroſtatics to them, do labour to procure ſamples of the ores of differing mines, eſpecially if they be found in the ſame country; and do either by trial, or ſtrict enquiry, inform themſelves, what proportion of the metal, that denominates them, they contain. For theſe proportions of ores and minerals being carefully weighed in air and water, and their ſpecific gravities being thereby made known, they may ſerve for a kind of ſtandard, by compariſon whereto we may oftentimes make not altogether unuſeful eſtimates of the metalline portions contained in other parcels of ore, of that ſpecies, whether afforded by the ſame mine, or vein of it, or by any other of the ſame metal hydroſtatically examined.

FOR inſtance, our Engliſh lead ores, that are worth taking notice of, may be, for diſtinction ſake, divided into three kinds or orders, and in each of theſe there may be allowed a latitude for greater or leſſer degrees of goodneſs. The firſt ſort is of thoſe ores, that, in the ordinary way of melting, hold ſome of them from 30 ℔. of lead in an hundred weight of ore, to 40; and others to 45 ℔. of the ſame metal, and theſe by ſeveral are ſlighted as mean, and ſcarce, if at all, worth working, eſpecially thoſe, that hold under 35 or 40. As for the ſecond ſort, that reaches from 45 to 60 ℔. in the hundred, the moſt uſual proportion I have found in many trials hath been about half the weight of the ore in clean and malleable lead. Theſe ores are thought indifferently good, and worth working: but other ores compriſed in this ſecond ſort held about 55, and ſome near 60, and theſe were looked upon, not only as good, but pretty rich. And for the third ſort, it conſiſts of thoſe, that yield from 60 to 80 in the hundred, and theſe ores are juſtly reputed very rich, (in lead) eſpecially theſe that come any thing near 80; for I confeſs, I never met with any that reached ſo far, but was aſſured by an ingenious and ſkilful gentleman, maſter of his majeſty's royal mint, that he had found ſome ſuch upon trial. But for me, I think that I have not above twice or thrice met with any that yielded me above 75. Theſe looked exceedingly promiſing, as if they were all metal, and I obſerved, whether the thing were caſual or not, ſome lumps to be compoſed of divers great cubes like dice, ſticking very hard to one another.

THE conſiderations, that moved me to offer the advice given at the beginning of this ſection, invited me to make reſearches of the ſpecific gravity, not only of divers Engliſh ores, as of lead, tin, *&c.* of which I had carefully made a collection, (that was loſt by a ſudden fire, broke out in the place where I kept them) but of the ores, that were preſented me from ſeveral countries, both in *Europe* and *America*; as Swediſh copper and iron ores, German ſilver and tin glaſs ores; Hungarian antimonial ores; *New-England* lead, iron, and copper ores, *&c.* The effects of ſome few of which reſearches, that chanced to come to hand, whilſt I was ſeeking for ſome hydroſtatical trials of drugs, I thought it not amiſs to inſert in a table annexed to the *Medicina Hydroſtatica*; becauſe perhaps they may be of ſome uſe in making a previous conjecture, about a mine's being, or not being likely to be wrought with profit, all other things con-

concurring that ſhould do ſo. Which laſt clauſe I deſire ſhould be taken notice of, becauſe there are divers other circumſtances, beſides the proportion of the metalline part in the foſſil, that are fit to be conſidered, [as the plenty or ſcarcity of the mineral, the eaſineſs or difficulty of coming at it, becauſe of its depth, or its being or not being troubled with waters, *&c.* its nearneſs to plenty of fuel, and the conveniency of water to drive mills; its nearneſs to, or remoteneſs from, the ſea, or ſome navigable river, convenient for its tranſportation, to omit other important circumſtances] before one begins to work a mine; which, as they happen to be commodious or inconvenient, may render the attempt adviſeable or imprudent.

But, Sir, I perceive (though late) that I have forgot I was to write, not a book of the trial of ores and other minerals, but a moderately ſized letter about an hydroſtatical way of exploring their ſpecific gravity. And therefore, to avoid increaſing the already too great prolixity of this paper, by making an apology for it, I ſhall lengthen it, only to beg you to pardon it, and to look upon the writer as,

SIR,

Your moſt humble and obedient ſervant,

R. B.

ADVERTISEMENT.

TO give the curious the ſatisfaction of ſeeing at one view, and of ſo eaſily comparing together the ſpecific gravities of a good number and variety of bodies, and to ſave them the labour of turning over many leaves of the foregoing tract, to find the particular body, whoſe ponderoſity they deſire to know; I have cauſed to be annexed a table, containing in an alphabetical order (though not a ſcrupulouſly exact one) the names of the drugs, and other bodies, whoſe gravities are delivered in the foregoing papers, without ſcrupling to add ſome others, that I chanced to light on in turning over ſome of my old and forgotten notes.

But I muſt to the following table premiſe this advertiſement, (warranted by ſeveral paſſages of the foregoing papers here laid together) that it is not to be expected, every one, that ſhall try the ſpecific gravities of the bodies here mentioned, ſhall find all of them to be preciſely the ſame, that the table exhibits: ſince (not to mention, that perhaps every experimenter will not employ ſo much care, and be aſſiſted with ſo much uſe, in making hydroſtatical trials, as thoſe this table conſiſts of were made with) the difference, that may ſometimes be found between his trials and mine, may very probably be imputed to that variety of texture and compactneſs, that may be found in ſeveral bodies of the ſame kind or denomination, neither nature nor art being wont to give all the productions, that bear the ſame name, a mathematical preciſeneſs, either in gravity or in other qualities.

The TABLE.

	Weight In air in gr.	Weight In water in gr.	Proportion.
A			
AMBER	306	12	$1\frac{4}{100}$ to 1.
Agat	251	156	$2\frac{64}{100}$ to 1.
A piece of alum-ſtone	$280\frac{3}{4}$	$152\frac{1}{4}$	$2\frac{18}{100}$ to 1.
Antimony good and ſuppoſed to be Hungarian one	391	295	$4\frac{7}{100}$ to 1.

	Weight In air in gr.	Weight In water in gr.	Proportion.
B			
Bezoar-ſtone	187	61	$1\frac{48}{100}$ to 1.
A piece of the ſame	$56\frac{1}{2}$	22	$1\frac{64}{100}$ to 1.
A fine oriental one	172	60	$1\frac{53}{100}$ to 1.
Another	237	61	$1\frac{34}{100}$ to 1.
C			
Coral red	$129\frac{1}{4}$	$80\frac{1}{4}$	$2\frac{63}{100}$ to 1.
Cryſtal	256	140	$2\frac{21}{100}$ to 1.
Cornelian	148	103	$3\frac{29}{100}$ to 1.
Calculus humanus	2570	1080	$1\frac{72}{100}$ to 1.
Coco-ſhell	331	85	$1\frac{34}{100}$ to 1.
Native crabs eyes	$77\frac{1}{2}$	$36\frac{1}{2}$	$1\frac{89}{100}$ to 1.
Crabs eyes artificial	$90\frac{1}{2}$	54	$2\frac{48}{100}$ to 1.
Calx of lead	$138\frac{1}{2}$	123	$8\frac{94}{100}$ to 1.
Copper-ſtone	$65\frac{1}{2}$	$49\frac{1}{2}$	$4\frac{90}{100}$ to 1.
Common cinnnabar	802	702	$8\frac{1}{50}$ to 1.
Cinnabar of antimony	197	169	$7\frac{30}{100}$ to 1.
Cinnabar native	197	171	$7\frac{57}{100}$ to 1.
Coral white	336	204	$2\frac{54}{100}$ to 1.
Another piece fine	139	85	$2\frac{57}{100}$ to 1.
Calculus humanus	302	97	$1\frac{47}{100}$ to 1.
Copper ore	1436	1090	$4\frac{15}{100}$ to 1.
Copper ore rich	413	314	$4\frac{17}{100}$ to 1.
Cinnabar native, very ſparkling	226	194	$7\frac{6}{100}$ to 1.
G			
Gold ore not rich, brought from the *Eaſt-Indies*	1100	682	$2\frac{63}{100}$ to 1.
Another lump of the ſame	1151	717	$2\frac{65}{100}$ to 1.
Granati Minera	217	147	$3\frac{1}{10}$ to 1.
Granate Bohemian			$4\frac{36}{100}$ to 1.
H			
Hæmatites Engliſh	1574	1156	$3\frac{76}{100}$ to 1.
I			
Ivory	$173\frac{1}{2}$	83	$1\frac{91}{100}$ to 1.
L			
Lapis manati	450	293	$2\frac{86}{100}$ to 1.
A fragment of the ſame	$218\frac{1}{2}$	123	$2\frac{29}{100}$ to 1.
Another	345	197	$2\frac{33}{100}$ to 1.
Another from *Jamaica*	2011	1127	$2\frac{27}{100}$ to 1.
Lapis lazuli one piece	385	256	$2\frac{98}{100}$ to 1.
Lead ore	686	590	$7\frac{14}{100}$ to 1.
Another			
Lapis calaminaris	477	380	$4\frac{92}{100}$ to 1.
Lapis judaicus	$261\frac{1}{2}$	164	$2\frac{60}{100}$ to 1.
M			
Marcaſites	814	631	$4\frac{45}{100}$ to 1.
Another from *Stalbridge*	243	189	$4\frac{1}{2}$ to 1.
Another more ſhining than ordinary	287	227	$4\frac{78}{100}$ to 1.
Mercury revived from ore			

	Weight In air in gr.	Weight In water in gr.	Proportion.
Manganeſe a piece —— ——	321	230	$3\frac{53}{100}$ to 1.
Mineral Corniſh like a ſhining marcaſite —	145	129	$9\frac{6}{100}$ to 1.
O			
Oſteocolla —— ——	195	108	$2\frac{74}{100}$ to 1.
Ore ſilver choice from *Saxony* ——	458	366	$4\frac{97}{100}$ to 1.
Another piece —— ——	1120	960	7 to 1.
Ore lead from *Cumberland* rich ——	1872	$1586\frac{1}{2}$	$1\frac{54}{100}$ to 1.
R			
Rhinoceros horn —— ——	8563	4260	$1\frac{99}{100}$ to 1.
Rock-cryſtal, another piece ——	256	140	$2\frac{20}{100}$ to 1.
S			
Sapphir			
Seed pearl			
Sulphur vive —— ——	371	185	2 to 1.
Germane very fine —— ——	306	152	$1\frac{98}{100}$ to 1.
Slate Iriſh —— ——	779	467	$2\frac{49}{100}$ to 1.
T			
A piece of talc like lapis amianthus ——	596	334	$2\frac{28}{100}$ to 1.
Talc { Venetian —— ——	802	508	$2\frac{73}{100}$ to 1.
Talc { Jamaican —— ——	1857	1238	3 to 1.
New Engliſh tin ore, Mr. *Hubert*'s ——	812	613	$4\frac{8}{100}$ to 1.
Tin ore black rich —— ——	1293	984	$4\frac{18}{100}$ to 1.
Another piece choice —— ——	2893	2314	5 to 1.
Tutty a piece —— ——	104	83	5 to 1.
Tin-glaſs —— ——	463	419	$9\frac{55}{100}$ to 1.
V			
Vitrum Antimonii per ſe ——	$357\frac{1}{2}$	$282\frac{1}{2}$	$4\frac{76}{100}$ to 1.
Vitriol Engliſh, a very fine piece ——	1093	512	$1\frac{88}{100}$ to 1.
Unicorns horn a piece —— ——	407	195	$1\frac{91}{100}$ to 1.

POSTSCRIPT.

WHEN I began to ſend the eſſay, called *Medicina Hydroſtatica*, to the preſs, and drew up the foregoing preface to it, I intended it ſhould, in the ſame book or volume, be accompanied by another help or two, to explore and improve the *Materia Medica*. But when the eſſay itſelf, and the annexed epiſtle about a previous exploration of ores, had been printed off, I could not but perceive, that the bulk of thoſe two tracts ſo far exceeded what I expected, that, if I ſubjoined what I at firſt deſigned to add to it, it would prove a miſ-ſhapen book, and inconvenient to be opened. Wherefore it ſeemed expedient to divide the whole intended work into two volumes or tomes, whereof what had already paſt the preſs ſhould make the firſt, which, that it might be the ſooner ſerviceable, ſhould forthwith come abroad by itſelf; and the ſecond ſhould conſiſt partly of the other papers abovementioned, as relating to the *Materia Medica*, and partly of a ſupplement to the firſt tome, containing divers hiſtorical paralipomena, that by miſtake were omitted, and are fit to be there ſupplied out of a fuller copy, than that, which by an overſight was made uſe of at the preſs.

THE CHRISTIAN VIRTUOSO:

SHEWING,

That, by being addicted to Experimental Philoſophy, a man is rather aſſiſted than indiſpoſed to be a good Chriſtian.

The FIRST PART.

To which are ſubjoined,

I. A diſcourſe about the diſtinction, that repreſents ſome things as above reaſon, but not contrary to reaſon.

II. The firſt chapters of a diſcourſe, entitled, Greatneſs of Mind promoted by Chriſtianity.

The PREFACE.

WHEN many years ago I was induced to write ſomething about the ſubject of the following treatiſe, I did it partly to give ſome ſatisfaction to a friend, and partly to impoſe upon myſelf an obligation, to conſider the more attentively, upon what grounds it may be aſſerted, that there is no inconſiſtence between a man's being an induſtrious virtuoſo, and a good Chriſtian. How little fond I was of troubling the public with a diſcourſe of this nature, may be gueſſed by my having thrown it aſide, among other neglected papers, for ſeveral years. And it had ſtill continued in that obſcurity, if the formerly unprevalent deſires of thoſe, that would have it appear in public, had not been enforced by an obſervation or two, that I could not but make. For I could ſcarce avoid taking notice of the great and deplorable growth of irreligion, eſpecially among thoſe, that aſpired to paſs for wits, and ſeveral of them too for philoſophers. And on the other ſide it was obvious, that divers learned men, as well as others, partly upon the ſcore of their abhorrence of theſe infidels and libertines, and partly upon that of a well-meaning but ill-formed zeal, had brought many good men to think, that religion and philoſophy were incompatible; both parties contributing to the vulgar error, but with this difference, that the libertines thought a virtuoſo ought not to be a Chriſtian, and the others, that he could not be a true one.

IT is like it may ſeem to ſome readers, that I have too much enlarged the notion of experience, and too much inſiſted on the proofs deducible from that topic: but it is not improbable, that others may approve the reaſons, with which that ample notion of experience is, where it is propoſed, accompanied. And the ingenious perſon, I was chiefly to pleaſe, being a lover and valuer of experience, and of arguments grounded on it, the deſire of gratifying him enticed me to ſay ſo much, that when I took up the thoughts of making this treatiſe public, I found the effects of my complaiſance ſo interwoven with the other parts of the diſcourſe, that I could not

not make any great alteration, (for ſome I did make) without almoſt ſpoiling the contexture of it.

I HOPE the equitable reader will not expect to find every ſubject, of which I have occaſion to diſcourſe, fully treated of: for I neither deſigned nor pretended to write a body of natural theology, nor a demonſtration of the Chriſtian religion, but thought it ſufficient for me to conſider the points I wrote of, as far forth as was neceſſary or very conducive to my purpoſe. And therefore I thought myſelf not only warranted, but obliged, (in point of diſcretion) to decline the mention of ſeveral arguments and reflections, that would indeed have been very proper, if my deſign had been to ſhew, why one ſhould be a Chriſtian; but impertinent to ſhew, that a virtuoſo, while ſuch, may be a true Chriſtian. But as, for this reaſon, I omitted many things, that would have enriched or adorned my diſcourſe; ſo I have endeavoured to make ſome amends, both by ſuggeſting ſome new ſubjects, and by adding, on thoſe that have been already treated of by others, divers thoughts, into which I was led by the attentive conſideration of the ſubject itſelf; on which ſcore, they may probably not have yet occurred to the reader, and may appear to him, either to be new as to the ſubſtance, or, if any of them be coincident with the more known ones, to have ſomething peculiar as to the way of propounding or of applying them. And, I confeſs, I was ſomewhat encouraged to communicate my thoughts on theſe ſubjects, by conſidering, that (though it ought not to be ſo, yet) it is notorious, that, in the age we live in, there are too many perſons, that are like to be found more indiſpoſed to be impreſſed on by arguments, in favour of religion, from profeſſed divines, how worthy ſoever, than from ſuch as I, who am a layman, and have been looked upon as no undiligent cultivator of experimental philoſophy. And (that the ſtile might not be unſuitable to the writer, and the deſign) I thought fit, in my arguments and illuſtrations, both to employ compariſons drawn from teleſcopes, microſcopes, *&c.* and to make frequent uſe of notions, hypotheſes, and obſervations, in requeſt among thoſe, that are called the new philoſophers. Which I the rather did, becauſe ſome experience has taught me, that ſuch a way of propoſing and elucidating things, is either more clear, or, upon account of its novelty, wont to be more acceptable, than any other to our modern virtuoſi; whom thus to gratify, is a good ſtep towards the perſuading of them. For it is eaſy to obſerve, that ſome men are more acceſſible to truth, and will be more prevailed upon by it, when it is preſented to them in one dreſs, than when it appears in another; as we daily ſee, that ſome perſons will be more eaſily prevailed with to take a medicine, and that it will have a more kindly operation upon them, if it be exhibited in that form and conſiſtence, that is beſt liked by the patients; whereof ſome love to have the ingredients (the medicine is to conſiſt of) offered them in a liquid, others in a ſoft, and others in a dry form.

THOUGH I am wont, as well as inclinable, to ſpare the preſent age; and though my cenſures of ſome reputed virtuoſi, that live in it, are written with as harmleſs and friendly deſigns, as was the ſeeming rudeneſs of the angel to St. *Peter*, when he ſtruck him on the ſide, and haſtily rouzed him, but to awake him, to take off his chains, and to free him from the danger that threatened him; yet I ſhall be more troubled and ſurpriſed, if I ſhall find the following treatiſe diſliked by divers perſons, that would paſs for virtuoſi, and by ſome that are really ſo. For ſome men, that have but ſuperficial (though conſpicuous) wits, are not fitted to penetrate ſuch truths as require a laſting and attentive ſpeculation; and divers, that want not abilities, are ſo taken up by their ſecular affairs, and their ſenſual pleaſures, that they neither have diſpoſition, nor will have leiſure, to diſcover thoſe truths, that require both an attentive and penetrating mind. And more than either of theſe ſorts of men there

are, whom their prejudices do so foreſtal, or their intereſt biaſs, or their appetites blind, or their paſſions diſcompoſe, too much to allow them a clear diſcernment and right judgment of divine things. Upon which (and other) accounts, I ſhall not think it ſtrange, if what I write ſhall make no great impreſſion on readers thus qualified, whom to convert, it is not enough to convince them: nor ſhall I be greatly diſcouraged, or think much the worſe of my arguments, if they do not make proſelytes of thoſe, whom ſiniſter conſiderations make ſuch reſolved adverſaries to the truth, that He alone, who can preach from heaven, is able to prevail upon them; and they muſt be converted almoſt as *Saul* the perſecutor was, by an extraordinary light from heaven, and a power able to ſtrike them to the ground. But though I am not ſo little acquainted with the preſent age, as to expect to plead for religion with the approbation of atheiſts, or of libertines; yet I ſhall not think my pains altogether miſpent, if what I have written, either ſtartle any irreligious reader ſo far, as to engage him to conſult abler aſſertors of Chriſtianity and virtue, than I pretend to be; or elſe prove ſo happy, as to confirm and ſtrengthen, by new arguments and motives, thoſe that have heartily embraced the Chriſtian faith and morals, though perhaps not upon the firmeſt grounds. For it will be no ſmall ſatisfaction to me, if, though I cannot convert the reſolvedly irreligious, I ſhall at leaſt furniſh thoſe, that are not ſo, with preſervatives againſt them, and hinder their impiety from being contagious.

But I fear, that thoſe, that are enemies both to the doctrines I propoſe, and to the aims I purſue, will not be the only perſons, that will find fault with the following tract; ſince, perhaps, there will not be wanting ſome ingenious men, that expected, as well as deſired, that I ſhould never write but as a naturaliſt, becauſe they themſelves eſteem nothing, ſave the laws and phænomena of nature, to be ſubjects worthy of a philoſophical pen: as if, becauſe rational ſpirits are inviſible and immaterial beings, all diſquiſitions about them muſt be airy and uncertain ſpeculations, and, like their objects, devoid of ſolidity and uſefulneſs. But though among theſe ingenious men there are ſeveral, whoſe expectations from me I am much more diſpoſed to gratify, than diſappoint; yet, on ſuch an occaſion as this, I muſt take the liberty to own, that I do not think the corporeal world, nor the preſent ſtate of things, the only or the principal ſubjects, that an inquiſitive man's pen may be worthily employed about; and that there are ſome things, that are grounded neither upon mechanical nor upon chemical notices or experiments, that are yet far from deſerving to be neglected, and much leſs to be deſpiſed, or ſo much as to be left uncultivated, eſpecially by ſuch writers, as being more concerned to act as Chriſtians, than as virtuoſi, muſt alſo think, that ſometimes they may uſefully buſy themſelves about the ſtudy of divine things, as well as at other times employ their thoughts about the inſpection of natural ones. There are ſome objects, whoſe nobleneſs is ſuch, that, though we derive no advantage from them, but the contentment of knowing them, and that but very imperfectly too, yet our virtuoſi themſelves juſtly think much pains and time, and perhaps coſt too, well ſpent in endeavouring to acquire ſome conjectural knowledge of them: as may be inſtanced in the aſſiduous and induſtrious reſearches they have made about the remote cœleſtial part of the world, eſpecially the ſtars and comets, that our age has expoſed to their curioſity. For moſt of theſe, though they require chargeable teleſcopes, and tedious (as well as unhealthy) nocturnal obſervations, are objects, of which we can know very little with any certainty; and which, for ought appears, we can make no uſeful experiments with. Since therefore we ſo much prize a little knowledge of things, that are not only corporeal, but inanimate; methinks we ſhould not undervalue the ſtudies of thoſe men, that aſpire to the knowledge of incorporeal and rational beings, which are incomparably more noble than all the ſtars

in the world, which are, as far as we know, but maſſes of ſenſeleſs and ſtupid matter. Since alſo the virtuoſi deſervedly applaud and cheriſh the laborious induſtry of anatomiſts, in their inquiries into the ſtructure of dead, ghaſtly, and oftentimes unhealthfully as well as offenſively fœtid bodies; can it be an employment improper for a Chriſtian virtuoſo, or unworthy of him, to endeavour the diſcovery of the nature and faculties of the rational mind, which is that, that ennobles its manſion, and gives man the advantage he has of the beaſts that periſh?

I AM content, that merely natural philoſophy ſhould often employ my thoughts and my pen; but I cannot conſent it ſhould engroſs them, and hinder me from being converſant with theological ſubjects. And ſince, among my friends, I have ſome (and thoſe not inconſiderable for their number, and much leſs for their merit) that preſs me to treat of religious matters, as well as others, that would have me addict myſelf to cultivate phyſical ones; I, who think myſelf a debtor to both theſe ſorts, am willing to endeavour to gratify both; and having already, on many occaſions, preſented the latter ſort with large, as well as public, effects of my complaiſance for them, I hope, they will not think it ſtrange, that I ſhould now and then have regard to the former ſort, too; eſpecially ſince I had higher motives, than complaiſance ought to be, to induce me to treat ſometimes of things, that might be grateful to thoſe friends, that are much ſo to religious compoſures.

I PRESUME it will be taken notice of, that, in the following treatiſe, as well as in divers of my other writings, eſpecially about ſubjects that are purely, or partly, philoſophical, I make frequent uſe of ſimilitudes, or compariſons: and therefore I think myſelf here obliged to acknowledge once for all, that I did it purpoſely. And my reaſons for this practice were, not only becauſe fit compariſons are wont to delight moſt readers, and to make the notions they convey better kept in memory; whence the beſt orators and preachers have made great and ſucceſsful uſe of metaphors, allegories, and other reſemblances; but I was induced to employ them chiefly for two other reaſons: 1. That though I freely confeſs, that arbitrary ſimilitudes, and likewiſe thoſe that are foreign to the ſubject treated of, ſuch as are moſt of the vulgar ones, that are uſually borrowed from the fictions of the poets, and from the uncertain and often ill-applied relations of *Pliny*, *Ælian*, and other too frequently fabulous writers, are ſcarce fit to be made uſe of but to vulgar readers, or popular auditories; yet compariſons fitly choſen, and well applied, may, on many occaſions, uſefully ſerve to illuſtrate the notions, for whoſe ſake they are brought, and, by placing them in a true light, help men to conceive them far better than otherwiſe they would do. And, 2. appoſite compariſons do not only give light, but ſtrength, to the paſſages they belong to, ſince they are not always bare pictures and reſemblances, but a kind of arguments; being oftentimes, if I may ſo call them, analogous inſtances, which do declare the nature, or way of operating, of the thing they relate to, and by that means do in a ſort prove, that, as it is poſſible, ſo it is not improbable, that the thing may be ſuch as it is repreſented: and therefore not only the illuſtrious *Verulam*, though not more a florid than a judicious writer, has, much to the ſatisfaction of his readers, frequently made uſe of compariſons, in whoſe choice and application he was very happy; but that ſevere philoſopher, monſieur *Des Cartes* himſelf, ſomewhere ſays, that he ſcarce thought, that he underſtood any thing in phyſics, but what he could declare by ſome apt ſimilitude; of which, in effect, he has many in his writings; [as where he compares the particles of freſh water to little eels; and the corpuſcles of ſalt in the ſea-water to little rigid ſtaves; and where, after the Stoics, he compares the ſenſe of objects, by the intervention of light, to the ſenſe that a blind man hath of ſtones, muds, &c. by the intervention of his ſtaff.] To which I ſhall add, that

proper

proper comparisons do the imagination almost as much service as microscopes do the eye; for, as this instrument gives us a distinct view of divers minute things, which our naked eyes cannot well discern, because these glasses represent them far more large, than by the bare eye we judge them; so a skilfully chosen and well applied comparison much helps the imagination, by illustrating things scarce discernible, so as to represent them by things much more familiar and easy to be apprehended.

I confess I might, on some occasions, have spoken, not only more positively and boldly, but, as to many learned readers, more acceptably, if I would have discoursed altogether like a Cartesian, or as a partizan of some other modern sect of philosophizers. But, besides that I am not minded to give myself up to any sect, I thought it convenient, that a discourse, designed to work on persons of differing persuasions about philosophical matters, should not declare itself dogmatically, or unreservedly, of a party; but employ rather the dictates of reason, or principles either granted or little contested, than proceed upon the peculiar principles of a distinct party of philosophizers.

If now and then I have insisted upon some particular subjects, more than appears absolutely necessary, I did it, because that, though I wrote this treatise chiefly for my friends, yet I did not write it for them only, but was willing to lay hold on some of the occasions, that the series of my discourse offered me, to excite in myself those dispositions, that I endeavoured to produce in others, and, by insisting upon some reflections, impress them more deeply upon my own mind; especially when I was treating of some points, either so important, or so opposed, or both, that they can scarce be too much inculcated.

The name of the person, to whom the following papers were addressed, not being necessary to be made public, some reasons made it thought convenient, that it should remain unmentioned.

POSTSCRIPT.

TO give an account of the prolixity, that some might otherwise censure, of the foregoing preface, I must advertise the reader, that it is of an ancient date; and that the first part of the treatise, that it belongs to, was already written, and it was then designed, that the second part should accompany it to the press: on which score it was presumed, that, as the particulars, that make up the preamble, would not appear superfluous, in regard of the variety of subjects to be treated of; so its length would scarce be found disproportionate to the bulk of the whole designed book.

THE CHRISTIAN VIRTUOSO:

SHEWING,

That, by being addicted to Experimental Philosophy, a man is rather assisted than indisposed to be a good Christian.

The FIRST PART.

SIR,

I Perceive by what you intimate, that your friends Dr. *W.* and Mr. *N.* think it very strange, that I, whom they are pleased to look upon as a diligent cultivater of experimental philosophy, should be a concerned embracer of the Christian religion; though

though divers of its articles are ſo far from being objects of ſenſe, that they are thought to be above the ſphere of reaſon. But though I preſume they may find many objects of the like wonder, among thoſe with whom I am compriſed by them, under the name of the new virtuoſi; and among theſe, they may meet with divers perſons more able than I, to eaſe them of their wonder; yet ſince they are pleaſed, by ſingling me out, as it were to challenge me to do it, I ſhall endeavour to make them think it at leaſt leſs ſtrange, that a great eſteem of experience, and a high veneration for religion, ſhould be compatible in the ſame perſon. Wherefore I ſhall not deny, that I am now and then buſied in deviſing, and putting in practice, trials of ſeveral ſorts, and making reflections upon them: and I own too, that (about natural things) I have a great reverence for experience, in compariſon of authority. But withal I declare, that, to embrace Chriſtianity, I do not think I need to recede from the value and kindneſs I have for experimental philoſophy, any thing near ſo far as your friends ſeem to imagine. And I hope it will appear, that if the experimental way of philoſophiſing I am addicted to, have any things in it, that indiſpoſe a man to aſſent to the truth, and live according to the laws of the Chriſtian religion; thoſe few things are more than countervailed by the peculiar advantages, that it affords a man of a well-diſpoſed mind, towards the being a good Chriſtian.

I SAID, a man of a well-diſpoſed mind, that is, one, that is both docile, and inclined to make pious applications of the truths he diſcovers; becauſe ſuch a qualification of mind, I hope, God, through his goodneſs, has vouchſafed me; and the occaſion given by your friends to the following diſcourſe relating peculiarly to me, a perſonal account of my opinions, and reaſons of them, ought to ſuffice. And it will be *ex abundanti*, (as they ſpeak) if my diſcourſe be found, as it often will be, to extend much further. Which reflection I deſire you would frequently have in your thoughts, to prevent miſtaking the deſign of the following epiſtle.

I DOUBT not, but the popular prejudices, that I perceive your two friends, among many other more devout than well-informed perſons, have entertained, will make them think, that what I have now delivered needs good proof, and perhaps better than it is capable of. And therefore I hope you will eaſily allow me the liberty, I am going to take, of briefly premiſing ſome things, to clear the way for the principal points deſigned to be diſcourſed of in this letter.

I KNOW you need not be told, that the philoſophy, which is moſt in requeſt among the modern virtuoſi, and which by ſome is called the new, by others the corpuſcularian, by others the real, by others (though not ſo properly) the atomical, and by others again the Carteſian (or the mechanical) philoſophy, is built upon two foundations, reaſon and experience. But it may not be impertinent to obſerve to you, that although the peripatetic (and ſome other) philoſophies do alſo pretend to be grounded upon reaſon and experience; yet there is a great difference betwixt the uſe, that is made of theſe two principles, by the ſchool-philoſophers, and by the virtuoſi. For thoſe, in the framing of their ſyſtem, make but little uſe of experience; contenting themſelves for the moſt part to employ but few and obvious experiments, and vulgar traditions, uſually uncertain, and oftentimes falſe; and ſuperſtructing almoſt their whole phyſics upon abſtracted reaſon; by which I mean the rational faculty, endowed but with its own congenit, or common notions and ideas; and with popular notices, that is, ſuch as are common among men, eſpecially thoſe that are any thing learned. But now, the virtuoſi I ſpeak of (and by whom, in this whole diſcourſe, I mean thoſe that underſtand and cultivate experimental philoſophy) make a much greater and better uſe of experience in their philoſophical reſearches. For they conſult experience both frequently and heedfully; and, not content with the phænomena that nature

ſpontaneouſly affords them, they are ſolicitous, when they find it needful, to enlarge their experience by trials purpoſely deviſed; and, ever and anon reflecting upon it, they are careful to conform their opinions to it; or, if there be juſt cauſe, reform their opinions by it. So that our virtuoſi have a peculiar right to the diſtinguiſhing title, that is often given them, of experimental philoſophers.

I CAN ſcarce doubt, but your friends have more than once obliged you to take notice of the profane diſcourſes and licentious lives of ſome virtuoſi, that boaſt much of the principles of the new philoſophy. And I deny not, but that, if the knowledge of nature falls into the hands of a reſolved atheiſt, or a ſenſual libertine, he may miſemploy it to oppugn the grounds, or diſcredit the practice, of religion. But it will fare much otherwiſe, if a deep inſight into nature be acquired by a man of probity and ingenuity, or at leaſt free from prejudices and vices, that may indiſpoſe him to entertain and improve thoſe truths of philoſophy, that would naturally lead him to ſentiments of religion. For, if a perſon thus qualified in his morals, and thereby diſpoſed to make uſe of the knowledge of the creatures to confirm his belief, and increaſe his veneration of the Creator (and ſuch a perſon, I here again advertiſe you, and deſire you would not forget it, I ſuppoſe the virtuoſo, this paper is concerned in, to be) ſhall make a great progreſs in real philoſophy; I am perſuaded, that nature will be found very loyal to her Author; and, inſtead of alienating his mind from making religious acknowledgments, will furniſh him with weighty and uncommon motives, to conclude ſuch ſentiments to be highly rational and juſt. On which occaſion I muſt not pretermit that judicious obſervation of one of the firſt and greateſt experimental philoſophers of our age, Sir *Francis Bacon*, that God never wrought a miracle to convince atheiſts; becauſe in his viſible works He had placed enough to do it, if they were not wanting to themſelves. The reaſon he gives for which remark, I ſhall confirm, by obſerving, that it is intimated in a paſſage of St. *Paul*, aſſerting
Rom. i. 20. both "that the inviſible things of God are clearly ſeen from the creation of the "world," as tokens and effects (as I remember the particle ἀπὸ in the Greek doth elſewhere ſignify) and that his divinity and eternal power may be ſo well underſtood by the things that are made, that the Gentiles, who had but the light of nature to lead them to the acknowledgment of the true God, were excuſeleſs, for not being brought by that guide to that acknowledgment.

AND indeed, the experimental philoſophy giving us a more clear diſcovery, than ſtrangers to it have, of the divine excellencies diſplayed in the fabric and conduct of the univerſe, and of the creatures it conſiſts of, very much indiſpoſeth the mind to aſcribe ſuch admirable effects to ſo incompetent and pitiful a cauſe as blind chance, or the tumultuous juſtlings of atomical portions of ſenſeleſs matter; and leads it to the acknowledgment and adoration of a moſt intelligent, powerful, and benign Author of things, to whom alone ſuch excellent productions may, with the greateſt congruity, be aſcribed. And therefore, if any of the cultivators of real philoſophy pervert it to countenance atheiſm, it is certainly the fault of the perſons, not the doctrine; which is to be judged of by its own natural tendency, not by the ill uſe that ſome bad men may make of it; eſpecially if the prevaricating perſons are but pretenders to the philoſophy they miſemploy; which character will perhaps be found to belong to moſt, if not all, the atheiſtical and profane men, the objection means. For moſt of theſe do as little underſtand the myſteries of nature, as believe thoſe of Chriſtianity; and of divers of them it may be truly ſaid, that their ſenſuality, and luſts, and paſſions, darkened and ſeduced their intellects: their immorality was the original cauſe of their infidelity; nor were they led by philoſophy to irreligion, but got and perverted ſome ſmattering of philoſophy, to countenance the irreligious principles they brought with them to the ſtudy of it.

BUT

BUT all this notwithſtanding, I fear, if not foreſee, that you will ſurmiſe, that the ſtudy of natural philoſophy, how innocent ſoever it may be in itſelf, will, in this libertine city, engage me to converſe with many, who, though they paſs for virtuoſi, are indeed atheiſts; whoſe contagious company muſt endanger (if not infect) me.

THIS obliges me to tell you, that though I have no reaſon to take it at all unkindly, that you are jealous of me on the ſcore of being ſolicitous for my ſafety; yet I hope my danger is not ſo great as you may apprehend it. For firſt, I muſt own to you, that I do not think there are ſo many ſpeculative atheiſts, as men are wont to imagine. And though my converſation has been pretty free and general among naturaliſts, yet I have met with ſo few true atheiſts, that I am very apt to think, that mens want of due information, or their uncharitable zeal, has made them miſtake or miſrepreſent many for deniers of God, that are thought ſuch, chiefly becauſe they take uncommon methods in ſtudying his works, and have other ſentiments of them than thoſe of vulgar philoſophers. And in the next place I muſt tell you, that having, through the goodneſs of God, choſen my religion, not inconſiderately, but upon mature deliberation, I do not find thoſe virtuoſi, you call atheiſts, ſuch formidable adverſaries, as thoſe that are afraid to hear them, do, by that apprehenſion, appear to think them. And indeed, I have obſerved the phyſical arguments of the atheiſts to be but very few, and thoſe far enough from being unanſwerable. And as for the very chief of them, though they are wont to puzzle ſuch as are not verſed in nice ſpeculations, becauſe they repreſent the aſſertion of a Deity as a doctrine encumbered with inextricable difficulties; yet I do not think the objections ſolidly grounded, ſince the ſame difficulties, or others not inferior, may be urged againſt thoſe hypotheſes and principles, that the deniers of God do or muſt admit. And indeed, moſt of the perplexing difficulties, the atheiſts lay ſo much ſtreſs on, do not proceed from any abſurdity contained in the tenent of the theiſts, but from the nature of things; that is, partly from the dimneſs and other imperfections of our human underſtandings, and partly from the abſtruſe nature, that, to ſuch bounded intellects, all objects muſt appear to have, in whoſe conception infinity is involved; whether that object be God, or atoms, or duration, or ſome other thing that is uncauſable. For, however we may flatter ourſelves, I fear we ſhall find, upon ſtrict and impartial trial, that finite underſtandings are not able clearly to reſolve ſuch difficulties, as exact a clear comprehenſion of what is really infinite.

BUT to purſue this diſcourſe would lead us too far. And it is more fit, after ſo much has been ſaid, concerning not only the deſign of this tract, but the new philoſophy, the virtuoſi, and myſelf, to proceed to thoſe more particular things, that directly tend to the main ſcope of our epiſtle.

THE firſt advantage, that our experimental philoſopher, as ſuch, hath towards being a Chriſtian, is, that his courſe of ſtudies conduceth much to ſettle in his mind a firm belief of the exiſtence, and divers of the chief attributes, of God: which belief is, in the order of things, the firſt principle of that natural religion, which itſelf is pre-required to revealed religion in general, and conſequently to that in particular, which is embraced by Chriſtians.

THAT the conſideration of the vaſtneſs, beauty, and regular motions, of the heavenly bodies; the excellent ſtructure of animals and plants; beſides a multitude of other phænomena of nature, and the ſubſerviency of moſt of theſe to man; may juſtly induce him, as a rational creature, to conclude, that this vaſt, beautiful, orderly, and (in a word) many ways admirable ſyſtem of things, that we call the world, was framed by an Author ſupremely powerful, wiſe, and good, can ſcarce be denied by an intelligent and unprejudiced conſiderer. And this is ſtrongly confirmed by

experience, which witneſſeth, that, in almoſt all ages and countries, the generality of philoſophers, and contemplative men, were perſuaded of the exiſtence of a Deity, by the conſideration of the phænomena of the univerſe; whoſe fabric and conduct, they rationally concluded, could not be deſervedly aſcribed, either to blind chance, or to any other cauſe than a divine Being.

BUT though it be true, "that God hath not left Himſelf without witneſs," even to perfunctory conſiderers, by ſtamping upon divers of the more obvious parts of his workmanſhip ſuch conſpicuous impreſſions of his attributes, that a moderate degree of underſtanding, and attention, may ſuffice to make men acknowledge his being; yet I ſcruple not to think that aſſent very much inferior to the belief, that the ſame objects are fitted to produce in an heedful and intelligent contemplator of them. For the works of God are ſo worthy of their Author, that beſides the impreſſes of his wiſdom and goodneſs, that are left as it were upon their ſurfaces, there are a great many more curious and excellent tokens and effects of divine artifice, in the hidden and innermoſt receſſes of them; and theſe are not to be diſcovered by the perfunctory looks of oſcitant or unſkilful beholders; but require, as well as deſerve, the moſt attentive and prying inſpection of inquiſitive and well-inſtructed conſiderers. And ſometimes in one creature there may be I know not how many admirable things, that eſcape a vulgar eye, and yet may be clearly diſcerned by that of a true naturaliſt; who brings with him, beſides a more than common curioſity and attention, a competent knowledge of anatomy, optics, coſmography, mechanics, and chemiſtry. But treating elſewhere purpoſely of this ſubject, it may here ſuffice to ſay, that God has couched ſo many things in his viſible works, that, the clearer light a man has, the more he may diſcover of their unobvious exquiſiteneſs, and the more clearly and diſtinctly he may diſcern thoſe qualities, that lie more obvious. And the more wonderful things he diſcovers in the works of nature, the more auxiliary proofs he meets with to eſtabliſh and enforce the argument, drawn from the univerſe and its parts, to evince that there is a God: which is a propoſition of that vaſt weight and importance, that it ought to endear every thing to us, that is able to confirm it, and afford us new motives to acknowledge and adore the divine Author of things.

IN reference to this matter, we may confidently ſay, that the experimental philoſophy has a great advantage of the ſcholaſtic. For in the peripatetic ſchools, where things are wont to be aſcribed to certain ſubſtantial forms and real qualities; (the former of which are acknowledged to be very abſtruſe and myſterious things, and the latter are many of them confeſſedly occult); the accounts of nature's works may be eaſily given in a few words, that are general enough to be applicable to almoſt all occaſions. But theſe uninſtructive terms do neither oblige nor conduct a man to deeper ſearches into the ſtructure of things, nor the manner of being produced, and of operating upon one another; and conſequently are very inſufficient to diſcloſe the exquiſite wiſdom, which the omniſcient Maker has expreſſed in the peculiar fabrics of bodies, and the ſkilfully regulated motions of them, or of their conſtituent parts: from the diſcernment of which things nevertheleſs it is, that there is, by way of reſult, produced in the mind of an intelligent contemplator a ſtrong conviction of the being of a divine Opificer, and a juſt acknowledgment of his admirable wiſdom. To be told, that an eye is the organ of ſight, and that this is performed by that faculty of the mind which from its function is called viſive, will give a man but a ſorry account of the inſtruments and manner of viſion itſelf, or of the knowledge
Pſ. xciv. 9. of that Opificer, who, as the Scripture ſpeaks, "formed the eye." And he that can take up with this eaſy theory of viſion, will not think it neceſſary to take the pains to diſſect the eyes of animals, nor ſtudy the books of mathematicians, to underſtand

ſtand viſion; and accordingly will have but mean thoughts of the contrivance of the organ, and the ſkill of the artificer, in compariſon of the ideas, that will be ſuggeſted of both of them to him, that being profoundly ſkilled in anatomy and optics, by their help takes aſunder the ſeveral coats, humours, and muſcles, of which that exquiſite dioptrical inſtrument conſiſts: and having ſeparately conſidered the figure, ſize, conſiſtence, texture, diaphaneity, or opacity, ſituation, and connections of each of them, and their coaptation in the whole eye, ſhall diſcover, by the help of the laws of optics, how admirably this little organ is fitted to receive the incident beams of light, and diſpoſe them in the beſt manner poſſible for completing the lively repreſentation of the almoſt infinitely various objects of ſight.

IT is eaſy for men to ſay in general terms, that the world is wiſely framed; but I doubt it often happens, that men confeſs, that the creatures are wiſely made, rather becauſe upon other grounds they believe God to be a wiſe agent, than becauſe ſo ſlight an account, as the ſchool philoſophy gives of particular creatures, convinces them of any divine wiſdom in the Creator. And though I am willing to grant, that ſome impreſſions of God's wiſdom are ſo conſpicuous, that (as I lately intimated) even a ſuperficial philoſopher may thence infer, that the author of ſuch works muſt be a wiſe agent; yet how wiſe an agent he has in thoſe works expreſſed himſelf to be, none but an experimental philoſopher can well diſcern. And it is not by a ſlight ſurvey, but by a diligent and ſkilful ſcrutiny of the works of God, that a man muſt be, by a rational and affective conviction, engaged to acknowledge with the prophet, that the author of nature is "wonderful in counſel, and excellent in working." Iſa. xxviii. 29.

II. AFTER the exiſtence of the Deity, the next grand principle of natural religion, is the immortality of the rational ſoul; whoſe genuine conſequence is, the belief and expectation of a future and everlaſting ſtate. For this important truth, divers arguments may be alledged, that may perſuade a ſober and well-diſpoſed man to embrace it: but to convince a learned adverſary, the ſtrongeſt argument, that the light of nature ſupplies us with, ſeems to be that, which is afforded by the real philoſophy. For this teacheth us to form true and diſtinct notions of the body, and the mind; and thereby manifeſts ſo great a difference in their eſſential attributes, that the ſame thing cannot be both. This it makes out more diſtinctly, by enumerating ſeveral faculties and functions of the rational ſoul; ſuch as to underſtand, and that ſo, as to form conceptions of abſtracted things, of univerſals, of immaterial ſpirits, and even of that infinitely perfect one, God himſelf: and alſo to conceive, and demonſtrate, that there are incommenſurable lines, and ſurd numbers; to make ratiocinations, and both cogent and concatenated inferences, about theſe things; to expreſs their intellectual notions, *pro re natâ*, by words or inſtituted ſigns to other men; to exerciſe free will about many things; and to make reflections on its own acts, both of intellect and will. For theſe and the like prerogatives, that are peculiar to the human mind, and ſuperior to any thing, that belongs to the outward ſenſes, or to the imagination itſelf, manifeſt, that the rational ſoul is a being of an higher order than corporeal; and conſequently, that the ſeat of theſe ſpiritual faculties, and the ſource of theſe operations, is a ſubſtance, that being in its own nature diſtinct from the body, is not naturally ſubject to die or periſh with it.

AND in reference to this truth, our virtuoſo hath an advantage of a mere ſchool-philoſopher. For being acquainted with the true and real cauſes of putrefaction, and other phyſical kinds of corruption; and thereby diſcerning, that the things, that deſtroy bodies, are the avolation, or other receſs of ſome neceſſary parts, and ſuch a depraving tranſpoſition of the component portions of matter, as is altogether incongruous to the ſtructure and mechanical modification, that is eſſential to a body of that ſpecies

ſpecies or kind it belongs to: our naturaliſt, I ſay, knowing this, plainly perceives, that theſe cauſes of deſtruction can have no place in the rational ſoul; which being an immaterial ſpirit, and conſequently a ſubſtance not really diviſible, can have no parts expelled or tranſpoſed, and ſo being exempted from the phyſical cauſes of corruption that deſtroys bodies, ſhe ought to laſt always. And being a rational creature, endowed with internal principles of acting, as appears in free-will, ſhe ought to live for ever, unleſs it pleaſe God to annihilate her; which we have no reaſon to ſuppoſe he will do. But on the other ſide, the modern peripatetics (for I queſtion, whether *Ariſtotle* himſelf were of the ſame opinion) maintain ſubſtantial forms, by ſome of them ſtiled *ſemi ſubſtantiæ*, to which in apes, elephants, and others, that paſs for ingenious animals, they aſcribe ſome ſuch faculties and functions, as ſeem to differ but gradually from thoſe of the rational ſoul; and (how innocent ſoever I grant their intentions to be) their doctrine tends much to enervate, if not quite to diſable the chief phyſical way of probation, whence the immortality of man's mind is juſtly inferred. For ſince according to the peripatetics, ſubſtantial forms are, as they ſpeak, enduced out of the power or potentiality of the matter; and do ſo depend upon it, not only as to action, but as to being, that they cannot at all ſubſiſt without it; but when the particular body (as an herb, a ſtone, or a bird) is deſtroyed, they periſh with it, or (as ſome of them ſcarce intelligibly expreſs the ſame thing) fall back into the boſom of the matter: I think they give great advantage to atheiſts and cavillers, to impugn the mind's immortality.

FOR if to an ape, or other brute animal, there belongs a being more noble than matter, that can actuate and inform it, and make itſelf the architect of its own manſion, though ſo admirable as that of an ape, or an elephant; if this being can in the body it hath framed, perform all the functions of a vegetable ſoul; and beſides thoſe, ſee, hear, taſte, ſmell, imagine, infer, remember, love, hate, fear, hope, expect, *&c.* and yet be a mortal thing, and periſh with the body; it will not be difficult for thoſe enemies of religion, who are willing to think the ſoul mortal, becauſe their brutiſh lives make them wiſh ſhe were, to fancy, that human minds are but a ſomewhat more noble, but not for that leſs mortal kind of ſubſtantial forms, as amongſt ſenſitive ſouls themſelves, which they acknowledge to be equally mortal, there is a great diſparity in degrees, that of a monkey, for inſtance, being very far ſuperior to that of an oiſter.

III. THE third main principle of unrevealed religion, and conſequently of revealed, (which preſuppoſes natural religion, as its foundation) is a belief of the divine providence. And in this grand article, as well as in the two foregoing, a man may be much confirmed by experimental philoſophy, both as it affords him poſitive inducements to acknowledge the article, and as it ſhews the great improbability of the two main grounds, on one or other of which (for they are not well conſiſtent) is founded the denial of God's providence.

A VIRTUOSO, that by manifold and curious experiments ſearches deep into the nature of things, has great and peculiar advantages to diſcover and obſerve the excellent fabric of the world, as it is an immenſe aggregate of the ſeveral creatures that compoſe it; and to take notice in its particular parts, eſpecially thoſe that are animated, of ſuch exquiſite contrivances, and ſuch admirable co-ordinations, and ſubordinations, in reference to each other, as lye hid from thoſe beholders, that are not both attentive and ſkilful. When our virtuoſo contemplates the vaſtneſs, ſcarce conceivable ſwiftneſs, and yet conſtant regularity of the various motions of the ſun, moon, and other celeſtial lights; when he conſiders, how the magnetiſm of the earth makes its poles conſtantly look the ſame way, notwithſtanding the motions of its fluid vortex; how by daily turning about its own center in four and twenty hours, it receives as much light, and benefit

benefit from the ſun, and all the glorious conſtellations of the firmament, as if they, with all the vaſt heavenly region they belong to, moved about it in the ſame time; how by its ſituation among them it enjoys the regular viciſſitudes of day and night, ſummer and winter, *&c.* how the ſeveral parts of the ſublunary world are mutually ſubſervient to one another, and moſt of them (one way or other) ſerviceable to man; how excellently the bodies of animals are contrived; what various and congruous proviſion is made for differing animals, that they may ſubſiſt as long as they ſhould, according to the inſtitution of nature, by furniſhing them, according to their reſpective natures, ſome with ſtrength to take their food by force, others with induſtry to procure it by ſubtilty, ſome with arms, as horns, hoofs, ſcales, tuſks, poiſons, ſtings, *&c.* to defend themſelves, and offend their enemies; ſome with wings or ſwiftneſs to fly from dangers; ſome with foreſight to prevent them; ſome with craft, and perhaps ſtrange fetches of it, to elude them; how being diſtinguiſhed into two ſexes, each of theſe is furniſhed with appoſite organs for the propagation of the ſpecies, and with ſkill and kindneſs to nouriſh and train up their young ones, till they can ſhift for themſelves; how admirable, and indeed aſtoniſhing, a proceſs is gone through in the formation of the fœtus, eſpecially of a human one; how divers animals are endowed with ſtrange inſtincts, whoſe effects ſometimes ſeem much to ſurpaſs thoſe of reaſon itſelf; though they are ſuperadded to the mechanical ſtructure of the animal, and argue a reſpect to things very remote from it, either in time, place, or both, and perhaps alſo to the grand fabric or ſyſtem of the world, and the general œconomy of nature. When, as I was ſaying, a philoſopher duly reflects on theſe things, and many others of the like import, he will think it highly rational to infer from them theſe three concluſions.

FIRST, that a machine ſo immenſe, ſo beautiful, ſo well contrived, and, in a word, ſo admirable as the world, cannot have been the effect of mere chance, or the tumultuous juſtlings and fortuitous concourſe of atoms, but muſt have been produced by a cauſe exceedingly powerful, wiſe, and beneficent.

SECONDLY, that this moſt potent Author, and (if I may ſo ſpeak) Opificer of the world, hath not abandoned a maſter-piece ſo worthy of Him, but does ſtill maintain and preſerve it, ſo regulating the ſtupendiouſly ſwift motions of the great globes, and other vaſt maſſes of the mundane matter, that they do not, by any notable irregularity, diſorder the grand ſyſtem of the univerſe, and reduce it to a kind of chaos, or confuſed ſtate of ſhuffled and depraved things.

THIRDLY, that as it is not above the ability of the divine author of things, though a ſingle being, to preſerve and govern all his viſible works, how great and numerous ſoever; ſo he thinks it not below his dignity and majeſty, to extend his care and beneficence to particular bodies, and even to the meaneſt creatures; providing not only for the nouriſhment, but for the propagation of ſpiders and ants themſelves. And indeed, ſince the truth of this aſſertion, that God governs the world he has made, would appear (if it did not by other proofs) by the conſtancy and regularity, and aſtoniſhing rapid motions of the vaſt celeſtial bodies, and by the long trains of as admirable as neceſſary artifices, that are employed to the propagation of various ſorts of animals, whether viviparous, or oviparous; I ſee not, why it ſhould be denied, that God's providence may reach to his particular works here below, eſpecially to the nobleſt of them, man; ſince moſt of thoſe learned men, that deny this, as derogatory to God's majeſty and happineſs, acknowledge, that at the firſt creation, or (if they diſlike that term) formation of things, the great author of them muſt not only have extended his care to the grand ſyſtem of the univerſe in general, but allowed it to deſcend ſo low, as to contrive all the minute and various parts, (and even the moſt homely ones) not only of greater

and (reputedly) more perfect animals, as elephants, whales, and men; but ſuch ſmall and abject ones, as flies, ants, fleas, *&c.* which being manifeſtly propagated by eggs laid by the female, cannot reaſonably be thought the off-ſpring of putrefaction. Whence I gather, as from matter of fact, that to be concerned for the welfare, even of particular animals, as it is agreeable to God's all-pervading wiſdom, and exuberant beneficence; ſo (whatever men's vanity may make them ſurmiſe) it is not truly derogatory to his adorable greatneſs and majeſty.

AND on this occaſion, I ſhall add, that ſince man is the nobleſt of God's viſible works; ſince very many of them ſeem made for his uſe; ſince, even as an animal, he is (as the Pſalmiſt truly ſpeaks) "wonderfully made," and curiouſly or artificially wrought; and ſince God has both given him a rational mind, and endowed it with an intellect, whereby he can contemplate the works of nature, and by them acquire a conviction of the exiſtence, and divers attributes, of their ſupremely perfect author; ſince God hath planted notions and principles in the mind of man, fit to make him ſenſible, that he ought to adore God, as the moſt perfect of beings, the ſupreme lord and governor of the world, the author of his own nature, and all his enjoyments; ſince all this, I ſay, is ſo, natural reaſon dictates to him, that he ought to expreſs the ſentiments he has for this divine being, by veneration of his excellencies; by gratitude for his benefits; by humiliation, in view of his greatneſs and majeſty; by an awe of his juſtice; by reliance on his power and goodneſs, when he duly endeavours to ſerve and pleaſe him; and, in ſhort, by thoſe ſeveral acts of natural religion, that reaſon ſhews to be ſuitable, and therefore due to thoſe ſeveral divine attributes of his, which it has led us to the knowledge of.

Pſalm cxxxviii. 14, 15.

AND here I ſhall take leave to add, that, from the Carteſian principles (which you know are embraced by a great part of the modern virtuoſi) I think, I may draw a double argument for divine providence.

FOR firſt, according to the Carteſians, all local motion (which is, under God, the grand principle of all actions among things corporeal) is adventitious to matter, and was at firſt produced in it, and is ſtill every moment continued and preſerved immediately by God: whence may be inferred, that he concurs to the actions of each particular agent (as they are phyſical) and conſequently, that his providence reaches to all and every one of them,

AND ſecondly, the ſame Carteſians believe the rational ſoul to be an immaterial ſubſtance, really diſtinct and ſeparable from the body. Whence I infer, that the divine providence extends to every particular man; ſince whenever an embryo, or little human body formed in the womb, is, by being duly organiſed, fitted to receive a rational mind, God is pleaſed to create one, and unite it with that body. In which tranſaction, there ſeems to me a neceſſity of a direct and particular intervention of the divine power; ſince I underſtand not, by what phyſical charm or ſpell an immaterial ſubſtance can be allured into this or that particular embryo, of many that are at the ſame time fitted to receive a human ſoul; nor by what merely mechanical tie, or band, an immaterial ſubſtance can be ſo durably (perhaps for 80 or 100 years) joined and united with a corporeal, in which it finds no parts, that it has organs to take hold of, and to which it can furniſh no parts to be faſtened upon by them. Nor do I better conceive, how a mere body can produce pain, pleaſure, *&c.* by its own mere action, or rather endeavour to act, on an immaterial ſpirit. Nor will the force of all that has been ſaid for God's ſpecial providence, be eluded, by ſaying, with ſome deiſts, that after the firſt formation of the univerſe, all things are brought to paſs by the ſettled laws of nature. For though this be confidently, and not without colour pretended; yet, I confeſs, it does not ſatisfy me. For, beſide the inſuperable difficulty there

there is, to give an account of the firſt formation of things, which many (eſpecially Ariſtotelian) deiſts will not aſcribe to God; and beſides that the laws of motion, without which the preſent ſtate and courſe of things could not be maintained, did not neceſſarily ſpring from the nature of matter, but depended upon the will of the divine author of things: beſides this, I ſay, I look upon a law as a moral, not a phyſical cauſe, as being indeed but a notional thing, according to which, an intelligent and free agent is bound to regulate its actions. But inanimate bodies are utterly incapable of underſtanding what a law is, or what it enjoins, or when they act conformably or unconformably to it; and therefore the actions of inanimate bodies, which cannot incite or moderate their own actions, are produced by real power, not by laws; though the agents, if intelligent, may regulate the exertions of their power by ſettled rules.

IV. I HAVE taken notice of two other accounts, upon which the experimental knowledge of God's works may, in a well-diſpoſed mind, conduce to eſtabliſh the belief of his providence; and therefore, though I ſhall not dwell long upon them, I muſt not altogether pretermit them.

FIRST then, when our virtuoſo ſees how many, and how various, and oftentimes how ſtrange, and how admirable ſtructures, inſtincts, and other artifices, the wiſe Opificer hath furniſhed even brutes and plants withal, to purchaſe and aſſimilate their food, to defend or otherwiſe ſecure themſelves from hoſtile things, and (to be ſhort) to maintain their lives, and propagate their ſpecies; it will very much conduce to perſuade him, that ſo wiſe an Agent, who has at command ſo many differing and excellent methods and tools, to accompliſh what he deſigns, and does oftentimes actually employ them, for the preſervation and welfare of beaſts, and even of plants, can never want means to compaſs his moſt wiſe and juſt ends, in relation to mankind; being able, by ways that we ſhould never dream of, to execute his menaces, and fulfil his promiſes. But of theſe rare ſtructures, inſtincts, and other methods, and, if I may ſo ſtile ſome of them with reverence, ſtratagems and fetches of divine ſkill, that God is pleaſed to employ in the conduct of the viſible world, eſpecially animals, I have already elſewhere purpoſely diſcourſed; and therefore ſhall now proceed, and obſerve, in the ſecond place, that, when we duly conſider the very differing ends, to which many of God's particular works, eſpecially thoſe that are animated, ſeem deſigned, in reference both to their own welfare, and the utility of man; and with how much wiſdom, and, I had almoſt ſaid, care, the glorious Creator has been pleaſed to ſupply them with means admirably fit for the attainment of theſe reſpective ends; we cannot but think it highly probable, that ſo wiſe, and ſo benign a Being has not left his nobleſt viſible creature, man, unfurniſhed with means to procure his own welfare, and obtain his true end, if he be not culpably wanting to himſelf. And ſince man is endowed with reaſon, which may convince him (of what neither a plant, nor brute animal is capable of knowing, namely) that God is both his maker, and his continual benefactor; ſince his reaſon likewiſe teacheth him, that upon both thoſe accounts, beſides others, God may juſtly expect and require worſhip and obedience from him; ſince alſo the ſame rational faculty may perſuade him, that it may well become the majeſty and wiſdom of God, as the ſovereign rector of the world, to give a law to man, who is a rational creature, capable of underſtanding and obeying it, and thereby glorifying the author of it; ſince (farthermore) finding in his own mind (if it be not depraved by vice, or luſts) a principle, that dictates to him, that he owes a veneration, and other ſuitable ſentiments, to the divinely excellent author of his being, and his continual and munificent benefactor; ſince, on theſe ſcores, his conſcience will convince him of his obligation to all the eſſential duties of natural religion; and ſince, laſtly,

his reaſon may convine him, that his ſoul is immortal, and is therefore capable, as well as deſirous, to be everlaſtingly happy, after it has left the body; he muſt in reaſon be ſtrongly inclined to wiſh for a ſupernatural diſcovery of what God would have him believe and do. And therefore if, being thus prepared, he ſhall be very credibly informed, that God hath actually been pleaſed to diſcover by ſupernatural revelation (what, by reaſon, without it, he can either not at all, or but rovingly, gueſs at) what kind of worſhip and obedience will be moſt acceptable to him; and to encourage man to both theſe, by explicit promiſes of that felicity, that man, without them, can but faintly hope for; he would be ready then thankfully to acknowledge, that this way of proceeding beſeems the tranſcendent goodneſs of God, without derogating from his majeſty and wiſdom. And by theſe and the like reflections, whereof ſome were formerly intimated, a philoſopher, that takes notice of the wonderful providence, that God deſcends to exerciſe for the welfare of inferior and irrational creatures, will have an advantage above men not verſed in the works and courſe of nature, to believe, upon the hiſtorical and other proofs, that Chriſtianity offers, that God has actually vouchſafed to man, his nobleſt, and only rational viſible creature, an explicit and poſitive law, enforced by threatning ſevere penalties to the ſtubborn tranſgreſſors; and promiſing to the ſincere obeyers rewards ſuitable to his own greatneſs and goodneſs. And thus the conſideration of God's providence, in the conduct of things corporeal, may prove, to a well-diſpoſed contemplator, a bridge, whereon he may paſs from natural to revealed religion.

I HAVE been the more particular and expreſs, in what I have ſaid about divine providence, becauſe I did not find other writers had made it needleſs for me to do ſo. And I dwelt the longer upon the exiſtence of the Deity, and the immortality of the ſoul, that I might let you ſee, that I did not ſpeak groundleſsly, or raſhly, but, that I had conſidered what I ſaid, when I aſſerted, that the experimental philoſophy might afford a well-diſpoſed mind conſiderable helps to natural religion. I find myſelf therefore now at liberty to proceed to farther conſiderations, and repreſent to you, that,

V. ANOTHER thing, that diſpoſes an experimentarian philoſopher to embrace religion, is, that his genius and courſe of ſtudies accuſtoms him to value and delight in abſtracted truths; by which term, I here mean ſuch truths, as do not at all, or do but very little, gratify mens ambition, ſenſuality, or other inferior paſſions and appetites. For, whereas the generality of thoſe, that are averſe from religion, are enclined to be ſo, upon this account (among others) that they have a contempt or undervaluation of all truths, that do not gratify their paſſions or intereſts; he, that is addicted to knowledge experimental, is accuſtomed both to purſue, eſteem and reliſh many truths, that do not delight his ſenſes, or gratify his paſſions, or his intereſts, but only entertain his underſtanding with that manly and ſpiritual ſatisfaction, that is naturally afforded it by the attainment of clear and noble truths, which are its genuine objects and delights. And though I grant, that the diſcoveries made by the help of phyſical or mechanical experiments are not, for the moſt part, of kin to religion; yet, beſides that ſome of them do manifeſtly conduce to eſtabliſh or illuſtrate natural theology, which is that (as, though noted already, deſerves to be inculcated) which revealed religion, and conſequently, that of Chriſtians, muſt be founded on, or muſt ſuppoſe: beſides this, I ſay, we may argue *à fortiori*, that he, that is accuſtomed to prize truths of an inferior kind, becauſe they are truths, will be much more diſpoſed to value divine truths, which are of a much higher and nobler order, and of an ineſtimable and eternal advantage.

VI. THERE is another thing, that is too pertinent to the main ſcope of this diſcourſe to be here pretermitted: and it is, that both the temper of mind, that makes a man moſt

moſt proper to be a virtuoſo, and the way of philoſophiſing he chiefly employs, conduce much to give him a ſufficient, and yet well grounded and duly limited docility, which is a great diſpoſition to the entertainment of revealed religion. In the vulgar and ſuperficial philoſophy, wherein a man is allowed to think, that he has done his part well enough, when he has aſcribed things to a ſubſtantial form, or to nature, or to ſome real quality, whether manifeſt or occult, without proving, that there are ſuch cauſes, or intelligibly declaring, how they produce the phænomena, or effects referred to them; in this philoſophy, I ſay, it is eaſy for a man to have a great opinion of his own knowledge, and be puffed up by it. But a virtuoſo, that cannot ſatisfy himſelf, nor dares pretend to ſatisfy others, till he can by hypotheſes, that may be underſtood and proved, declare intelligibly the manner of the operation of the cauſes he aſſigns, will often find it ſo difficult a taſk to do ſo, that he will eaſily diſcern, that he needs further information, and therefore ought to ſeek for it where it is the moſt likely to be had; and not only to admit, but welcome it if he finds it. Beſides, the litigious philoſophy of the ſchools ſeldom furniſhes its diſciples with better than dialectical or probable arguments, which are not proper, either fully to ſatisfy the perſon that employs them, or leave his adverſary without any anſwer, plauſible at leaſt, if not full as probable as the objection, upon which account, men, that have more wit than ſincere love of truth, will be able to diſpute ſpeciouſly enough, as long as they have a mind to do ſo. And as ſuch ſlippery arguments are not able to convince even him that employs them, if he be a man of judgment; ſo if he deals with a witty adverſary, they will leave him to elude any arguments of the like nature, with which he ſhall be preſſed. And in effect we ſee, that in the Ariſtotelian philoſophy there are divers queſtions, ſuch as, whether the elements retain their diſtinct nature in a mixed body? Whether the celeſtial orbs are moved by intelligences? To omit many others, which are as it were ſtated queſtions; and as they have been diſputed from age to age, are like to continue queſtions for many more, if that philoſophy laſt ſo long. But a virtuoſo, that is wont in his reaſonings to attend to the principles of mathematics, and ſound philoſophy, and to the clear teſtimonies of ſenſe, or well verified experiments, acquires a habit of diſcerning the cogency of an argument, or way of probation, and eaſily diſcerns, that dialectical ſubtilties and ſchool tricks cannot ſhift off its force, but finds more ſatisfaction in embracing a demonſtrated truth, than in the vain glory of diſputing ſubtilly againſt it.

VII. ANOTHER thing, that may diſpoſe a ſtudious ſearcher of truth, (not by ſpeculations only, but) by experiments, for theology, is, that his inquiſitiveneſs, and courſe of ſtudies, makes him both willing and fit to ſearch out and diſcover deep and unobvious truths. I have with trouble obſerved, that the greater part of the libertines we have among us, being men of *Pilate*'s humour, (who, when he had ſcornfully aſked what is truth? would not ſtay for an anſwer) do with great faſtidiouſneſs decline the ſtudy of all truths, that require a ſerious and ſettled application of mind. Theſe men are, for the moſt part, a ſort of ſuperficial and deſultory wits, that go no further than the outſide of things, without penetrating into the receſſes of them; and being eaſily tired with contemplating one, paſs quickly to another; the conſideration whereof they with the ſame lightneſs forſake. And upon this account, among others, it is, that this ſort of men, though often much applauded by others, becauſe the moſt are but ſuperficial, as well as they, do almoſt as ſeldom make good philoſophers, as good Chriſtians. For though all the good arguments, that may be brought to evince the truth of natural (and revealed) religion, be not abſtruſe; yet ſome of the chief ones, eſpecially thoſe, that prove the exiſtence and ſpecial providence of God, and the ſoul's immortality, are, if not of a metaphyſical, yet at leaſt of a philoſophical nature; and

About some causes of atheism.

will ſcarce be clearly underſtood, and duly reliſhed, but by a perſon capable of, and ſomewhat accuſtomed to attentive and laſting ſpeculations, (as in another paper has been more fully declared.) But now, a man addicted to proſecute diſcoveries of truths, not only by ſerious meditation, but by intricate and laborious experiments, will not eaſily be deterred from effectually proſecuting his end, by the troubleſomeneſs or difficulties that attend the clearing of thoſe notions, and matters of fact, whereon ſolid arguments for natural or revealed religion are founded; how remote ſoever thoſe truths may be from vulgar apprehenſions. In ſhort, whereas a ſuperficial wit, ſuch as is frequently found in libertines, and often helps to make them ſuch, may be compared to an ordinary ſwimmer, who can reach but ſuch things as float upon the water; an experimental philoſopher may be compared to a ſkilful diver, that cannot only fetch thoſe things, that lie upon the ſurface of the ſea, but make his way to the very bottom of it, and thence fetch up pearls, corals, and other precious things, that in thoſe depths lie concealed from other men's ſight and reach.

WE have already ſeen, that experimental philoſophy is, in its own nature, friendly to religion in general.

WHEREFORE I ſhall now add, that the reverence I pay experience, eſpecially as it gives both grounds and hints to rational notions and concluſions, does not a little conduce to the aſſent I give to the truth of the Chriſtian religion in particular.

THIS excellent religion is recommended to well-diſpoſed minds by a greater number of prerogatives, and other arguments, than it were proper for me to inſiſt on in this diſcourſe: and yet my deſign engages me to conſider a few of them ſomewhat particularly.

AND firſt, I ſhall obſerve, that whereas the three grand arguments, that jointly evince the truth of the Chriſtian religion in general, are (at leaſt in my opinion) the excellency of the doctrine, which makes it worthy to have proceeded from God; the teſtimony of the divine miracles, that were wrought to recommend it; the great effects produced in the world by it; two of theſe three arguments (for the firſt is of a more ſpeculative nature) are bottomed upon matters of fact, and conſequently are likely to be the moſt prevalent upon thoſe, that have a great veneration for experience, and are duly diſpoſed to frame ſuch pious reflections, as it warrants and leads them to make. This laſt clauſe I add, becauſe, though I have formerly more than intimated ſomething of the like import, yet it is ſo neceſſary to my deſign, that you ſhould take ſpecial notice of it, that I muſt not here omit to advertiſe you, that when, in this diſcourſe, I ſpeak of an experimental philoſopher, or virtuoſo; I do not mean, either on this hand, a libertine, though ingenious, or a ſenſualiſt, though curious; or on that hand, a mere empiric, or ſome vulgar chemiſt, that looks upon nothing as experimental, wherein chemiſtry, mechanics, *&c.* are not employed; and who too often makes experiments, without making reflection on them, as having it more in his aim to produce effects, than to diſcover truths. But the perſon I here mean, is ſuch a one, as by attentively looking about him, gathers experience, not from his own trials alone, but from divers other matters of fact, which he heedfully obſerves, though he had no ſhare in the effecting them; and on which he is diſpoſed to make ſuch reflections, as may (unforcedly) be applied to confirm and encreaſe in him the ſentiments of natural religion, and facilitate his ſubmiſſion and adherence to the Chriſtian religion.

AN experimental philoſopher thus diſpoſed, will, with the divine aſſiſtance, (which he will be careful to implore) find pregnant motives to the belief of Chriſtianity, in the two laſt of the three arguments of its truth, that I lately propoſed. That which is drawn from the effects of this religion in the world, as it is laſt named, ſo I ſhall defer

defer the conſideration of it, till I have treated of the other, namely, the teſtimony of divine miracles, whoſe difficulty makes it requiſite for us to conſider it the more attentively, and diſtinctly declare the grounds, upon which experience may be eſteemed a good topic on the preſent occaſion. For the clearing of this matter, I ſhall repreſent to you, that the word experience may admit of divers ſenſes, whereof one is far more comprehenſive than another, and likewiſe of ſeveral diviſions and diſtributions. For beſides its more reſtrained acceptation, it is ſometimes ſet in contradiſtinction to reaſon, ſo as to comprehend, not only thoſe phænomena, that nature or art exhibits to our outward ſenſes, but thoſe things, that we perceive to paſs within ourſelves; and all thoſe ways of information, whereby we attain any knowledge that we do not owe to abſtracted reaſon. So that, without ſtretching the word to the utmoſt extent of which it is capable, and to which it has been enlarged; it may be looked upon as ſo comprehenſive a term, that I think it may be of ſome importance to my preſent deſign, and perhaps to theology itſelf, to propoſe to you a diſtribution of experience, that will not, I hope, be found uſeleſs to clear the extent of that term. I ſhall then take the freedom to enlarge the ſignification of the word beyond its commoneſt limits, and divide it, for diſtinction's ſake, into immediate and vicarious experience; or rather ſomewhat leſs compendiouſly, but perhaps more commodiouſly, into perſonal, hiſtorical, and ſupernatural, (which may be alſo ſtiled theological;) referring the firſt of the three members of this diſtribution to immediate experience, and the two others to vicarious.

I CALL that perſonal experience, which a man acquires immediately by himſelf, and accrues to him by his own ſenſations, or the exerciſe of his faculties, without the intervention of any external teſtimony. It is by this experience, that we know, that the ſun is bright; fire hot; ſnow cold and white; that upon the want of aliments we feel hunger; that we hope for future goods; that we love what we judge good, and hate what we think evil; and diſcern, that there is a great difference between a triangle and a circle, and can diſtinguiſh them by it.

BY hiſtorical experience I mean that, which, though it were perſonal in ſome other man, is but by his relation or teſtimony, whether immediately or mediately, conveyed to us. It is by this, that we know, that there were ſuch men as *Julius Cæſar*, and *William the Conqueror*, and that *Joſeph* knew that *Pharoah* had a dream, which the Egyptian wiſe men could not expound.

BY theological experience I mean that, by which we know, what, ſuppoſing there is ſome divine revelation, God is pleaſed to relate or declare concerning himſelf, his attributes, his actions, his will, or his purpoſes, whether immediately, (or without the intervention of man) as he ſometimes did to *Job* and *Moſes*, and conſtantly to Chriſt our Saviour; or by the intervention of angels, prophets, apoſtles, or inſpired perſons, as he did to the Iſraelites, and the primitive Chriſtian church; and does ſtill to us, by thoſe written teſtimonies we call the Scriptures.

BY perſonal experience we know, that there are ſtars in heaven; by hiſtorical experience we know, that there was a new ſtar ſeen by *Tycho* and other aſtronomers in *Caſſiopæa*, in the year 1572, and by theological experience we know, that the ſtars were made on the fourth day of the creation.

BY this you may ſee, that I do not in this diſcourſe take experience in the ſtricteſt ſenſe of all, but in a greater latitude, for the knowledge we have of any matter of fact, which, without owing it to ratiocination, either we acquire by the immediate teſtimony of our own ſenſes and other faculties, or accrues to us by the communicated teſtimony of others. And I make the leſs ſcruple to take this liberty, becauſe I obſerve, that even in common acceptation, the word experience is not always meant of

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that which is immediate, but is often taken in a latitude. As when we ſay, that experience teaches us, who perhaps were never out of *England*, that the torrid zone is habitable and inhabited; and perſuades learned men, that never had opportunity to make nice celeſtial obſervations, that ſtars may be generated and periſh, or at leaſt begin to appear, and then diſappear in the celeſtial region of the world. And on this kind of hiſtorical experience, conſiſting of the perſonal obſervations of *Hippocrates*, *Galen*, and other phyſicians, tranſmitted to us, a great part of the practice of phyſic is founded. And the moſt rational phyſicians reckon upon, as matters of fact, not only what other phyſicians have left upon record, but divers preſent things, which themſelves can know but by the relation of their patients; as that a man has a particular antipathy to ſuch a thing, which the doctor perhaps judges fit for him to uſe; or that a woman with child longs for this or that determinate thing. And phyſicians reduce theſe and the like matters of fact to experience, as to one of the two columns of phyſic diſtinguiſhed from reaſon.

SINCE then learned men, as well as common uſe, confine not the appearance of the word experience to that which is perſonal, but employ it in a far greater latitude, I ſee not, why that, which I call theological experience, may not be admitted; ſince the revelations, that God makes concerning what he has done, or purpoſes to do, are but teſtimonies of things, moſt of them matters of fact, and all of them ſuch, as ſo far forth as they are merely revelations, cannot be known by reaſoning, but by teſtimony: whoſe being divine, and relating to theological ſubjects, does not alter its nature, though it give it a peculiar and ſupereminent authority.

HAVING premiſed and cleared the propoſed diſtribution of experience, it will now be ſeaſonable to conſider, how it may be applied to the matters of fact, that recommend the credibility of the Chriſtian religion; and on this occaſion I ſhall diſtinctly offer you my thoughts in the two following propoſitions.

PROP. I. "We ought to believe divers things upon the information of experience, "(whether immediate, or vicarious) which, without that information, we ſhould judge "unfit to be believed, or antecedently to it did actually judge contrary to reaſon."

THIS propoſition may be underſtood, either of perſons, or of things, and will hold true as to both.

AND firſt, as to perſons; if your own obſervation of what occurs among mankind do not ſatisfy you, that we are obliged, after ſufficient trial, frequently to alter the opinions, which upon probable reaſons we had before entertained, of the fidelity, or prudence, or juſtice, or chaſtity, *&c.* of this or that perſon; I ſhall refer you to the records of hiſtory, or appeal to the tribunals of judges. For both in the one, and at the other, you will find but too many inſtances and proofs from matters of fact, that perſons looked on, even by intelligent men, as honeſt, virtuous, and perhaps holy too, have proved guilty of falſeneſs to their friends, perfidiouſneſs to their princes, diſloyalty to their huſbands or wives, injuſtice to their neighbours, ſacrilege, perjury, or other impieties to their God: and in the courts of juſtice, you will find a great part of the time employed to detect and puniſh, not only civil tranſgreſſions, as thefts, cheats, forgery, falſe-witneſs, adultery, and the like heinous crimes, perpetrated by thoſe, that before they were thoroughly ſifted, paſſed for honeſt; but you will find ſins againſt nature, ſuch as ſodomy, and other unnatural luſts, the murders of parents by their children, and innocent children by their parents, nay, ſelf-murder too; though this be a crime, which cannot be acted without a violation of what ſeems the moſt univerſal and radicated law of nature, (and is acknowledged ſo by

wicked men) ſelf-preſervation. But it will not be neceſſary more ſolicitouſly to prove, that we ought, upon the teſtimony of experience, to change the opinions we thought we had rationally taken up of perſons; and therefore I ſhall now proceed to make good the propoſition in the ſenſe I chiefly intended, which is as it relates to things.

IF experience did not both inform and certify us, who would believe, that a light black powder ſhould be able, being duly managed, to throw down ſtone walls, and blow up whole caſtles and rocks themſelves, and do thoſe other ſtupendous things, that we ſee actually performed by gun-powder, made uſe of in ordnance, and in mines? Who would think, that two or three grains of opium ſhould ſo ſtupify a whole body, as to force a ſleep, and oftentimes even without that ſuſpend the ſharpeſt torments in the cholic, gout, and other the moſt painful diſeaſes, and that in patients of quite different ages, ſexes, and conſtitutions, in whom alſo the diſeaſes are produced by differing, or even by contrary cauſes? Who would believe, that the poiſon, adhering to the tooth of a mad dog, though perhaps ſo little as to be ſcarce diſcernable by ſenſe, ſhould be able, after the ſlight hurt is quite healed, to continue in the warm and ſtill perſpirable body of the bitten perſon, not only for ſome days or months, but ſometimes for very many years? And after having lurked all that while, without giving any trouble to the patient, ſhould on a ſudden pervert the whole oeconomy of his body, and put him into a madneſs like that of the dog that bit him, diſcovering itſelf by that as admirable as fatal ſymptom of hydrophobia.

BUT, beſides a multitude of inſtances, that may be given of truths, that, were it not for experience, we ſhould refuſe to believe; becauſe the ſmall ſtrength of ſuch agents ſeems altogether diſproportionate to the effects aſcribed to them; many other inſtances might be alledged, wherein we aſſent to experience, even when its informations ſeem contrary to reaſon, and that which, perhaps, we did actually and without ſcruple take to be true.

SINCE gravity is the principle, that determines falling bodies to move towards the center of the earth; it ſeems very rational to believe, with the generality of philoſophers, that therein follow *Ariſtotle*, that, in proportion as one body is more heavy than another, ſo it ſhall fall to the ground faſter than the other. Whence it has been, eſpecially by ſome of the peripatetic ſchool, inferred, that of two homogeneous bodies, whereof one does, for example, weigh ten pounds, and the other but one pound, the former being let fall from the ſame height, and at the ſame time, with the latter, will reach the ground ten times ſooner.

BUT notwithſtanding this plauſible ratiocination, experience ſhews us (and I have purpoſely tried it) that (at leaſt in moderate heights, ſuch as thoſe of our towers, and other elevated buildings) bodies of very unequal weight, let fall together, will reach the ground at the ſame time, or ſo near it, that it is not eaſy to perceive any difference in the velocity of their deſcent.

IT is generally taken for granted by naturaliſts, as well as others, that ſtrong and loud noiſes, as they are heard much farther off than fainter ſounds, ſo, if the ſonorous bodies be equally diſtant from the ear, the very ſtrong ſound will arrive much ſooner at it, than the other. And yet by the experiments of the moderns about the velocity of ſounds (in making divers of which, I have endeavoured to be accurate) it appears, that weaker ſounds are (at leaſt as to ſenſe) tranſmitted through the air as ſwiftly as ſtronger ones. And indeed, it is often obſerved, that when cannons and muſkets are diſcharged together, the noiſes of both arrive alſo together at the ear; which would not be, if the ſound of a cannon were any thing near as much ſwifter, as it is louder, than that of a muſket.

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IT ſeems irrational to conceive, that a ſmaller and weaker loadſtone may draw away a piece of ſteel from a larger and ſtronger; and yet experience (which both others and I have made) evinces, that in ſome caſes this paradox is a truth.

IT has generally, by philoſophers as well as other men, been looked upon as manifeſt, and conſonant to reaſon, that cold condenſes water more or leſs, according as the degree of the cold is; and conſequently that ice is water reduced into a leſſer volume. But it is plain, by experiments carefully made (ſome of which I have elſewhere publiſhed) that by glaciation, water is rather expanded; or at leaſt, that ice takes up more room, than the water did before it was congealed. And of this ſort of inſtances, where we believe, upon the authority of experience, things, that are contrary to what we ſhould otherwiſe judge to be a dictate or concluſion of reaſon; I could add many, if I thought it as needful in this place, as in ſome other papers, where I have given them already.

An eſſay of improbable truths.

AND now it will be ſeaſonable to put you in mind, that in one part of the propoſition, hitherto diſcourſed of, it appears, that I deſigned to extend the force of the arguments, grounded upon experience, to that, which is not immediate, but vicarious; that is, not perſonally our own, but communicated by others; provided it be competently atteſted, and duly conveyed to us.

THERE will need but a little reflection on what is judged reaſonable, and freely practiſed, by philoſophers themſelves, to juſtify this propoſition. For how many concluſions have the modern naturaliſts admitted, though not only abſtracted reaſon never led men to make them, but plauſible arguments, and the notions and axioms of the moſt generally received philoſophy were repugnant to them. Thus, that in heaven itſelf there ſhould be generations and corruptions, was not only unobſerved before the time of *Ariſtotle* (who thence argues the incorruptibility of cœleſtial bodies) but is contradicted by his arguments; and yet both many others, and I, have ſeen great ſpots (perhaps bigger than *England*, or than *Europe* itſelf) generated and diſſipated on or near the ſurface of the ſun; and ſeveral of the modern philoſophers and aſtronomers, having never had the good fortune to ſee any of theſe (which indeed of late years have but rarely appeared) muſt take theſe phænomena upon the credit of thoſe that have obſerved them. And much more muſt they do ſo, who, in ſpite of the vulgar philoſophy, which made all comets ſublunary, believe, there were celeſtial, and perhaps firmamentary, comets. For, that they were above the concave of the moon's orb, we muſt believe upon the affirmation of thoſe that obſerved them, which very few have done themſelves. And the height of the famous comet, or diſappearing ſtar, in *Caſſiopæa*, in the year 1572, whereon ſo much ſtreſs is laid by our philoſophers and mathematicians, is admitted and urged, chiefly upon the belief they have, not only of *Tycho*'s veracity, but his ſkill in obſerving the motions and phænomena of that celeſtial light, and particularly its having no parallax.

IN ſhort, the great architect of experimental hiſtory, Sir *Francis Bacon*, when he divides it but into three parts, aſſigns the ſecond of them to what he calls præter-generations, ſuch as monſters, prodigies, and other things; which being (as to us) but caſualties, all thoſe that happened in other times and places than we have lived in (and thoſe will be confeſſed to be incomparably more than any of us has perſonally obſerved) we muſt take upon the credit of others. And yet theſe (vicarious experiments) by ſuggeſting new inſtances of nature's power, and uncommon ways of working; and by overthrowing, or limiting, received rules and traditions, afford us a conſiderable and inſtructive part of natural hiſtory, without which, it would not be either ſo ſound, or ſo compleat.

PROP. II. After what has been hitherto diſcourſed, it may be, I hope, both ſeaſonable and warrantable to advance to, and aſſert, our ſecond propoſition; *viz.* That "we ought to have a great and particular regard to thoſe things, that are recommended to our belief, by what we have reduced to real, though ſupernatural, "experience."

FOR, 1. It is manifeſt, that the moſt rational men ſcruple not to believe, upon competent teſtimony, many things, whoſe truth did no way appear to them by the conſideration of the nature of the things themſelves; nay, though what is thus believed upon teſtimony be ſo ſtrange, and, ſetting aſide that teſtimony, would ſeem ſo irrational, that, antecedently to that teſtimony, the things at laſt admitted as truths were actually rejected as errors, or judged altogether unfit to be believed. And I muſt here deſire you to conſider, that the points, wherein experience over-rules that, which, before it ſupervened, was judged to be moſt agreeable to reaſon, concerning things merely natural or civil, whereof human reaſon is held to be a proper judge: whereas many of the points recommended by ſupernatural experience concern things of a ſuperior order; many of which are not to be adequately eſtimated by the ſame rules with things merely corporeal or civil; and ſome of which, as the eſſence and manner of exiſtence, and ſome peculiar attributes, of the infinite God, involve or require ſuch a knowledge of what is infinite, as much paſſes the reach of our limited intellects.

BUT this is not all. For, 2. You may conſider in the next place, that, whereas it is as juſtly as generally granted, that the better qualified a witneſs is in the capacity of a witneſs, the ſtronger aſſent his teſtimony deſerves; we ought, of all the things that can be recommended to us by teſtimony, to receive thoſe with the higheſt degree of aſſent, that are taught us by God, by the intervention of thoſe perſons, that appear to have been commiſſioned by him to declare his mind to men. For the two grand requiſites of a witneſs, being the knowledge he has of the things he delivers, and his faithfulneſs in truly delivering what he knows; all human teſtimony muſt on theſe accounts be inferior to divine teſtimony: ſince this (latter) is warranted both by the veracity of God (which is generally acknowledged by thoſe that believe his exiſtence) and by his boundleſs knowledge; which makes it as impoſſible He ſhould be deceived Himſelf, as the other does, that He ſhould deceive us. And, becauſe that, for the delivery of the divine teſtimony we are ſpeaking of, it has oftentimes pleaſed God, who is a moſt free (as well as a moſt wiſe) Agent, to make uſe of unpromiſing perſons as his inſtruments; I ſhall not on this occaſion altogether overlook this circumſtance, that an experimental philoſopher ſo often increaſes his knowledge of natural things, by what he learns from the obſervations and practices, even of mean (and perhaps of illiterate) perſons (ſuch as ſhepherds, plowmen, ſmiths, fowlers, *&c.*) becauſe they are converſant with the works of nature; that he is not only willing to admit, but often curious to ſeek for, informations from them; and therefore is not like to find much repugnancy in receiving the doctrines of revealed religion, ſuch as Chriſtianity, if the teachers of it were honeſt men, and had opportunity to know the truth of the things they deliver, though they were fiſhermen, tentmakers, or ſome other mean profeſſion.

AND indeed (to enlarge a little upon a ſubject, that, I fear, has ſcarce been conſidered) ſuch a perſon as our virtuoſo will, with both great willingneſs and no leſs advantage, exerciſe himſelf in peruſing, with great attention and much regard, the writings of the apoſtles, evangeliſts, and ancient prophets; notwithſtanding any meanneſs of their firſt condition, or of their ſecular employments. And, in theſe ſacred

writings, he will not only readily ſuffer himſelf to be inſtructed in theſe grand and catholic articles of religion, which, becauſe of their neceſſity or very great uſefulneſs, are to be met with in many places, and in variety of expreſſions, by honeſt and duly diſpoſed readers; but he will, inſtead of diſdaining ſuch tutors, both expect, and carefully ſtrive, to improve his knowledge of divine things in general, even by thoſe hints and incidental paſſages, that a careleſs or ordinary reader would overlook, or not expect any thing from. For, as the fecundity of the ſcriptures is not wont to be enough diſcerned, when the ſacred writers tranſiently touch upon, or glance at, a great many ſubjects, that they do not expreſly handle, and that therefore are not vulgarly taken notice of; ſo the docility we have aſcribed to our virtuoſo will make him repoſe a great deal of truſt in the teſtimony of inſpired perſons, ſuch as Chriſt and his apoſtles, about things of all ſorts, either uſually taken notice of or not, that relate to objects of a ſupernatural order; eſpecially if among theſe God Himſelf, and his purpoſes, be compriſed, ſince divers of thoſe things are not knowable without revelation, and others are beſt known by it. And to be allowed to ground a belief about ſuch things on the relations and other teſtimonies of thoſe that were, in the
Luke i. 2. ſcripture-phraſe, "eye-witneſſes and miniſters" of the things they ſpeak of, will by our virtuoſo be juſtly reputed ſuch an advantage, in order to the knowledge of things divine, as the conſulting with navigators and travellers to *America* is to him, that is curious to learn the ſtate of that new world. For an ordinary ſeaman or traveller, that had the opportunity with *Columbus* to ſail along the ſeveral coaſts of it, and paſs up and down through the country, was able at his return to inform men of an hundred things, that they ſhould never have learned by *Ariſtotle*'s philoſophy, or *Ptolemy*'s geography; and might not only acquaint them with divers particulars, conſonant to the opinions, which their formerly received phyſics and coſmography did ſuggeſt, but alſo rectify divers erroneous preſumptions and miſtakes, which till then they thought very agreeable to the dictates of thoſe ſciences, and ſo to reaſon. And as one, that had a candid and knowing friend intimate with *Columbus*, might better rely on his informations about many particulars of the natural hiſtory of thoſe parts, than on thoſe of an hundred ſchool-philoſophers, that knew but what they learned from *Ariſtotle*, *Pliny*, *Ælian*, and the like ancient naturaliſts; ſo, and much more, may we rely on the accounts given us of theological things, by the apoſtles, and conſtant attendants
John i. 18. of Him that lay in the "boſom of God his Father," and commiſſioned them to
Acts xx. 27. declare to the world "the whole counſel of God," as far as it was neceſſary for man to know.

We know, that fuller trials are allowed among ingenious men, to rectify the informations of the more imperfect ones; and therefore I ſhall add, that though the innate notions and ſentiments, that nature gives us of the attributes and mind of God, be highly to be prized; yet the informations, that theological experience affords of thoſe abſtruſe things, is far more excellent and compleat. For methinks, thoſe great
1 Cor. ii. 10. "depths of God" may be compared to the depths of the ocean. And we know, that in the ſea, there are ſome abyſſes ſo deep, that the ſeaman's ſounding-lines have never been able to reach to the bottom of them; and where they are not unfathomable, all we are wont to do, by our ſoundings, is, to fetch from the bottom ſome little gravel, or mud, or ſhells, or ſome ſuch thing, that ſticks to the tallowed end of the plummet, and gives us but a very imperfect account of the bottom, even of the ſhallower parts of the ſea: but, if a ſkilful diver be employed, he will not only tell us, whether the bottom be muddy, gravelly, or ſandy, but will be able to give us a kind of topography of that ſubmarine land, and acquaint us with many ſurpriſing particulars, that we ſhould never otherwiſe have diſcovered, or perchance ſo much.

much as dreamed of. And peradventure it may be no hyperbole to ſay, that the informations of a plummet, which reaches not to ſome depths, and brings but a very ſlender account of ſoils that lie in any, are not more ſhort of thoſe of a diver, than the informations philoſophy gives us of ſome divine things are of thoſe compleater ones, that may be had from the holy Scriptures. And when I remember, how many opinions about the ſubmarine parts, that I, among many other men, thought probable, I found cauſe to change, upon the converſation I had with a famous diver, that ſometimes, by the help of an engine, ſtayed ſeveral hours at the bottom of the ſea; I find the leſs reluctancy to ſuffer opinions about divine matters, that before ſeemed probable to me, to be rectified by the fuller diſcoveries made of thoſe things by the preachers of the goſpel.

You may find ſome things appliable to the confirmation of what has been newly delivered in an eſſay, (which you may ſee when you pleaſe) that conſiders the bounds and uſe of experience in natural philoſophy. Wherefore remembring, that before this late excurſion I was ſpeaking of miracles, I ſhall now reſume the ſubject, and proceed to tell you, that I have the more inſiſted upon the miracles, that may be pleaded to recommend the Chriſtian religion, becauſe I thought, that an argument grounded on them is little leſs than abſolutely neceſſary, to evince, that any religion, that men believe to be ſupernaturally revealed, and conſequently that the Chriſtian, does really proceed from God.

FOR, though the excellency of the Chriſtian doctrine, and other concurrent motives, may juſtly perſuade me, that it is worthy, and likely to be given by God; yet that *de facto* this doctrine comes from Him by way of ſupernatural revelation, I can ſcarce be ſufficiently aſcertained, but by the miracles wrought by Chriſt and his diſciples, to evince, that the doctrine they preached, as commiſſioned by God to do ſo, was indeed his, being as ſuch owned by Him. But theſe miracles having been wrought (when it was moſt fit and needful they ſhould be wrought) in the firſt ages of the church, we, that live at ſo great a diſtance from them, can have no knowledge of them by our own ſenſes, or immediate obſervation; but muſt believe them upon the account of the formerly mentioned hiſtorical or vicarious experience, which is afforded us by the duly tranſmitted teſtimony of thoſe, that were themſelves (to ſpeak once more in an evangeliſt's phraſe) "eye-witneſſes and miniſters" of the things they relate. And ſince we ſcruple not to believe ſuch ſtrange prodigies, as celeſtial comets, vaniſhing and re-appearing ſtars, iſlands founded by ſubterraneal fires in the ſea, darkenings of the ſun for many months together, earthquakes reaching above a thouſand miles in length, and the like amazing anomalies of nature, upon the credit of human hiſtories; I ſee not, why that vicarious experience ſhould not more be truſted, which has divers peculiar and concurrent circumſtances to confirm it, and particularly the death, that moſt of the firſt promulgators chearfully ſuffered to atteſt the truth of it, and the ſucceſs and ſpreading of the doctrine authoriſed by thoſe miracles, and received chiefly upon their account. To which things ſome perhaps would add, that it is leſs credible, that the Author of nature ſhould, for moſt weighty purpoſes, make ſtupendous alterations of the courſe of nature, than that nature herſelf, for no ſuch end, ſhould by ſuch prodigies, as are newly mentioned, as it were, throw herſelf out of her own courſe. Luke i. 2.

MIRACLES being ſo neceſſary to the eſtabliſhment of revealed religion in general, it may be looked upon as a farther diſpoſition in our virtuoſo, to receive the Chriſtian religion, that the philoſophy, he cultivates, does much conduce to enable him to judge aright of thoſe ſtrange things, that are by many propoſed as miracles, and believed to be ſo.

FOR firſt, the knowledge he has of the various (and ſometimes very wonderful) operation of ſome natural things, eſpecially when they are ſkilfully improved, and dexterouſly applied by art, particularly mathematics, mechanics, and chemiſtry, will qualify him to diſtinguiſh between things, that are only ſtrange and ſurpriſing, and thoſe that are only miraculous; ſo that he will not miſtake the effects of natural magic, for thoſe of a divine power. And by this well-inſtructed warineſs, he will be able to diſcover the ſubtil cheats and colluſions of impoſtors; by which, not only multitudes of all religions, eſpecially heathen, but even learned men of moſt religions, for want of an inſight into real philoſophy, have formerly been, or are at this day, deluded, and drawn into idolatrous, ſuperſtitious, or otherwiſe erroneous tenents or practices.

AND on the other ſide, the knowledge our virtuoſo may have of what cannot be juſtly expected or pretended from the mechanical powers of matter, will enable him to diſcern, that divers things are not produceable by them, without the intervention of an intelligent ſuperior power; on which ſcore he will frankly acknowledge, and heartily believe, divers effects to be truly miraculous, that may be plauſibly enough aſcribed to other cauſes in the vulgar philoſophy; where men are taught and wont to attribute ſtupendous unaccountable effects to ſympathy, antipathy, *fuga vacui*, ſubſtantial forms, and eſpecially to a certain being, preſumed to be almoſt infinitely potent and wiſe, which they call nature: for this is repreſented as a kind of goddeſs, whoſe power may be little leſs than boundleſs; as I remember *Galen* himſelf compares it to that of God, and ſaith, that He could not do ſuch a thing, becauſe nature cannot; and cenſures *Moſes* for ſpeaking as if he were of another mind. The whole paſſage is ſo weighty, that I thought to direct you to it in the margin; though, to comply with my haſte, I forbear to deſcribe and deſcant upon ſo prolix a one, and add to it divers other paſſages, that I have met with in famous authors; who, for want of knowing the true extent of the powers of matter and motion, left to themſelves in the ordinary courſe of things, aſcribe to natural cauſes, as they call them, ſuch effects as are beyond their reach, unleſs they be elevated by agents of a ſuperior order.

Galen, de Uſu part. lib. 11. *Cap.* 14.

I KNOW it may be objected, that the hitherto-mentioned diſpoſitions, that experimental knowledge may give a man to admit the hiſtories of the miracles recorded in the goſpel; and likewiſe to expect, that God will be able to perform the promiſes and menaces that are in his name delivered there, may be countervailed by this, that thoſe, who are ſo much acquainted with the myſteries of nature, and her various and ſtrange ways of working, as a virtuoſo may well be, may by that knowledge be ſtrongly tempted to think, that thoſe ſurpriſing things, that other men call miracles, are but effects of her power; the extent of which is not eaſily diſcerned by ordinary men, nor ſafely defined by philoſophers themſelves. But this objection being plauſible enough, to make me think it deſerved to be ſeriouſly conſidered, I took an occaſion, that was once offered me, to examine the validity of it in a paper by itſelf; and this being at your command, I ſhall refer you to it. And I hope, that in the mean time it may ſuffice to ſay, that to make it reaſonable to judge this or that particular performance a ſupernatural one, it is not at all neceſſary, that it ſurpaſs the whole power of nature, that is, of phyſical agents, provided it ſurpaſs the power of that cauſe, or that complex of cauſes, from which the effect muſt in reaſon, if it be purely natural or phyſical, be ſuppoſed to have proceeded. As for inſtance, that a fiſherman or two ſhould ſpeak other languages than their own, does not at all exceed the power of nature, if they employed a competent time in learning them. But that a great number of fiſhermen, and other illiterate perſons, ſhould all on a ſudden

ſudden become linguiſts, and in an hour's time be able to ſpeak intelligibly to a great number and variety of nations in their reſpective languages, as the new teſtament relates, that the apoſtles and their companions did on the day of pentecoſt: that gift of tongues, I ſay, was an ability, which, in thoſe circumſtances of place, time, and perſons, wherein it was exerciſed, may juſtly be concluded to have been ſupernatural or miraculous. See Acts ii.

I FEAR you will think I have dwelt too long upon the argument for Chriſtianity, drawn from that ſort of matter of fact we call miracles; though the uncommon way, that my deſign led me to repreſent them in, would not permit me to make it out in fewer words. Wherefore I ſhall now paſs on to another argument, in favour of the ſame religion, that is afforded by experience, being drawn from the ſtrangely ſucceſsful propagation, and the happy effects, of Chriſtianity in the world. But having formerly had occaſion to diſplay this argument in a ſeparate paper, which you may command a ſight of, if I ſhall not have time to annex a tranſcript of it to the latter ſheets of this firſt part of the preſent eſſay, I will refer you for more ample proof to that writing, and content myſelf in this place briefly to touch ſome of the heads, and ſubjoin a reflection or two, that you will not meet with in that paper.

IT is a notorious matter of fact, that, in leſs than half an age, the Chriſtian religion was ſpread over a great part of the then known world; inſomuch that, in a few years after it began to be preached, the apoſtle of the Gentiles could tell the Romans with joy, that their faith (*i. e.* profeſſion of the goſpel) "was ſpoken of throughout "the whole world." And in the ſecond century, *Tertullian*, and other famous witers, ſhew, that the goſpel had already numerous proſelytes in a great number of different kingdoms and provinces. But I forbear to mention what he and others have magnificently ſaid of the ſucceſs of the goſpel, becauſe I had rather refer you to the plain narratives made of it by *Euſebius*, *Socrates Scholaſticus*, and other grave authors; being of opinion, that mere hiſtorians may give, to a philoſophical reader, a more advantageous idea of the efficacy of that excellent doctrine, than eloquent orators, as ſuch, can do. The wonderful quick progreſs of this religion being aſcertained to our virtuoſo, by a thing he is ſo much ſwayed by as experience; it does not a little diſpoſe him to believe the truth of ſo prevalent a religion. For, if he conſiders the perſons, that firſt promulgated it, they were but half a ſcore of illiterate fiſhermen, and a few tent-makers and other tradeſmen. If he conſiders the means, that were employed to propagate this doctrine, he finds, that they had neither arms, nor external power, to compel men to receive it; nor riches, honours, or preferments, to bribe or allure them to it; nor were they men of philoſophical ſubtilty, to entrap or entangle the minds of their auditors. Nor did they make uſe of the pompous ornaments of rhetoric, and fetches of oratory, to inveigle or entice men; but treated of the moſt ſublime and abſtruſe matters, in a moſt plain and unaffected ſtile, as became lovers and teachers of truth. If he conſiders the nature of the doctrine, that in little time obtained ſo many proſelytes, he will find, that (inſtead of being ſuited to the natural apprehenſions or the received opinions of men; and inſtead of gratifying their corrupt affections, or complying with ſo much as their innocenteſt intereſts) it preſcribed ſuch mortifications, and ſuch great ſtrictneſs of life, and high degrees of virtue, as no legiſlator had ever dared to impoſe upon his ſubjects, nay, nor any philoſopher on his diſciples. And this doctrine was propoſed in ſuch a way, and was accompanied with predictions of ſuch hardſhips and perſecutions, that ſhould in thoſe times be the portion of its ſincere profeſſors, as if the Law-giver had deſigned rather to fright men from his doctrine, than allure them to it; ſince they could not believe what He ſaid, and foretold, to be true, without believing, that they ſhould Rom. i. 8.

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be made great ſufferers by that belief. If our virtuoſo conſiders the oppoſition made to the progreſs of the goſpel, he will find cauſe to wonder, that it could ever be ſurmounted. For the heathens, which made by far the greateſt part of the world, were deeply engaged in polytheiſm, idolatry, magical rites and ſuperſtitions, and almoſt all kind of crimes, and ſome of theſe were ſhameleſs debaucheries, which oftentimes made a part of their worſhip. And the Jews were by the corrupt leaven of the Phariſees, and the impious errors of the Sadducees, and the general miſtakes of the nation about the perſon, office, and kingdom, of the *Meſſias*; and by their dotage upon their vain traditions, and numerous ſuperſtitions grounded upon them: the Gentiles, I ſay, and the Jews, who were thoſe, that were to be converted, were, on theſe and other accounts, highly indiſpoſed to be made proſelytes. Eſpecially when they could not own themſelves to be ſuch, without expoſing their perſons to be hated and deſpiſed, their poſſeſſions to be confiſcated, their bodies to be impriſoned and tormented, and oftentimes their lives to be in as ignominious as cruel ways deſtroyed. And whilſt the ſecular magiſtrates made them ſuffer all theſe miſchiefs, the venerated prieſts, the ſubtil philoſophers, and the eloquent orators, perſuaded the world, that they deſerved yet more than they endured, and employed all their learning and wit to make the religion odious and ridiculous, as well as the embracers of it miſerable: accuſing the martyrs, and other Chriſtians, of no leſs than atheiſm, inceſt, and the inhuman ſhedding and drinking the innocent blood of infants. Theſe and the like matters of fact when our virtuoſo reflects on, and conſiders by what unpromiſing means (as far as they were but ſecular) ſuch ſeemingly inſurmountable difficulties were conquered; he cannot but by this hiſtorical experience be inclined to think, that effects, ſo diſproportionate to the viſible means, could not be brought to paſs without the peculiar aſſiſtance and extraordinary bleſſing of God: by whom thoſe ſucceſsful preachers averred themſelves to be commiſſionated. For, that the ſupernatural help, the Chriſtian doctrine appears to have had, was divine, not diabolical, will ſeem evident to our virtuoſo, from the nature, tendency, and effects of the doctrine itſelf, which expreſsly teacheth, that there is but one God; that He alone is to be worſhipped, and not idols, nor any of the heathen dæmons or deities; that the devils are wicked, apoſtate, malicious, and miſerable creatures, that are hated of God, and do extremely hate mankind; and that thoſe vices, as well as rites of worſhip, that they have eſtabliſhed in the world, were abominable to God, and would be by degrees deſtroyed by Him: as in effect they ſoon began to be in many places of the world, where the worſhippers of Chriſt caſt the devil out of his temples, out of men's veneration, and oftentimes out of their bodies too.

ONE circumſtance there is of the propagation of the goſpel, which, though it may ſeem more extrinſical than thoſe hitherto mentioned, is yet too conſiderable to be here pretermitted; ſince it is this, that the quick ſpreading and ſucceſs of the Chriſtian doctrine in the world was foretold both by the prophets of the old teſtament, and the Author and promulgators of the new. For it being notorious, that there have been divers errors and ſuperſtitions, that have with too much celerity been ſpread far and wide in the world, either by mere accidents, (as they were reputed) that were very friendly to them, or by the induſtry and artifices of men: this, I ſay, being ſo, it ought to be no ſmall ſatisfaction to equitable judges, that the quick progreſs and notable effects of the Chriſtian religion were foretold, partly by the ancient prophets, and partly by the Meſſias and his apoſtles. For by theſe accompliſhed predictions it may appear, that the wonderful ſucceſs of the goſpel was not an effect of chance, but was long before determined by divine providence, as a work fit to be dear to God, and to be accompliſhed in a wonderful way by his peculiar aſſiſtance,

(as will by and by be ſomewhat more fully declared). That the triumphs of the goſpel were foretold by ſeveral of the old prophets, may appear by their yet extant writings; ſome of which are alledged to that purpoſe by thoſe writers of the new teſtament, that were endowed with the ſame prophetic ſpirit. And if you pleaſe to conſider the paſſages cited in the margin, you will eaſily grant, that thoſe ancient inſpired writers foreſaw, that, in the days of the Meſſias, there ſhould be a great and notable converſion of the Gentiles, of ſeveral nations, to the worſhip of the only true God of Iſrael: and though God did not think fit, that thoſe predictions extant in the goſpel ſhould be ſo conſpicuous and pompouſly ſet forth, that ſpeak of the converſion, that ſhould be made, not only of the heathen world, but (of a more refractory portion of mankind) a great part of the Jewiſh nation, to the Chriſtian doctrine; yet there are divers paſſages in the new teſtament, that are real, though ſome of them unheeded, prophecies of the wonderful progreſs of the goſpel, and the large extent of the kingdom of the Meſſias. Thus Chriſt foretold, that his twelve apoſtles ſhould be his witneſſes, not only in *Judea* and *Samaria*, but to the uttermoſt parts of the earth. And according to the moſt probable explication of that text, in the xxivth of St. *Matthew*'s goſpel, which is uſually referred to the end of the world, but ſeems rather to reſpect the deſtruction of *Jeruſalem*; there is a prediction, that before "the end (of the Jewiſh polity, as well as the Moſaical œconomy) the go- "ſpel of the kingdom (of the Meſſias) ſhould be preached or proclaimed in the "whole world," (in that ſenſe of the term world, that was then much in uſe, and was employed by the evangeliſt *Luke* to ſignify the Roman world or empire.) To which may be added, that ten or twelve fiſhermen (called the apoſtles) were ſent to convert all nations to the worſhip of a crucified Perſon; which would have been a ſtrange commiſſion to be given ſuch men at that time, if their Maſter, who ſent them, had not foreſeen the ſucceſs, as well as known the truth, of the doctrine He ſent them to preach. The quick diffuſion of the Chriſtian faith, and the ſwift growth of the Chriſtian church from deſpicable beginnings to a greatneſs very diſproportionate to them, are more than intimated by what Chriſt ſays of the leaven hid in a great quantity of meal; and of the muſtard-ſeed, that quickly grows (in the hot and fertile country of *Judea*) to a wonderful bigneſs and height; ſince theſe paſſages, that perfunctory readers look on but as mere parables, were really prophecies, that quickly began to be manifeſtly fulfilled. And it may bring no ſmall authority to the predictions of the new teſtament, that, when divers of them were made, there appeared no likelihood, that they ſhould ever be made good. When a poor virgin, that was betrothed to a carpenter, confidently pronounces, that *all ages ſhould call her bleſſed*; what probability was there, that what ſhe ſaid ſhould come to paſs? And when another private woman, then living in a village, had it foretold her, that a cenſured action of hers ſhould be reported through the whole world, to her great praiſe; what ſober man, that were not a prophet, would venture to loſe his credit, by making ſuch a promiſe? And therefore, ſince we ſee ſuch unlikely predictions actually accompliſhed, it may well convince an unbiaſſed man, that the authors of them, as well as the ancient ſeers, were really endowed with a truly prophetic ſpirit; and that the events, by that foretold, were not effects of chance or policy, but of divine providence.

Gen. xlix. 11. Iſa. ii. 2. Pſ. ii. 8. Mal. i. 11.

Mat. xxiv. 14. Παρὰ τὴν οἰκουμένην. Luke ii. 1.

Mat. xxvi. 13.

I THOUGHT it not improper to make the mention of theſe predictions follow ſo cloſe the diſcourſe of the miracles, becauſe true prophecies of unlikely events, fulfilled by unlikely means, are ſupernatural things; and as ſuch (eſpecially their Author and deſign conſidered) may properly enough be reckoned among miracles. And I may add, that theſe have a peculiar advantage above moſt other miracles, on the ſcore of their

their duration: ſince the manifeſt proofs of the prediction continue ſtill, and are as viſible as the extent of the Chriſtian religion; and ſome of them are ſtill more and more accompliſhed by the converſions made of multitudes of infidels, in ſeveral vaſt regions of *America*, (to name no other countries). So that if we may call ſome miracles tranſient ones, ſuch as the turning water into wine at a wedding-feaſt in *Galilee*; and the darkening of the ſun, when the moon was full, at the crucifixion of Chriſt: accompliſhed predictions may be ſtiled permanent ones; and their difference may be ſet forth by the differing ſtates of the Moſaic manna: for, though both that, which fell daily (except on the ſabbath) in the wilderneſs, and that which was laid up in a pot before the teſtimony, were ſupernatural productions; yet, whereas a portion of the former outlaſted not two or three days, that kept in the pot was preſerved many ages, and continued to be (as it was foretold it ſhould) a viſible miracle.

Exod. xvi. 14, 21, 26, 33.

THERE is another reaſon, why the wonderful propagation of the goſpel ſhould be annexed to the argument drawn from miracles in favour of the Chriſtian religion. For the preachers of it both pretended and appealed to miracles, as proofs of the truth of their doctrine: and (if we conſider the great diſadvantages they lay under, and the powerful oppoſition of all ſorts, that they met with and ſurmounted) it cannot reaſonably be thought, that ſuch unlikely men ſhould ſo ſucceſsfully preach ſo uninviting a doctrine, unleſs it were confirmed by conſpicuous miracles: or, at leaſt, if ſo uneaſy and perſecuted a religion was propagated without miracles, that propagation itſelf (as one of the fathers well obſerves) may juſtly paſs for a miracle; and be no leſs fit than another, to confirm the religion ſo admirably propagated.

THE paſt diſcourſe has, I hope, manifeſted, that a virtuoſo has ſome helps, that other men generally ſpeaking have not, to make him judiciouſly approve the arguments for the truth of the Chriſtian religion, that are grounded on the miracles wrought in its favour, and the wonderful ſucceſs of it in the world. But becauſe a revealed religion, how true ſoever it be, can ſcarce be proved but by moral demonſtrations; and becauſe, for this reaſon, it is not always ſufficient, that the arguments be good in their kind, but there are ſome qualifications required in the minds of them that are to be convinced by him; I ſhall now add, that experimental philoſophy does alſo diſpoſe the minds of its cultivators to receive due impreſſions from ſuch proofs, as miracles do, as well as other topics, afford the Chriſtian religion.

ANOTHER thing then, that qualifies an experimentarian for the reception of a revealed religion, and ſo of Chriſtianity, is, that an accuſtomance of endeavouring to give clear explications of the phænomena of nature, and diſcover the weakneſs of thoſe ſolutions, that ſuperficial wits are wont to make and acquieſce in, does inſenſibly work in him a great and ingenuous modeſty of mind. And on the ſcore of this intellectual (as well as moral) virtue, not only he will be very inclinable, both to deſire and admit further information, about things which he perceives to be dark or abſtruſe; but he will be very unapt to take, for the adequate ſtandard of truth, a thing ſo imperfectly informed, and narrowly limited, as his mere or abſtracted reaſon, (as I think I have elſewhere intimated, that one may call that, which is furniſhed only with its own, either congenite, or very eaſily and very early acquired notions and ideas, and with popular notices). And though a vulgar philoſopher, that allows himſelf to refer the obſcureſt things in nature to ſubſtantial forms, real qualities, ſympathy, antipathy, and ſome few other terms, which, to be employed by him, need not, and perhaps for their darkneſs cannot, be clearly underſtood; and by which he pretends to explain all things in nature, and may indeed explicate one thing as well as another; though (I ſay) ſuch a titular philoſopher may preſume, that he underſtands every thing, and may be eaſily tempted to think, that he muſt not hope, nor deſire, to learn from

from leſs able men than his firſt teachers; and that, that cannot be true, or be done, which agrees not with his philoſophy; yet a ſober and experienced naturaliſt, that knows what difficulties remain yet unſurmounted in the preſumedly clear conception and explications even of things corporeal, will not, by a lazy or arrogant preſumption, that his knowledge about things ſupernatural is already ſufficient, be induced to reject, or to neglect any information, that may encreaſe it.

AND this frame of mind is a very happy one for a ſtudent in revealed theology, where cautiouſneſs is not more neceſſary for the avoiding of errors, than docility is advantageous for the learning of truth: ſince the knowledge and goodneſs of the divine teacher is ſuch, that a ſcholar, to improve his intellect, needs but bring a mind fitted to receive the genuine informations, that are moſt liberally offered (in the Scripture) and will never deceive him; that employs, together with fervent prayers, a due care not to miſtake the meaning of them.

AN aſſiduous converſation with the exquiſitely framed, and admirably managed works of God, brings a ſkilful conſiderer of them to diſcover, from time to time, ſo many things to be feaſible, or to be true, which, whilſt he argued but upon grounds of incompetently informed reaſon, he judged falſe or unpracticable; that little by little he acquires a habit of receiving ſome ſorts of opinions, and eſpecially thoſe that ſeem unfriendly to religion, but as probationers, with a diſpoſition to reform or diſcard them upon further information. And this as he is reſolved to ſubmit to, in caſe he meets with it, ſo he is diſpoſed to receive, if not to expect it, by having often found himſelf obliged, upon ſubſequent information, to mend or lay aſide his former opinions, though very agreeable to the beſt light he had to judge by, when he entertained them. As though it ſeems a viſible truth, that the diſcus of *Venus* is, in all reſpects to the ſun, totally luminous; yet when the teleſcope diſcovers her to have her full and her wane, like the moon, he will believe this further obſervation againſt the firſt made with his naked eyes.

AND indeed, I have ſometimes doubted, whether to be verſed in mathematics, and other demonſtrative parts of philoſophy, bring a greater advantage to the mind, by accuſtoming and aſſiſting it to examine ſtrictly things propoſed for truths, and to evince ſtrongly the truths a man knows to others, than by fitting him to diſcern the force of a good argument, and ſubmit willingly to truths clearly evinced, how little ſoever he may have expected to find ſuch concluſions true. It will not be difficult to apply theſe reflections to our preſent purpoſe, ſince there are ſeveral paſſages in the Scripture, that ſufficiently declare, both that multitudes perſiſt in a criminal infidelity, out of an over-weaning conceit of their own knowledge, and a readineſs to be ſwayed rather by ſtrong prejudices, than by the ſtrongeſt arguments that would remove them; and that docility is a very happy diſpoſition to the entertainment of revealed religion: in reference to which, this qualification will be the more eaſily found in our virtuoſo; becauſe, whereas the things, about which he has been accuſtomed to be ſenſible of his ignorance, or deſire further inſtruction, are within the ſphere of nature, and the juriſdiction of philoſophy; many of the things that revealed religion declares, (ſuch as are the decrees, the purpoſes, the promiſes, *&c.* of God, and his moſt peculiar manner of exiſting and operating) are things ſo ſublime and abſtruſe, that they may well be looked upon as of an higher order than merely phyſical ones, and cannot be ſatisfactorily reached by the mere light of nature. It is true, that our philoſopher, becauſe he is ſo, will examine more ſtrictly, than ordinary men are wont or able to do, the proofs brought for this or that propoſed revelation. But that is no diſadvantage to a ſupernatural religion, ſuch as the Chriſtian, if it be, as we now ſuppoſe it to be, true;

true; and the real truth about religion itſelf does not require credulity, but only docility. And perhaps this matter may be illuſtrated, by comparing what happens to a philoſopher in the examen of opinions, and to a chemiſt in that of metals. For if a piece of coin, that men would have paſs for true gold, be offered to an ordinary man, and to a ſkilful refiner; though the latter will examine it more ſtrictly, and not acquieſce in the ſtamp, the colour, the ſound, and other obvious marks, that may ſatisfy a ſhop-keeper, or a merchant; yet when he has tried it by the ſeverer ways of examining, ſuch as the touch-ſtone, the cupel, aqua fortis, *&c.* and finds it to hold good in thoſe proofs, he will readily and frankly acknowledge, that it is true gold, and will be more thoroughly convinced of it, than the other perſon, whoſe want of ſkill will make him ſtill apt to retain a diſtruſt, and render him indeed more eaſy to be perſuaded, but more difficult to be fully ſatisfied. On the like account, though our virtuoſo will examine with more ſtrictneſs and ſkill, than ordinary men are able, miracles, prophecies, or other proofs, ſaid to be ſupernatural, that are alledged to evince a revealed religion; yet if the certain and genuine characters of truth appear in it, he will be more thoroughly convinced of it than a leſs ſkilful man, whoſe want of good criteria (or touch-ſtones) and ſound judgment will incline him to be diffident, and to be ſtill afraid of having been impoſed on.

I EXPECT in the mean time, that you ſhould here object againſt what has been ſaid in the later leaves of the paſt diſcourſe, that it hath degraded the human intellect, by aſcribing ſo much to experience, natural or ſupernatural, that it has left nothing for reaſon to do, unleſs ſervilely to obey.

BUT though this objection be plauſible, yet the anſwer to it will not be very difficult, if the matter itſelf be duly conſidered, and reaſon be brought to act, even on this occaſion, not as an intereſted party, but an unbiaſſed judge.

FOR we have already ſhewn, that rational philoſophers ſcruple not to alter or renounce the opinions, that ſpecious reaſons had ſuggeſted to them, when once they either find thoſe opinions contradicted by experience, or meet with other opinions more conformable to experience. And *Ariſtotle* himſelf, though he be accuſed to have, perhaps the firſt of all the ancient naturaliſts, perverted phyſics, by wreſting them to a compliance with logical and metaphyſical fancies; yet even he confeſſes, not only that in the ſcience of nature, reaſon ought to comport with the phænomena, and the phænomena with reaſon; but that to adhere to plauſible ratiocinations, with the neglect of ſenſible obſervations, is a weakneſs, or diſeaſe (ἀῤῥωστία) of mind. I will not here mention what I ſay in another paper, by way of attempt to ſettle the bounds of reaſon and experience, in reference to natural philoſophy; but it may concern our preſent argument, to employ a few lines in this place, towards the further clearing the lately propoſed objection. We may obſerve then, that, whether or no it be true, which is taught by *Ariſtotle*, and commonly received in the ſchools, that the underſtanding is like blank paper; and that it receives no knowledge, but what has been conveyed to it through the ſenſes: whether, I ſay, this be or be not admitted, it is plain, that the notions, which are either congenite with the underſtanding, or ſo eaſily and early acquired by it, that divers philoſophers think them innate, are but very few in compariſon of thoſe, that are requiſite to judge aright about any one of a multitude of things, that occur either in natural philoſophy, or theology. For in the divine nature, power, wiſdom, and other attributes, there is a fecundity, that has produced a world of contrivances, laws, and other things, that exceedingly ſurpaſs both the number and variety, that the dim and limited intellect of man could reach to, by framing and compounding ideas, without the aſſiſtance of the patterns, afforded by the works and declarations of God.

ON the account of the ſame prerogative of the divine knowledge, it muſt frequently happen, that the notions and opinions men take up of the works and mind of God, upon the mere ſuggeſtions of the abſtracted reaſon, (if I may ſo call it) newly ſpoken of, muſt not only be almoſt always very deficient, but will be oftentimes very erroneous. Of which we ſee evident proofs in many of the opinions of the old philoſophers, who, though men of ſtrong natural parts, were miſled by what they miſtook for reaſon, to maintain ſuch things about the works and the author of nature, as we, who, by the favour of experience and revelation, ſtand in a much clearer light, know to be falſe, and often juſtly think utterly extravagant.

THE importance of the ſubject lately ſpoken of, and its being too little conſidered, may make it deſerved to be inculcated; and therefore I ſhall ſubjoin on this occaſion, that that, which I have lately called abſtracted reaſon, is but a narrow thing, and reaches but to a very ſmall ſhare of the multitude of things knowable, whether human or divine, that may be obtained by the help of further experience, and ſupernatural revelation. This reaſon, furniſhed with no other notices than it can ſupply itſelf with, is ſo narrow and deceitful a thing, that he, that ſeeks for knowledge only within himſelf, ſhall be ſure to be quite ignorant of far the greateſt part of things, and will ſcarce eſcape being miſtaken about a good part of thoſe he thinks he knows.

BUT notwithſtanding what has been hitherto ſaid, I am far from intending to deny reaſon any of its juſt prerogatives. For I ſhew in another paper, that experience is but an aſſiſtant to reaſon, ſince it doth indeed ſupply informations to the underſtanding; but the underſtanding remains ſtill the judge, and has the power or right to examine and make uſe of the teſtimonies, that are preſented to it. The outward ſenſes are but the inſtruments of the ſoul, which hears by the intervention of the ear, and in reſpect of which the eye itſelf is but a more immediate optical tube; and the ſenſe does but perceive objects, not judge of them. Nor do the more wary among the philoſophers, truſt their eye to teach them the nature of the viſible object; but only to employ it to perceive the phænomena it exhibits, and the changes that happen to itſelf by the action of it. And whereas it is confeſſed, that the ſenſories may deceive us, if the requiſites of ſenſation be wanting, as when a ſquare tower appears round at a great diſtance, and a ſtrait ſtick half in the water appears crooked, becauſe of the doubled medium; it is the part of reaſon, not ſenſe, to judge, whether none of the requiſites of ſenſation be wanting; which (give me leave to add) oftentimes requires, not only reaſon, but philoſophy; and then alſo it is the part of reaſon to judge, what concluſions may, and what cannot be ſafely grounded on the informations of the ſenſes, and the teſtimony of experience. So that when it is ſaid, that experience corrects reaſon, it is ſomewhat an improper way of ſpeaking; ſince it is reaſon itſelf, that upon the information of experience, corrects the judgments ſhe had made before.

AND this (borrowed from the forementioned paper, becauſe it was never publiſhed) prompts me to illuſtrate the uſe of reaſon, by comparing her to an able judge, who comes to hear and decide cauſes in a ſtrange country. For the general notions he brings with him, and the dictates of juſtice and equity can give him but a very ſhort and imperfect knowledge of many things, that are requiſite to frame a right judgment about the caſes, that are firſt brought before him; and before he has heard the witneſſes, he may be very apt to fall into prejudicate opinions of things, (whether perſons or cauſes.) But when an authentic and ſufficient teſtimony has cleared things to him, he then pronounces, according to the light of reaſon, he is maſter of; to which the witneſſes did but give information, though that ſubſequent information may

have obliged him to lay aſide ſome prejudicate opinions he had entertained before he received it. And what is ſaid of natural experience, in reference to the underſtanding, may, with due alteration, be applied to ſupernatural revelation: for here alſo the underſtanding is to examine, whether the teſtimony be indeed divine; and whether a divine teſtimony ought to be (as it will eaſily perceive it ſhould) believed, in what it clearly teaches; to omit other uſes of reaſon, (about theological matters) which belong not to this place, where it may ſuffice to have ſhewn, that reaſon is not degraded from the dignity, that belongs to her, of perceiving and judging; though ſhe be obliged by her own dictates, to take in all the aſſiſtance ſhe can from experience, whether natural, or ſupernatural; and by the fuller accounts of things ſhe receives from thoſe informations, to rectify, if need be, her former and leſs mature judgments.

IN ſhort, thoſe, that cry up abſtracted reaſon, as if it were ſelf-ſufficient, exalt it in words; but we that addreſs reaſon to phyſical and theological experience, and direct it how to conſult them, and take its informations from them, exalt it in effect; and reaſon is much leſs uſefully ſerved by the former ſort of men, than by the latter; ſince whilſt thoſe do but flatter it, theſe take the right way to improve it.

I HOPE you will not imagine, that I have in the foregoing part of this letter ſaid all that I could ſay pertinently. For being mindful of the brevity becoming an epiſtolary diſcourſe, I omitted ſeveral arguments, that would have challenged their places in a treatiſe; and have but touched upon moſt of thoſe I have mentioned; though reaſonings of this kind are uſually like tapeſtry, which loſes much by being looked on whilſt the hangings are folded up, which ſhould be diſplayed to their full dimenſions.

BUT having offered you ſome things, which perhaps you have not met with elſewhere; and having, though but tranſiently, touched upon the grounds of divers other conſiderable arguments, I hope, that your learning and ſagacity will both ſupply what you will diſcern to have been omitted, and enforce what has been but intimated; and then I ſhall not deſpair, that what I have ſaid may ſuffice to perſuade you, that experimental philoſophy may greatly aſſiſt a well-diſpoſed mind, to yield an hearty and operative aſſent to the principles of religion. I am,

SIR,

Your moſt, &c.

The End of the FIRST PART.

REFLEC-

REFLECTIONS
UPON A
THEOLOGICAL DISTINCTION.

According to which it is ſaid,

That ſome ARTICLES of FAITH are above Reaſon, but not againſt Reaſon.

In a LETTER to a FRIEND.

ADVERTISEMENT.

AFTER the author had begun the ſecond part of his *Chriſtian Virtuoſo*, and made ſome progreſs in it, which he deſigned to continue till he had compleated it; he was obliged to leave the country, where he enjoyed ſome leiſure, and to remove to London; where ſickneſs, and buſineſs, and a multitude of viſits he could not avoid receiving, did ſo diſtract him, that theſe remora's, added to the fertility of the ſubjects, that remained to be treated of, which he found much greater than he was at firſt aware of, made him lay aſide the materials he had prepared for the ſecond part, to a fitter opportunity, and comply with the occaſions he had to publiſh ſome tracts, that required more. And it is for the like reaſons, that having at preſent ſome other eſſays of a quite differing nature in the preſs, he is obliged to poſtpone his reſuming and finiſhing the ſecond part of the *Chriſtian Virtuoſo* (which will require more ſheets than the former) for ſome longer time; though yet, to comply with the ſolicitations of the printer, he conſents, both to let the firſt part come abroad, and (to make the book of a more decent ſize) add to it, by way of ſubſtitution, a diſcourſe, that is of affinity enough to the other, upon the account of ſome of the points it handles, and more upon that of its ſcope; and that will not be ill received, if it have the good fortune to find the public as kind to it, as private peruſers have been.

For my learned FRIEND Mr. *H. O.*

SIR,

I. I CAN neither admire nor blame the curioſity you expreſſed, to receive ſome ſatisfaction about the important diſtinction, that is made uſe of in defence of ſome myſteries of the Chriſtian religion; namely, that *they are indeed above reaſon, but not againſt reaſon.* For though divers learned men have, eſpecially of late, employed it, yet I perceive you and your friends *N. N.* think, that they have not done it ſo clearly, as both to prevent the exceptions of infidels, or render them more groundleſs; and at leaſt, to obviate the ſurmiſes of thoſe others, who have been perſuaded to look upon this diſtinction but as a fine evaſion, whereby to elude ſome objections,

that cannot otherwise be answered. And indeed, as far as I can discern by the authors, wherein I have met with it, (for I pretend not to judge of any others) there are divers that employ this distinction, few that have attempted to explain it, (and that I fear not sufficiently,) and none that has taken care to justify it.

II. In order to the removal of the difficulties, that you take notice of, I shall endeavour to do these two things: 1. To declare in what sense I think our distinction is to be understood. And 2, To prove, that it is not an arbitrary or illusory distinction, but grounded upon the nature of things.

Though I do not desire to impose my sentiments on any man, much less on you; yet because I, as well as others, have had some occasions to make use of the distinction we are considering, I think myself obliged, before I go any further, to acquaint you in what sense I understand it.

III. By such things then in theology, as may be said to be above reason, I conceive such notions and propositions, as mere reason, that is, reason unassisted by supernatural revelation, would never have discovered to us; whether those things be to our finite capacities clearly comprehensible or not. And by things contrary to reason, I understand such conceptions and propositions, as are not only undiscoverable by mere reason, but also, when we understand them, do evidently and truly appear to be repugnant to some principle, or to some conclusion of right reason.

IV. To illustrate this matter a little, I shall propound to you a comparison drawn from that sense, which is allowed to have the greatest cognation with the understanding, which I presume you will readily guess to be the sight. Suppose then, that on a deep sea, a diver should bid you tell him, what you can see there; that, which you would answer, would be, that you can see into a sea-green liquor, to the depth of some yards, and no further: so that if he should further ask you, whether you see what lies at the bottom of the sea, you would return him a negative answer. If afterwards the diver letting himself down to the bottom, should thence bring up and shew you oisters, or muscles with pearls in them; you would easily acknowledge, both that they lay beyond the reach of your sight, and consequently argued an imperfection in it; though but such an imperfection, as is not personal, but common to you with other men, and that the pearls have the genuine colour and lustre, that naturally belong to such gems. But if this diver should pretend, that each of these pearls he shews you, is as large as a tennis-ball, or some of them bigger than the shells they were enclosed in, and that they are not round but cubical, and their colour not white or orient, but black or scarlet; you would doubtless judge what he asserts to be not only (or not so properly) undiscernible by your eyes, but contrary to the informations of them, and therefore would deny what he affirms. Because, that to admit it would not only argue your sight to be imperfect, but false and delusory; though the organ be rightly qualified, and duly applied to its proper objects.

V. This illustration may give you some superficial notion of the difference betwixt a thing's being above reason, and its being contrary to it. But this may better appear, if we consider the matter more distinctly. And to offer something in order to this, I shall beg leave to say, that in my opinion, the things, that may be said to be above reason, are not all of one sort, but may be distinguished into two kinds, differing enough from each other.

VI. For it seems to me, that there are some things, that reason by its own light cannot discover; and others, that, when proposed, it cannot comprehend.

VII. And first, there are divers truths in the Christian religion, that reason, left to itself, would never have been able to find out, nor perhaps to have so much as dreamed of; such as are most of those, that depend upon the free will and ordination of God; as,

as, that the world was made in six days, that Christ should be born of a virgin, and that in his person there should be united two such infinitely distant natures as the divine and human; and that the bodies of good men shall be raised from death, and so advantageously changed, that the glorified persons shall be like (or equal) to the angels.

VIII. Of this kind of theological truths, you will easily believe, that it were not difficult for me to offer divers other instances; and indeed there are many truths, and more, I think, than we are wont to imagine, that we want mediums or instruments to discover, though, if they were duly proposed, they would be intelligible to us. As for my part, when by looking on the starry heaven, first with my naked eyes, and then with telescopes of differing lengths, I do not only descry more and more stars, according to the goodness of the instruments I employed, but discovered great inducements to think, that there are, in those inestimably remote regions, many celestial lights, that only the want of more reaching telescopes conceal from our sight.

IX. And thus much I presume you will close with the more easily, because it disagrees not with the sentiments of some few (for I dare say not many) orthodox divines. But I must take leave to add, that, besides these mysterious truths, that are too remote and hidden to be detected by human reason, there is another sort of things, that may be said to be above reason.

X. For there are divers truths delivered by revelation, (contained in the holy scriptures), that not only would never have been found out by mere natural reason; but are so abstruse, that, when they are proposed as clearly as proper and unambiguous expressions can propose them in, they do nevertheless surpass our dim and bounded reason, on one or other of those three accounts, that are mentioned in a Dialogue about things transcending reason; namely, either as not clearly conceivable by our understanding, such as the infiniteness and perfections of the Divine Nature; or inexplicable by us, such as the manner, how God can create a rational soul, or how, this being an immaterial substance, it can act upon a human body, and be acted on by it; (which instance I rather chose, than the creation of matter, because it may be more easily proved;) or else asymmetrical or unsociable, that is, such as we see not how to reconcile with other things, which also manifestly are, or are by us acknowledged to be true; such as are the divine prescience of future contingents, and the liberty that belongs to man's will, at least in divers cases.

XI. It will not, perhaps, be improper to observe, on this occasion, that as of things, that are said to be above reason, there are more kinds than one; so there may be a difference in the degrees, or at least the discerniblenes, of their abstruseness.

XII. For some things appear to surpass or distress our understandings, almost as soon as they are proposed, at least before they are attentively looked into; as what is said to be infinite, either in extent or number. But there are other things, the notions whereof, as they first arise from the things considered in gross, and as it were indefinitely, are such, as do not choke or perplex our understandings; and are so far intelligible, that they may be usefully employed in ordinary discourse. But when we come to make a deep inspection into these, and prosecute to the uttermost the successive inferences that may be drawn from them, we reason ourselves into inextricable difficulties, if not flat repugnancies too. And to shew you, that I do not say this gratis, be pleased to consider with me, that we usually discourse of place, of time, and of motion, and have certain general indeterminate conceptions of each of these, by the help of which we understand one another, when we speak of them;

though:

though, if we will look thoroughly into them, and attentively consider all the difficulties, that may be discovered by such an inspection, we shall find our reason oppressed by the number and greatness of the difficulties, into which we shall argue ourselves, or at least may be argued by others; though these men, who do make such shrewd objections against the hypothesis we embrace, will hardly be able themselves to pitch on any, that will not allow us to repay them in the same coin.

XIII. What has been newly said may, I hope, assist us to clear a difficulty, or scruple, (about the distinction we treat of), which, since it sprung up in my own mind, may very probably occur also to your thoughts; namely, that, if any theological proposition be granted to surpass our reason, we cannot pretend to believe it, without discovering, that we do not sufficiently consider what we say; since we pretend to exercise an act of the understanding, in embracing somewhat, that we do not understand, nor have a notion of.

XIV. But on this occasion we may justly have recourse to a distinction, like that I have lately intimated. For, in divers cases, the notions men have of some things may be different enough, since the one is more obvious and superficial, and the other more philosophical or accurate. And of these two differing kinds of conceptions I have already offered some instances in the very differing notions men have of place and time; which, though familiar objects, I elsewhere shew to be each of them of so abstruse a nature, that I do not wonder to find *Aristotle* himself complaining of the difficulty, that there is to give a clear and unexceptionable notion of place; nor to find so acute a wit as St. *Austin* ingenuously confessing his disability to explicate the nature of time.

XV. And what is said of the great intricacies, that incumber a deep scrutiny into these familiar objects of discourse, will hold as to the divisibility of quantity, as to local motion, and as to some other primary things, whose abstruseness is not inferior in degree, though differing as to the kinds of things, wherein it consists.

XVI. By such instances as these, it may appear, that without talking as parrots, (as your friends would intimate, that those that use our distinction must do), or as irrational men, we may speak of some things, that we acknowledge to be on some account or other above our reason; since the notions we may have of those things, however dim and imperfect, may yet be of use, and may be in some measure intelligible, though the things they relate to may, in another respect, be said to transcend our understanding; because an attentive considerer may perceive, that something belongs to them, that is not clearly comprehensible, or does otherwise surpass our reason (at least in our present state).

XVII. Having dispatched the objection, that required this digression; I shall now step again into the way, and proceed in it by telling you, that any one apposite instance may suffice to clear the former part of the expression, that is employed, when it is said, that a mystery, or other article of faith, is above reason, but not contrary to it: for if there be so much as one truth, which is acknowledged to be such, and yet not to be clearly and distinctly comprehensible, it cannot justly be pretended, that to make use of the distinction we are treating of is to say something, that is not intelligible, or is absurd. And it will further justify the expression quarrelled at, if we can make it appear, that it is neither impertinent or arbitrary, but grounded on the nature of things. And this I shall endeavour to do, by shewing, that though I admit two sorts of things, which may be said to be above reason, yet there is no necessity, that either of them must (always) be contrary to reason.

XVIII. As for the first sort of things said to surpass reason, I see not, but that men may be unable, without the assistance of a more knowing instructor, to discover some

some truths; and yet be able, when these are revealed or discovered to them by that instructor, both to understand the disclosed propositions by their own rational faculty, and approve them for true, and fit to be embraced. The intellect of man being such a bounded faculty as it is, and naturally furnished with no greater a stock or share of knowledge, than it is able by its own endeavours to give itself, or acquire; it would be a great unhappiness to mankind, if we were obliged to reject, as repugnant to reason, whatever we cannot discover by our own natural light; and consequently, to deny ourselves the great benefits we may receive from the communications of any higher and more discerning intellect. An instance to my present purpose may be found among rational souls themselves, though universally granted to be all of the same nature. For though a person but superficially acquainted (for example) with geometry would never have discovered by his own light, that the diameter of a square is incommensurable to the side; yet when a skilful mathematician dextrously declares, and by a series of demonstrations proves, that noble theorem, the disciple, by his now instructed reason, will be able both to understand it, and to assent to it; insomuch that *Plato* said, that *he was rather a beast than a man, that would deny it.*

XIX. Other instances may be alledged to exemplify the truth newly mentioned. And indeed, there is not so much as a strong presumption, that a proposition or notion is therefore repugnant to reason, because it is not discoverable by it; since it is altogether extrinsecal and accidental to the truth or falsity of a proposition, that we never heard of it before; or that we could never have found it out by our own endeavours; but must have had the knowledge of it imparted to us by another. But then this disability to find out a thing by our own search doth not hinder us from being able by our own reason both to understand it when duly proposed, and to discern it to be agreeable to the dictates of right reason. To induce you to assent to the latter part of this observation, I shall add, that these intellectual assistances may oftentimes not only enlighten (but gratify) the mind, by giving it such informations, as both agree with its former maimed or imperfect notices, and compleat them. When, for example, an antique medal, half consumed with rust, is shewed to an unskilful person, though a scholar, he will not by his own endeavours be able to read the whole inscription, whereof we suppose some parts to be obliterated by time or rust, or to discover the meaning of it. But when a knowing medalist becomes his instructor, he may then know some (much defaced) letters, that were illegible to him before; and both understand the sense of the inscription, and approve it as genuine, and suitable to the things whereto it ought to be congruous. And because divers philosophical wits are apt, as well as you, to be startled at the name of mystery, and suspect that, because it implies something abstruse, there lies hid some illusion under that obscure term; I shall venture to add, that agreeably to our doctrine we may observe, that divers things, that relate to the old testament, are in the new called mysteries, because they were so under the Mosaic dispensation; though they cease to be so, now that the apostles have explained them to the world. As the calling of the Gentiles into the church of God is by their apostle called a mystery; because, to use his phrase, it "had been hid from ages and generations;" though he adds, "but now it is made manifest to his saints." And the same writer tells the *Corinthians*, that he "shows them a mystery," which he immediately explains, by foretelling, that all pious believers shall not die, because that "those, that shall "be found alive at the coming of Christ, shall not sleep, but be changed;" as the other "dead shall be raised incorruptible." Which surprising doctrine, though, because it could not be discovered by the light of nature, nor of the writings of the old

Col. i. 26. Eph. iii. 3, 5, 6. 1 Cor. xv. 51, 52.

testament, he calls a mystery, yet it is no more so to us, now that he hath so expressly foretold it, and therefore declared it.

See Matth. xiii. 11. Eph. v. 31.

XX. OTHER instances I content myself to point at in the margin, that I may pass on to confirm the observation I formerly intimated; that divers things, which the scripture teaches beyond what was known, or (in probability) are discoverable by natural light, are so far from being against reason, by being (in the sense declared) above it, that these discoveries ought much to recommend the scripture to a rational mind; because they do not only agree with the doubtful or imperfect notions we already had of things, but improve them, if not compleat them. Nay, I shall venture to add, that these intellectual aids may not seldom help us to discern, that some things, which not only are above reason, but at first sight seem to be against it, are really reconcileable to reason, improved by the new helps afforded it by revelation. To illustrate this by a philosophical instance: when *Galileo* first made his discoveries with the telescope, and said, that there were planets that moved about *Jupiter*; he said something, that other astronomers could not discern to be true, but nothing that they could prove to be false. And even when some revelations are thought not only to transcend reason, but to clash with it; it is to be considered, whether such doctrines are really repugnant to any absolute catholic rule of reason, or only to something, which so far depends upon the measure of acquired information we then enjoy, that, though we judge it to be irrational, yet we are not sure, that the thing, this judgment is grounded on, is clearly and fully enough known to us. As, to resume the former example, when *Galileo*, or some of his disciples, affirmed *Venus* to be sometimes horned like the moon; though this assertion were repugnant to the unanimous doctrine of astronomers, who thought their opinion very well grounded on no less a testimony than that of their own eyes; yet in effect the proof was incompetent, because their unassisted eyes could not afford them sufficient information about this case. And so when *Galileo* spoke of hills and valleys (and shadows) in the moon, they were not strait to reject what he taught, but to have, if not a kind of implicit faith, yet a great disposition to believe what he delivered, as upon his own knowledge, about the figure and number of the planets. For they knew, that he had, and had already successfully made use of, a way of discovering celestial objects, that they were not masters of, nor therefore competent judges of, all the things, though they might well be of many, that he affirmed to be discoverable by it. And though they could not see in the moon what he observed, (vallies, mountains, and the shadows of these) yet they might justly suspect, that the difference of the idea that they framed of that planet, and that which he proposed, might well proceed from the imperfection of their unaided sight; especially considering, that what he said of the differing constitution of what is there analogous to sea and land, did rather correct and improve, than absolutely overthrow, their former notices. For he allowed the spots they saw to be darker parts of the moon, and gave causes of that darkness, which their bare eyes could not have led them to any such knowledge of. And the non-appearance of the mountainous parts of the moon in that form to the naked eye might well be imputed to the great distance betwixt them and us, since at a far less distance square towers appear round, *&c.*

XXI. IT now remains, that I say something, that may both make some application of the form of speech hitherto discoursed of, and afford a confirmation of the grounds, whereon I think it may be justified. This I am the rather induced to do, because I expect it will be objected, that he that acknowledges, that the thing, he would have us believe, transcends our reason, has a mind to deceive us, and procures

for himself a fair opportunity to delude us, by employing an arbitrary distinction, which he may apply as he pleases.

XXII. But to speak first a word or two to this last clause, I acknowledge, that such a distinction is capable enough of being misapplied; and I am apt to think, that by some school-divines, and others, it has been so. But since there are other distinctions, that are generally and justly received by learned men, and even by philosophers themselves, without having any immunity from being capable to be perverted; I know not, why the distinction we are considering should not be treated as favourably as they. And however, the question at present is not, whether our distinction may possibly be misapplied by rash or imposing men, but whether it be grounded on the nature of things. To come then to the thing itself; I consider, that for an opinion to be above reason, in the sense formerly assigned, is somewhat, that (as was noted in reference to the first sort of things that surpass it) is extrinsical and accidental to its being true or false. For to be above our reason is not an absolute thing, but a respective one, importing a relation to the measure of knowledge, that belongs to the human understanding, such as it is said to transcend: and therefore it may not be above reason, in reference to a more enlightened intellect, such as in probability may be found in rational beings of an higher order, such as are the angels, and, without peradventure, is to be found in God, whom when we conceive to be a Being infinitely perfect, we must ascribe to Him a perfect understanding and boundless knowledge. This being supposed, it ought not to be denied, that a superior intellect may both comprehend several things, that we cannot, and discern such of them to be congruous to the fixed and eternal ideas of truth, and consequently agreeable to one another, as dim-sighted mortals are apt to suspect, or to think to be separately false, or, when collated, inconsistent with one another. But to launch into this speculation would lead me farther than I have time to go. And therefore I shall content myself to offer you one argument, to prove, that of things, that may be said to be above reason, in the sense formerly explained, it is no way impossible, that even such an one should be true, as is obnoxious to objections not directly answerable. For I consider, that of things above reason, there may be some, which are really contradictory to one another, and yet each of them is maintainable by such arguments, as very learned and subtile men do both acquiesce in and enforce, by loading the embracers of the opposite opinion with objections they cannot directly answer.

XXIII. This I take to be manifest in the case of the controversy about the endless divisibility of quantity, as suppose of a strait line. For many eminent mathematicians, and a greater number of naturalists, and in particular almost all the Epicureans, and other atomists, stiffly maintain the negative. The affirmative is nevertheless asserted, and thought to be mathematically demonstrated by *Aristotle* in a peculiar tract; and both by his school, and by several excellent geometricians besides. And yet in reality the assertions of these two contending parties are truly contradictory; since of necessity a strait line proposed must be, at least mentally, divisible, into parts, that are themselves still further divisible; or it must not be so, and the subdivisions must at length come to a stop. And therefore one of the opposite opinions must be true. And it is plain to those, that have, with competent skill and attention, impartially examined this controversy, that the side, that is pitched upon, which soever it be, is liable to be exposed to such difficulties, and other objections, as are not clearly answerable, but confound and oppress the reason of those, that strive to defend it.

XXIV. I HAVE, Sir, the more largely discoursed of the foregoing distinction, not only because I did not find myself to have been prevented by others, but because I look upon the explaining and justifying of it to be of importance, not alone to the defence of some mysteries of the Christian religion, but (what perhaps may have escaped your observation) of some important articles of natural theology itself. For though natural religion taught divers heathen philosophers, such truths as these, *viz.* the production of the rational soul or mind, which is an immaterial substance; the formation of the world out of the universal matter, though this action required, that an incorporeal substance gave motion to a body; that God knows men's thoughts and intentions, how carefully soever they strive to hide them; and that God foreknows the events of the free actions of such men, as are not to be born these many ages: though, I say, these and some other sublime truths were by divers men embraced before the gospel began to be preached; yet when I attentively consider, how hard it is to conceive the modus of these things, and explain how some of them can be performed; and also, how some of the divine attributes, as eternity, immensity, omnipresence, and some others, belong to God; and how some actions, as the moving of bodies, and the creation of human minds, with all their noble faculties, are exercised by Him: when I consider such things, I say, I acknowledge, that, to my apprehension, there are some doctrines, allowed to have been discovered by the mere light of nature, that are liable to such objections from physical principles, and the settled order of things corporeal, as, if they be urged home, will bring those, that are ingenuous, to acknowledge, that their intellects are but dim and imperfect, and indeed disproportionate to the sublimest and most mysterious truths; and that they cannot perfectly comprehend them, and answer all the difficulties that incumber them, though they find themselves obliged to admit them, because of the weighty positive reasons, that recommend those heteroclite truths to their assent.

XXV. IF you should now tell me, that, after all I have said, it is plain, that the questioned distinction, if it were granted, might be of very bad consequence, as affording shelter to any unintelligible stuff, that some bold enthusiast, or conceited philosophizer, may obtrude under the venerable title of a mystery, above the jurisdiction of reason; and that, though the distinction were admitted, it would not be a good proof of any disputed article of the Christian religion: if, I say, this shall be objected, I shall answer, (what in part is intimated already) that I do not deny, but that our distinction is liable to be ill employed; but that this is no other blemish than what is common with it to divers other distinctions, that are without scruple admitted, because they are useful, and not rejected, because they have not the privilege, that they can never be misapplied. And therefore, both in reference to those distinctions, and to that we have been treating of, it becomes men to stand upon their guard, and strictly examine, how far the notion, or doctrine, proposed as a mystery, does require, and is entitled to the benefit of this distinction. I shall also readily grant the greatest part of the second member of your objection. For I think it were great weakness in a Christian, to urge our distinction as a positive proof; since, though it be extrinsecal to an abstruse notion, to be, or not to be, above reason, (as was just now noted to another purpose); yet, generally speaking, that abstruseness is less fit to bring credit to a conception, or a doctrine, than it is to make it to be distrusted. Nor are Christians such fond discoursers, as to pretend, that such an article of religion ought to be believed, because it is above reason, as if that were a proof of its truth; but only, that, if it be otherwise well proved, it ought to be believed, notwithstanding its being above reason.

XXVI. And this I shall represent in favour of those, that believe abstruse articles, that are clearly revealed in the scripture, upon the authority of the divine Revealer, (who never deceives others, nor can be Himself deceived), that since, as we have lately shewn by the contradictory opinions about the divisibility of quantity, some doctrines must be true, whose difficulties do not appear to be surmountable by our dim reason; and since the perfectness of God's knowledge permits us not to doubt, but that He certainly knows which of the two contending opinions is the true, and can declare so much to men; it would not be a sure ground of rejecting a revealed article, to alledge, that it is encumbered with confounding difficulties, and liable to many and weighty objections.

XXVII. And (to add somewhat, that may help to defend some truths of natural, and others of revealed religion) that a thing may be rationally assented to upon clear positive evidence, though we cannot directly answer the objections, that a speculative and subtil wit may devise against it, is a truth, which, as important as it is to religion in general, and the Christian religion in particular, I think one may sufficiently manifest by this one instance, that because we can walk up and down, and so remove our bodies from place to place; by this one argument, I say, we are justly satisfied, that there is a local motion in the world, notwithstanding all the specious and subtil arguments, that *Zeno* and his followers have employed to impugn that truth: against which they have alledged such difficulties, as have not only puzzled and perplexed but (for aught yet appears) nonplus'd the ancient philosophers, and, I doubt, those moderns too, that have attempted to give clear solutions of them.

XXVIII. If now, Sir, we look upon what hath hitherto been discoursed, I hope you will allow me to gather thence the conclusion I aim at, which is, that there is no necessity, that every notion or proposition, that may be found delivered in the holy scriptures, that surpasses our reason, must therefore be contradictory to it: and that in case the Christian religion be true, and its mysteries or other articles divinely revealed, it is not enough for the confutation of any of them, to reject the expression, that it is above reason, but not contrary to it; as if it involved an unintelligible or groundless distinction: for though this will not evince the truth of a mystery, since that must be established upon its proper grounds and arguments; yet it will keep it from being therefore absurd or false, because it transcends our reason: since to do so may belong almost indifferently to a chimerical notion, and a mysterious truth. And if the expression be employed to justify any thing, that, though stiled a mystery, is but a pretended one, the error will lye, not in the groundlessness of the distinction, but the erroneousness of the application. I am,

SIR,

Your most, &c.

GREATNESS of MIND
PROMOTED BY
CHRISTIANITY.
In a LETTER to a Friend.
The FIRST PART.

To my honoured Friend Sir *R. M.*

SIR,

I Do not wonder, that a great ſoul, like yours, ſhould enquire, what aſpect religion, and particularly that of Chriſtians, has upon *greatneſs of mind:* but I confeſs, I ſomewhat marvel, that you ſhould be put upon the enquiry by the ſuggeſtions of ſuch a libertine as Mr. *N. N.*'s confidently pretending, that his atheiſtical and ſenſual principles are much more friendly, than the doctrines of Chriſtianity, to a noble frame of mind. Wherefore I dare not permit the ſenſe I have of my own weakneſs, how great and juſt ſoever, to keep me from preſenting you with my thoughts; and the rather, becauſe I preſume you are not indiſpoſed to receive a ſatisfaction in this point, ſince you ſeem to expect it from a pen, that is no better than mine; which, you well know, muſt not be on this occaſion aſſiſted by the arguments and ornaments, that the fine ſentences of the fathers, and other divines and humaniſts, might afford to a perſon, that were at leiſure, and furniſhed with a library. Yet I ſhall not much either excuſe or deplore my being ſo ill accommodated for the taſk you impoſe upon me; becauſe as you ſeem to deſire but my own thoughts, ſo I know not, whether common place-books would afford me any great aſſiſtance on ſo uncommon a theme; and, I confeſs, that, when the matter will bear it, I, as well as you, do leſs care for authorities, eſpecially taken from diſcourſes, deſigned rather to perſuade than prove, in compariſon of thoſe arguments, that are ſuggeſted by a due conſideration of the nature of the thing. But yet, I preſume, you will readily give me leave to do that frequently enough, which your friend perhaps will call preaching. For beſides that your deſires, and my haſte, confine me to the Bible and my own thoughts; the frequent citation of texts of holy ſcripture is exacted by the nature of the queſtion I am to handle: it being neceſſary, for the evincing of the doctrines of Chriſtianity not to be inconſiſtent with greatneſs of mind, that we as well conſider, what thoſe doctrines are, which ſure will be beſt declared by the ſcriptural texts that contain them, as what are the attributes of greatneſs of mind.

CHAP. I.

TO proceed then with ſome method, as well as much brevity, I conceive it will be no unfit way to come to a reſolution in our inquiry, if I firſt ſet down and enumerate the chiefeſt things, that in the eſtimation of intelligent men do, as if they were ſo many ingredients, make up what we call magnanimity or greatneſs

of

of mind, that not being a ſingle ſtar, but a conſtellation of elevated and radiant qualities; and then ſhew, that religion, eſpecially that of the Chriſtians, is at leaſt conſiſtent with each of theſe, if it do not alſo promote it. But in this enumeration, though I ſhall, *ex abundanti*, take in ſome qualities, that are not eſſential to greatneſs of mind, but rather acceſſions to it; yet I ſhall not ſcrupulouſly diſtinguiſh thoſe things, that are neceſſary to compleat it, and thoſe that are partly ſome of them ſigns, and ſome of them effects, of it; hoping from your equity, that theſe additional things will be thought to make full amends, if, through haſte or miſtake, I ſhould chance to have omitted any property, that you may judge to belong to the true notion of generoſity.

I SHALL, in the following diſcourſe, take it for granted, (and I hope I need not tell you that I do ſo), that as we think not maſons, but jewellers, fit to judge of the genuineneſs and value of precious ſtones; ſo you will allow me to take the notion and meaſures of greatneſs of mind, not from the opinions of the injudicious vulgar, but the judicious eſtimates of reaſon, improved by philoſophy, and enlightened by natural theology.

I KNOW the undiſcerning multitude, whoſe judgment ſeems rather lodged in the eye than in the brain, when they hear men name greatneſs of mind, are apt to fancy ſomething, that, like the coronation of a king, is attended with pomp and ſplendor, and a numerous train of gazers, and the loud acclamations of the people. And, at leaſt, when mention is made of an heroic ſoul, they imagine, that it cannot be but in a great commander, like a Roman emperor, or a Tartarian general, that leads and defeats armies, and deſolates whole countries, and leaves them peopled only with carcaſes. But reaſon and religion, that look on human things with eyes untroubled by thoſe pompous outſides, that dazzle the vulgar, can eaſily ſee a vaſt difference betwixt greatneſs of fortune and greatneſs of mind. And not only Chriſtianity teaches, that 'God, who is no Προσοπολήπτης, reſpecter of perſons,' *Acts* x. 34. 'ſees not perſons as man ſees them;' 2 *Sam.* xiv. 14. and that 'a thing that is ſublime 'amongſt men, may be an abomination to Him.' But philoſophers themſelves can eaſily diſtinguiſh betwixt that real greatneſs, that truly belongs to the man, and that theatrical one, that fortune may have annexed to his condition. And, though they pay a peculiar honour and reſpect to great virtue in ſovereigns, rather than in ſubjects, becauſe in the former it is more diffuſively beneficial, and cannot laſt without reſiſting ſtronger temptations; yet, they do not think, that a great empire always either finds, or makes, a great ſoul. And if dignities, how high ſoever, be attained by mean ſubmiſſions, or weak actions, they think this extrinſecal greatneſs can no more make a mean ſoul great, than high ſtilts can make a dwarf a proper man. Perhaps they look upon many, who, for making a great buſtle and noiſe in the world, are, by themſelves, and the ſhallow vulgar, thought great ſpirits, but as gnats, that are in themſelves ſmall and worthleſs creatures, and are really conſiderable for nothing, ſave the noiſe and the ſtings wherewith they are able to diſturb men's reſt. That lucky monarch, that overcame ſo great a part of the then known world, and conquered countries, faſter than one would have thought he could have travelled over them, has this character given of his ſtupendous exploits by the Roman hiſtorian, that all he had done was, 'that he durſt well deſpiſe deſpicable things.' And in a poet of the ſame nation this is his elogy,

Fælix terrarum prædo, non utile mundo
Editus exemplum.

AND if ſuch perſons as they had ſo little reſpect for ſo great a monarch, that was a lawful ſovereign; what liberty, think you, do philoſophers allow themſelves, who

ſo

ſo little value the favourites of fortune for their being ſo, that even ſuch as thoſe proſperous uſurpers, *Phocas*, *&c.* that her fondneſs, and the applauſe of a multitude, (as blind, perhaps, as ſhe is painted) have ſeated in the throne, philoſophers, in their thoughts, do as well doom to a ſcaffold, as religion does to hell? And certainly, true greatneſs of mind muſt be ſomething, that both reſides in the ſoul, and is perfective of it; neither of which properties belong to any thing, that fortune can beſtow: and all that outward greatneſs can do is not to make a ſoul great, but to afford one, that is, the opportunty of ſhewing itſelf to be ſo. And all theſe ſubmiſſions and reſpects, that cuſtom, or fear, or intereſt, make men pay to thoſe, whom only their titles, or their places, or their power, make great ones, do as little argue or increaſe the real worth of thoſe envied perſons, as the ſtanding for more than formerly in an account turns a braſs counter into ſilver or gold. And as no leſs ſkill in arithmetic is required, to multiply, *&c.* a thouſand farthings than a a thouſand guineas, though one of the latter be worth above a thouſand of the former; ſo the ordering or diſpoſing of all things according to the beſt rules, and after the beſt manner they are capable of, may argue no leſs greatneſs of mind in a private man, than is exerciſed by a great monarch, in thoſe actions, that attract the eyes, and buſy the tongues, of nations. And as it uſually ſpeaks a man a better artiſt to make a pocket-watch, than a great town-clock, all the advantage the latter has of the former conſiſting in the greatneſs of the matter that is wrought, and not that of the ſkill that is diſplayed; ſo it ſometimes happens, that thoſe productions of virtue argue a greater ſoul, that make by far a leſſer ſhew and noiſe. And you may remember, not only that *Socrates*, notwithſtanding his private, and even neceſſitous, condition, was by the oracle preferred to all the *Grecians*, when *Greece* was the theatre of generous minds; but, that a far truer oracle than that of *Delphos* pronounced the poor widow's mind, and circumſtances, to have made her mite a greater liberality, than all that the rich man had beſtowed upon the Corban. And it is the ſentence of no worſe a judge than *Solomon*.

Mark xii. 43. Prov. xvi. 32.

LET us not then, from the mean notions of the vulgar, and the fond opinions of common ſouls, take our eſtimates of ſo ſublime and extraordinary a quality, as greatneſs of mind. For many things, to which they give not only their approbation but their applauſe, are, and ought to be, as little eſteemed, if they be condemned by the wiſe, as a piece of braſs money, that has long paſſed current among the people, ought to be thought good gold, when refiners and ſay-maſters have declared it counterfeit. And if you aſk me, what notion then of greatneſs of mind I am willing to allow, I ſhall freely tell you, that, in my apprehenſion, the man, that has a great mind, is he, that uſes his utmoſt moral diligence to find out what are the beſt things he can do, and then, without being deterred by dangers, or diſcouraged by difficulties, does reſolutely and ſteadily purſue them, as far as his ability and opportunities will ſerve; and this out of an internal principle of love to God and man, and with a ſincere aim to glorify the one, and benefit the other.

CHAP. II.

BUT, before I deſcend to particulars, it will not be amiſs to take notice of one conſideration, that may, in general, make it probable, that the Chriſtian religion is rather favourable, than oppoſite, to true magnanimity. That this argument may make ſomewhat the more impreſſion, I ſhall, though very briefly, obſerve, that the aſpects, both of the Author, the rules, the aims, or ſcopes, and the rewards of virtue, as it is recommended by Chriſtianity, have a great and direct tendency to elevate it, and make it heroic.

AND

And firſt, the prime Author of the doctrine of the goſpel being God Himſelf, who both knows man perfectly, and is mentioned in ſcripture as a Φιλάνθρωπος, or Lover of mankind; it is but reaſonable to ſuppoſe, that the doctrines and laws He cauſed to be ſolemnly delivered to mankind, and confirmed by miracles, and whoſe ſyſtem is, in the Apocalypſe, honoured with the title of the everlaſting goſpel, (*i. e.*) not to be ſucceeded by a more perfect inſtitution, as the Moſaic law was by that, ſhould be fitted to beget and advance ſolid and ſublime virtue, and be, more than any other inſtitution, perfective of human nature. Tit. iii. 4. Rev. xiv. 6.

Next, the rules, and (if there be any ſuch) the counſels of the Chriſtian religion require, and tend to, extraordinary degrees of virtue. The divine Legiſlator, being able to look into the hearts of men, makes his laws reach thoſe, and thoſe principally too. The "loving God with all our hearts, with all our minds, *&c.* and our "neighbour as ourſelves," as comprehenſive as thoſe two grand principles of virtue are, is by our Saviour made the ſummary of the moral law, and adopted into the goſpel; the "cleanſing ourſelves from all filthineſs, both of fleſh and ſpirit;" and the "abſtaining from all kind or appearance of evil," are the negative parts of the Chriſtian's duty; and for the poſitive parts, we are plainly told, that, "unleſs our "righteouſneſs exceed that" boaſted one "of the ſcribes and phariſees, we ſhall not "enter into the kingdom of heaven." We are urged "to grow in grace, to add "to our faith, virtue," and to that, a whole train of excellent qualities. And, for fear any ſuch thing ſhould be thought to be purpoſely omitted, becauſe left unmentioned, this general exhortation is given us; "finally, my brethren, whatſoever "things are true, *&c.*" But there is yet a more aſpiring path of virtue traced us out in the goſpel, where it propoſes to us the example of Chriſt, as one, whoſe ſteps we are to tread in: for not only that divine Perſon never committed any ſin, neither was guile found in his mouth; but the ſupreme and omniſcient Judge, God Himſelf, declared, by a voice from heaven, his full approbation, both of his perſon, and his doctrine, when He ſaid, "This is my beloved Son, in whom I am well pleaſed; "hear ye Him." And his ſinleſs life, which was a living law, did not only ſurpaſs the examples, but even the precepts and the ideas too, of the heathen moraliſts and philoſophers, as may be elſewhere ſhewn. And the becoming a ſerious diſciple of ſo perfect and divine a Teacher does itſelf ſo engage a man to renounce his former vices, that, when St. *Paul* had diſſuaded his *Romans* from divers other vices, inſtead of exhorting them to the contrary virtues in particular, he only deſires them, in general, "to put on the Lord Jeſus Chriſt," as a comprehenſive duty, which contained in it all the virtues, he declined to enumerate. 2 Cor. vii. 1. 1 Theſſ. v. 22. Matth. v. 20. 2 Pet. iii. 18. i. 5. Phil. iv. 8. 1 Pet. ii. 22. Mat. xvii. 5. Rom. xiii. 14.

Thirdly, but though He calls us to high degrees of virtue, yet He does not to unattainable ones: for, though philoſophy wiſely forebore (though not always to commend, yet) to enjoin things diſproportionate to human infirmities; yet He may well be allowed to engage us to more than human virtues, that by his divine aſſiſtances, if they be duly ſought, is always ready to enable us to acquire and practiſe them. "Of his fulneſs," ſays St. *John*, "we have all received, and grace for grace;" (*i. e.*) either graces anſwerable to his, as the faculties of a child's mind are to thoſe of a perfect man; or, grace upon grace, (*i. e.*) an accumulation of graces heaped upon one another; which may keep you from wondering, that St. *Paul* ſhould dare to ſay, "that he could do all things through Chriſt, that ſtrengthened him." And where his invitations meet with an honeſt and a willing mind, his commands do not only chalk out the way, but give ſtrength to walk in it; and He uſually does, by his Spirit, ſuch a kind of work, as He ſometimes did miraculouſly by his power, when He at once bid and enabled a paralytic perſon, that wanted ſtrength to ſtir from John i. 16. Phil. iv. 13. Mat. ix. 6.

Matt. xiv. 29. from his bed, to riſe and walk; and when, having commanded St. *Peter* to walk to Him upon the ſea, He enabled him ſecurely to tread upon the waves; thereby approving and rewarding the excellent notion that diſciple had, that the command of Chriſt was a ſufficient cauſe to put him upon action, though a miracle were requiſite to carry him through with it.

FOURTHLY, the rewards propoſed to virtue and piety by the Chriſtian religion do exceedingly tend to animate and heighten them, whether we conſider the recompences the goſpel propounds in this life, or thoſe that it promiſes in the next. The great preſent rewards of virtue are, you know, the approbation of good men, and the applauſe of a man's own conſcience. The firſt of theſe is as well attainable by Chriſtian heroes, as by any other; for virtue loſes neither its worth nor amiableneſs by being baptized; and though in ſome times and places leſſer degrees of it may be diſregarded, or traduced, yet, generally ſpeaking, the greater degrees of it will either invite or extort men's eſteem. Among the Roman perſecutors, the exemplary lives and conſtancy of the primitive Chriſtians brought it to be proverbially ſaid, *that ſuch a man was a good man, ſaving that he was a Chriſtian*; and, *Soli Chriſtiani mortis contemptores* was uſually in heathen's mouths. There are divers qualities, and thoſe more preſſed by the Chriſtian than any other inſtitution, that have in them ſo much of native lovelineſs, that St. *Paul* might juſtly ſay of them, "that he that exerciſes
Rom. xiv. 18. "himſelf in them, is," generally ſpeaking, "both acceptable to God, and approved "by men." Nor did thoſe virtues, that recommended the great *Conſtantine*, whilſt he was a Gentile, loſe their luſtre, or the veneration they procured him, when he turned Chriſtian, and practiſed them with higher aims, than that of ſatisfying himſelf, and pleaſing his people.

AND as for the reward of a good conſcience, which was able to make *Hercules* undergo all his labours, and made all the other heroes of the Gentile world; I think, it will not be doubted, but that this inward recompence is received, not only without any defalcations, but with great improvements, by him, whoſe virtues flow from religion. For to him the applauſes of conſcience may well be more acceptable
Dan. iii. 7. than all the various ſorts of muſic, that ſolemnized the dedication of *Nebuchadnezzar*'s golden image, ſince in him conſcience does not, as in mere natural men, act only the part of a domeſtic judge, but that of a delegate from God Himſelf; and its abſolutions are leſs welcome, as they are approbations of reaſon, than as they are the pledges of God's acceptance, and of that higher reward, that will be conſequent to it in the life to come.

FOR theſe joys, that are placed on the other ſide of the grave, are much the nobleſt part of the recompence of virtue, and proportionable incitements to the practice of it; and yet, on the account of future rewards, the Chriſtian has much greater motives to heroic virtue, than the heathen moraliſt or philoſopher. For the poſthume ſtate of man is ſo dim and uncertain, that we find even the greateſt men among the heathens ſpeak very doubtfully, and not without ifs and ands, of a future ſtate, and much more of a future happineſs, as may be inſtanced in *Socrates*, *Cyrus*, *Seneca*, and many others; ſo that they rather ſeemed to have wiſhed, or hoped, than believed, their future felicity: and, I fear, that many of them, finding that happy ſtate deſcribed chiefly by the poets, reckoned it among poetic fictions. And thoſe, that did, though but waveringly, expect recompences in the life to come, had but poor and mean ideas ſuggeſted to them of it; the hopes they were entertained with being of fortunate iſlands and the Elyſian fields, which are not ſo tranſcendent, as to make a diffident man very forward to quit the gardens of *Epicurus*, that he has here in poſſeſſion, upon the doubtful hopes of other gardens in *Elyſium*. Whereas, to excite

cite the Chriſtian to an heroic degree of virtue, he is not allowed to hope, but commanded to be entirely confident of paſſing out of this world into a place, to which the poets Elyſium is much more inferior, than the poſſeſſion of a garden is to that of an empire. To attempt the deſcription of that celeſtial happineſs, would be, contrary to my inclination, to launch out into a common place; and were a work, that, if my haſte did not, my diſability would diſſuade me from: and therefore, though it be a ſtate made up of the confluence of all ſorts of things rationally deſirable, yet having only ſaid in general of all the other goods, that it comprizes, that the ſcripture tells us, "that eye has not ſeen, nor ear heard, nor the heart of man con- 1 Cor. ii. 9.
"ceived, what God has laid up for them that fear him;" I ſhall particularly take notice only of thoſe parts of this ineſtimable reward, that may peculiarly concern my preſent purpoſe, by being the chief things, that heroic ſouls are wont to aſpire to, a good name, honour, and dignity.

To have a good name for good actions cannot but be a very deſirable thing, the applauſe of wiſe and good men being a loud echo from without, that by repeating it confirms the approbation given by the conſcience within. But though to do virtuous and worthy actions be the beſt and likelieſt way of acquiring a good name, yet it is not a certain one: for ſuch is the ignorance, the malice, or the enmity of a great many, that no man is ſure to eſcape being miſrepreſented or traduced, as we ſee that the ſublimity, the brightneſs, and the regular courſes, of the ſtars themſelves, could not hinder wanton poets, or fanciful aſtronomers, from giving thoſe luminous conſtellations the names not only of the nobler beaſts, as the lion, the eagle, and the whale; but even of animals, that lye under an ill name, as the dog, the goat, and ſcorpion. And though it be true, that oftentimes innocency, long clouded, does, like lightning, break out at laſt; yet oftentimes too that happens not, till malice and envy are dead, becauſe the maligned perſon is ſo; by which means he does not live to know he is juſtified, and many, if not all, of thoſe miſinformed men are dead and gone, for whoſe good opinion he was chiefly concerned. But though the Chriſtian may, as well as any other, be traduced by calumny, which often ſerves good men as the heathen perſecutors did the martyrs, (when they expoſed them to the people's view, clothed in the ſkins of beaſts, to make them hideous and hateful); yet he is juſtly cheered by the aſſurance he has, that there will come a time, when oppreſſed and diſfigured innocency ſhall ſhine forth and triumph, and his good name, as well as his body, ſhall have a glorious reſurrection, even in the ſight of his accuſers and enemies, and of all thoſe, whom their ſlanders did either prevail with, or ſtartle. For at that great and general aſſize, to which there ſhall be a far greater confluence than the Aſſyrian monarch drew to the plains of *Babylon*, the heroic diſ- Dan. iii.
ciples of the apoſtles will be able to ſay, upon happier terms than the apoſtles themſelves did here below, that they are made a "ſpectacle to God, to angels, and to 1 Cor. iv. 9.
"men." And in that illuſtrious aſſembly of the "firſt-born, whoſe names are Heb. xii.
"written in heaven," being preſent, the men, not only of all nations, but of all 23.
ages, the vizards ſhall be as well taken off as the maſques; and the formerly traduced ſaints being welcomed with the title of "good and faithful ſervants," ſhall ſolemnly Matt. xxv.
be acquitted by the ſentence, not of a fallible or partial judge, but of an infinite 21.
and ſupreme One, "that ſearches the hearts and reins," and cannot be deceived or Jer. xvii.
bribed; and, to be ſure that the injured ſaint ſhall come off with honour enough, 10.
he ſhall then be abſolved by being crowned.

This celeſtial crown comprehending, in the ſcripture dialect, both the remaining parts of the Chriſtian's reward, honour and dignity, or glory and preferment; it will be pertinent to mention ſome advantages, that give it an high preference above the crowns of monarchs here below.

AND firſt, earthly crowns may ſometimes be the fruits and recompences of worth and virtue, but are not at all the proofs of them. They are uſually the gifts of nature, and not unfrequently of fortune; and hiſtory gives us cauſe to wiſh, they were more ſeldom the acquiſts of crimes. But the celeſtial crowns proclaim, though not the merit, the worth of them that receive them, being never adjudged but to ſuch,
Col. i. 12. whom previous graces and virtues have fitted and qualified for "the inheritance of "the ſaints in light."

BESIDES, as an earthly crown may be acquired without merit, ſo it may be poſſeſſed without happineſs. And if crimes be made ſteps to a throne, they prove ſo many thorns to him that ſits on it, who is there a more illuſtrious (not a leſs tormented) malefactor; the ſublimity of a throne, as little as the height of a ſcaffold, keeping a criminal perſon from feeling the puniſhments inflicted on him there. As may
Acts xii. 21. appear by the inſtance of *Herod Agrippa*, whoſe throne, and gliſtering habit, which *Joſephus* takes notice of, though they procured him not only the acclamations, but adorations, of the dazzled multitude, could not protect him from the incenſed juſtice of an higher King than he; ſo that, whilſt others treated him as a god, he found himſelf one of the moſt miſerable of men, and was fain to haſten from a ſeat, which occaſioned (but could not protect) his impiety. But a celeſtial crown, as it is graciouſly beſtowed for the ſupreme recompence of virtue, and on that account may be called a crown of righteouſneſs; ſo it always proves a bleſſing, as inſeparable from happineſs, as a thing is from itſelf. The crowns of this world, by the very advantage of being hereditary, ſhew, that they cannot preſerve the poſſeſſors from
Rev. ii. 10. death. But the crown, I ſpeak of, is, by the divine Beſtower of it, called "a crown "of life;" and of it, in reſpect of other crowns, may be truly ſaid, what *Solomon*
Eccl. vii. 12. ſaid of wiſdom, in reference to other goods, that the excellency of it is, that it gives "life to the owner thereof." And though earthly crowns be ſuch tranſitory things,
Dan. ii. that we may obſerve, that even the four great monarchies of the world were by God repreſented to *Nebuchadnezzar* but as parts of a dream, whereas the kingdom, pro-
Heb. xii. 28. miſed to Chriſtians, is called in the ſcripture "a kingdom that cannot be moved," as the believers crown is, in oppoſition to thoſe fading crowns of laurel, that adorn
1 Pet. v. 4. the heads of the Roman conquerors, called an "unwithering crown of glory:" as if the laurel, placed on the Chriſtian's head, could grow and flouriſh in the wreath, better than it did on the tree.

BUT all that I have yet ſaid is inferior to this laſt prerogative of the celeſtial crown, that it does not only confer a relative dignity or pre-eminence, but an eſſential worth and excellency; as if the diamonds, which adorned that crown, ſhould impart their own ſparklingneſs, tranſparency, and incorruptibility, to the perſon that wears it. The higheſt preferments here below do raiſe a man above others, without raiſing him above himſelf. By being at the top of a ladder, a man comes to an higher ſtation, but is not really taller than he was; and a vane, by being placed on the top of the higheſt ſteeple, is not from iron turned into gold or ſilver, but remains ſtill of the ſame baſe metal it was, and is but a weather-cock, and ſo the ſport of the winds. But a celeſtial crown is always attended with a perſonal improvement, befitting ſo high a dignity. The heavenly coronation has a virtue like that of the unction of
1 Sam. x. 6. *Saul*, who, upon his being made king, was enabled to propheſy, and was turned into another man. And the reſemblance holds in this too, that Chriſt is ſaid to
Rev. i. 6. have made his redeemed ones, not only "kings, but prieſts to God and his Father;" as if the kingly dignity were not enough, unleſs the ſacred character of a prieſtly office were added. Congruouſly to which, St. *Peter* calls Chriſtians, in general, a
1 Pet. ii. 9. "royal prieſthood;" the underſtanding, the will, the affections, are all refined and elevated;

elevated; and the very body itſelf is transformed into a ſpiritual body. As if the glorified ſoul did ſhine, with an undiminiſhed ſplendor, through its happily changed manſion. And we may well ſuppoſe, that this will be a bright and noble ſtructure, if we remember, that the angels, who, in their apparitions to good men, were wont to be very careful not to frighten them, did yet appear with a majeſtic ſplendor; and that angel, that the apoſtles ſaw in our Saviour's ſepulchre, is repreſented, as a young man clothed "in a long white and ſhining garment." And we are told by St. *Paul*, that, in the future ſtate, "our vile bodies ſhall be transformed into the "likeneſs of his glorious body;" and how glorious it is in heaven, we may gueſs, by what it was at his transfiguration here on earth, during which, the ſcripture relates, "that his face did ſhine as the ſun, and his raiment was white as the light." And of *Moſes* and *Elias*, though they came to ſpeak to him of his death, it is added by St. *Luke*, "that they alſo appeared in glory." And ſince our Saviour has aſſured us, that "thoſe that ſhall be accounted worthy of that ſtate," ſhall be like, or equal to the angels; and that then the "righteous ſhall ſhine like the ſun in the kingdom "of their Father," who knows but, that the transfigured ſoul and body of ſome happy ſaint may be as glorious a ſight, as that which appeared to St. *John* in the Apocalypſe, when he ſaw an angel "ſtanding in the ſun?" If it be ſaid, that theſe are very bold hyperboles, I hope the texts, I have mentioned, will keep them from ſeeming altogether groundleſs conceits. And when, among other excellent prerogatives, that our Saviour promiſes the perſevering believers, one is, "that he will give them "power over the nations, and to rule them with a rod of iron;" and the other, which may well be the laſt, is expreſſed in theſe words. "To him that overcometh, will "I grant to ſit with me in my throne, even as I overcame, and am ſet down with "my Father in his throne." And though I readily yield, that theſe expreſſions are not to be ſtrictly and literally taken; yet, when I conſider the infinite power, and goodneſs of God; and that, for ought we know, he may have numberleſs dominions, and ſets of governable creatures, that we are yet ſtrangers to; I think, God's attributes, and Chriſt's expreſſions, may warrant us to expect amazing things from him, that is able, and has declared himſelf willing, to do for us "above what we can aſk, "or," in our preſent ſtate, ſo much as "think." And, at leaſt, that will be allowed me, which I drive at in this celebration of our future happineſs, that the Chriſtian religion, by propoſing ſuch ineſtimable rewards, preſents believers with far higher motives to heroic virtue, than morality, or philoſophy, can afford other men.

Mark xvi. 5. Luke.xxiv. 4. Phil. iii. 21. Matt.xvii. 2. Luke ix. 31. Matt.xxii. 30. Matt. xiii. 43. Rev. xix. 17. Rev. ii. 26, 27. Rev. iii. 1. Eph.iii. 20.

ADVERTISEMENT.

THE author being deſired to add yet ſomething to the foregoing diſcourſes, to give the book they make parts of, a thickneſs more proportionate to its largeneſs; he did, among other papers of his, that he turned over, in compliance with that requeſt, light upon an epiſtolary diſcourſe, which by its very being unfiniſhed ſeemed (by reaſon of its ſhortneſs) the more fit to ſerve the preſent turn. For this tract having been drawn up in a country, whence the author was obliged to remove, before he had made any conſiderable progreſs in his work; he was eaſily induced to put it up in a bundle of other writings, which, like this, were laid aſide, till he ſhould be at much leiſure to complete them. But, upon the newly mentioned occaſion, finding, that among divers looſe and leſſer memoirs, that had been thrown together in order to the deſigned treatiſe, there were fifteen or twenty pages at the beginning that were coherent enough; he was content they ſhould attend the Chriſtian virtuoſo, becauſe of the affinity of the things deſigned in both the papers; which being to re-

commend the Chriſtian religion to worthy ſouls, it was congruous enough, that a diſcourſe, which ſhews, that the Chriſtian religion may very well conſiſt with a philoſophic genius, ſhould be accompanied by another, that tends to manifeſt, that greatneſs of mind, which compriſes uncommon degrees of virtue, is not only conſiſtent with Chriſtianity, but may be highly promoted by it. Thoſe, that reflect on this aim, will not (it is hoped) think it ſtrange, that the ſtile is a little raiſed; ſince though the ſubject be theological, yet the writer (who was then many years younger than he now is) being a perſon of honour, and writing for a noble gentleman, who, like himſelf, was a layman; it was thought not only allowable, but fit, that the ſtile ſhould not be altogether unſuitable to the ſubject and to the aim; which was to make impreſſions on an illuſtrious perſon, not by dry precepts, or languid diſcourſes, but by exciting him to heroic virtue, by the nobleſt patterns and ideas, and the moſt moving incentives, he could propoſe.

AND though the diſcouragements lately mentioned, and ſince encreaſed by the author's not being able to find ſome of the principal materials he had, in looſe ſheets, provided for the following diſcourſe, oblige him to lay aſide the thoughts of completing it; yet becauſe it is very poſſible, that ſome elevated ſoul may have a mind to proſecute the deſign, or cultivate ſo noble a ſubject; he thought it not amiſs (as little ſamples of his method or way of treating it) to ſubjoin to the greater fragment, beſides the index of the heads of diſcourſe, intended for the firſt part, five or ſix leſſer fragments, that he lighted on, whilſt he was ſeeking for ſome papers belonging to the ſame tract, that ſhould have been, but were not found in their company.

CHAP. III.

First fragment.

TO have high aims and noble deſigns, is ſo genuine a mark, and effect of greatneſs of mind, that there is not any more generally acknowledged; inſomuch that ambition, though it be but a depravation or a counterfeit of this heroic frame of mind, does yet ſo dazzle the eyes of the greater part of men, as to paſs for magnanimity; and noble attempts do oftentimes, even when they fail of ſucceſs, not miſs of eſteem.

——*Magnis tamen exidit auſis,*

was meant for an encomium by him, that ſaid it. And I remember, that one of the ancients reckons it among the glories of that great captain *Hannibal*, who long ſucceſsfully diſputed with the Romans the empire of the world, that he reſolved to beſiege *Rome*, though he never proved able to lead his army within the ſight of her walls.

Now as to have elevated aims is one of the chief ſigns, and indeed parts of an heroic temper of mind; ſo there are no men, that ſeem to me to have nobler and ſublimer aims, than thoſe, to which a true Chriſtian is encouraged; ſince he aſpires to no leſs things than to pleaſe and glorify God, to promote the good of mankind, to improve, as far as poſſible, his perſonal excellencies in this life, and to ſecure to himſelf for ever a glorious and happy condition in the next.

CHAP. IV.

Second fragment.

ONE of the grand difficulties, that he, who would be highly virtuous, muſt expect to ſurmount and conquer, eſpecially in ſuch a degenerate age as ours, is the temptation, that is afforded by the univerſality of vicious cuſtoms and examples. I wiſh

I wiſh it were needleſs ſolicitouſly to prove, either how great an influence examples, eſpecially bad ones, have on the generality of men; or how general bad examples have been in moſt ages, and in particular in that we live in. The ſcandal given by bad examples, though it be one of the moſt obvious temptations, is none of the leaſt dangerous. For intereſt, baſhfulneſs, and that very complaiſance and civility, that is ſo uſually found in well-bred or good-natured perſons, makes them very unwilling to offend or diſoblige the company they live with, and whom they have ſeveral inducements rather to pleaſe and gratify by imitation and compliance, than tacitly to reproach by non-conformity to their ſentiments, and practices And in effect we find, that many, that could not be perverted by the frowns and threats of the vicious, have been debauched by their company and example. Againſt this powerful temptation religion ſtrongly arms its hero, both by precepts and precedents. "Thou "ſhalt not follow a multitude to do evil," was the expreſs command of the Moſaic law. "Say not thou a confederacy to all to whom this people ſhall ſay a confederacy," was the command of God to his prophet. Our Saviour makes it an argument to diſſuade his diſciples from an anxious ſolicitude about meat and drink, and clothing, that after all theſe things the Gentiles (which are by far the moſt numerous part of mankind) do ſeek. And upon the ſame ground, he endeavours in the ſame divine ſermon upon the mount, to keep them from vain repetitions in prayer. And whereas it may ſeem an immodeſty to dare to diſſent from others, that vaſtly ſurpaſs us in number; the heroic conqueror of *Canaan* ſpeaks thus to the whole body of the victorious Jewiſh nation, that they may chooſe to ſerve whom they thought fit, and worſhip either the gods, whom their fathers ſerved, or thoſe worſhipped by the neighbouring nations; "but as for me and my houſe, we will ſerve the Lord." "Be you "not conformed to this world," ſays St. *Paul.* And another apoſtle, ſpeaking of himſelf and the true Chriſtians of his time, ſcruples not to affirm it paſſionately and roundly, "we know, that we are of God, and the whole world lies in wickedneſs." 1 John, v. 9.

Nor does religion furniſh us with precepts only to diſobey cuſtom and example, but with precedents too, of which there are three ſo illuſtrious, that I know not how to paſs them by. The firſt is afforded by *Lot*, who lived in a place, that was grown ſo proverbial for the height of wickedneſs, that to aggravate their ſins by the moſt hyperbolical compariſon, we muſt liken them to themſelves; and they were grown ſo wicked, that in a place, where an admirable plenty, and an unbounded libertiniſm could not but make them very populous, there could not be found half a ſcore of good men, the generality of that curſed people being fallen ſo much, not only from virtue, but from common honeſty, that they did not reſtrain themſelves ſo much as to human vices. And yet, even the ſins of *Sodom*, which cried ſo loud as to reach heaven, and bring down fire and brimſtone from thence, diſturbed *Lot*'s quiet, without deſtroying his innocence; and an apoſtle aſſures us, that that "juſt man was but vexed "with the filthy converſation of the wicked," not prevailed with in the leaſt to imitate it.

The next inſtance of a religious courage, inflexible to bad examples, is afforded us by the three friends of *Daniel*, who, at the great ſolemnity of the dedication of *Nebuchadnezzar*'s golden image; when they had, beſides that great and ſtern monarch's command, the example, not only of many men, but many nations, and a more numerous aſſembly of perſons, conſiderable for quality and dignity, than the world ever ſaw before or ſince, ſingly oppoſed their naked conſtancy to the haughty tyrant's menaces, and the proſtrate world's example. And yet theſe men were courtiers, bred among that ſupple ſort of fine creatures, that were as accuſtomed to bow their conſciences, as their knees to their proud maſter. They had not only lives to loſe,

loſe, but the chief dignities of the province of *Babylon*, then the queen of nations. And they could not upon their refuſal quit the ſtatelieſt palace in the world, without immediately changing it for a burning fiery furnace.

THE laſt inſtance I ſhall name, and the moſt illuſtrious that can be named, is that I am ſupplied with by *Noah*: he lived in an age, in which there were as many heinous ſinners almoſt as there were men: though vice has generally had a *Benjamin*'s portion in the diſtribution of mankind betwixt it and virtue, yet, *Methuſala* excepted, the inequality was grown ſuch, as gave vice rather a monopoly than a ſhare of men; or if a diſtribution were to be admitted, it was ſuch a one as that made of *Saul* and his army, when all the people were on one ſide, and only he and *Jonathan* on the other. It is ſtrange, that when the world was ſo recent, that many that were then alive might remember and converſe with one, that for two hundred years lived contemporary with *Adam*, (for ſo we may gather *Methuſala* to have done) men ſhould ſo ſoon forget all ſentiments of piety. But yet in *Noah*'s time the world could not be compared to its preſent ſtate, where though it be night in one place, it is day in another; but to the ſtate of *Tohu va Bohu*, or the firſt chaos, where darkneſs was over the face of the univerſal deep. For the ſcripture tells us, "that all fleſh had corrupted his way upon "the earth, that every imagination of the thoughts of man's heart was only evil con- "tinually." And though *Noah*'s family were ſaved with him in the ark, yet it may be doubted, whether that were a certain token of their being untouched by the general contagion. For that wonderful veſſel contained beaſt clean and unclean, harmleſs and rapacious, and in it were ſaved wolves as well as lambs, and vultures as well as doves. And where God gives the reaſon, why he vouchſafed to receive *Noah* and his houſe into the ark, he expreſſes it thus; "for thee have I ſeen righteous before "me in this generation," without making mention of any of his family. Nor was the wickedneſs of the antediluvian world more univerſal than it was great; that mungrel breed were guilty of ſins as gigantic as themſelves. The text ſays, "that "the earth was filled with violence" through them; and thoſe impious rebels againſt their maker broke the laws of nature with an inſolence, that provoked him to break off the courſe of nature to puniſh them, ſince nothing leſs than an univerſal deluge of water could place limits to ſuch an impetuous and overflowing impiety. But all theſe ſinful examples, how general ſoever, could not prevail on *Noah* ſo much as to keep him from giving one of a quite contrary nature: the ſcripture calls him an herald or "preacher of righteouſneſs;" and though it appears not, that he made any converts, he perſevered in his rejected admonitions for ſix ſcore years, a time long enough to have tired his patience, eſpecially ſince he did not any of his hearers obſtinacy. And his conſtancy raiſed him as much above the reach of their temptations, as the waters that puniſhed their ſin raiſed his ark above their drowned manſions. And now go and compare with any conſtancy of the following times, where virtue has always had ſome party, though not a numerous one, this unequalled ſingularity of *Noah*, which God himſelf ſeems to have taken ſpecial notice of, not only by that patriarch's wonderful preſervation, but by ſaying emphatically, "thee have I ſeen "righteous before me in this generation," which was ſo brutiſh and depraved, that I know not, whether he were not obliged to live among worſe brutes before he finiſhed the ark than afterwards, when in it he was ſhut up with lions, foxes, and tygers.

Gen. vi. 12.

2 Peter ii. 5.

Gen. vii. 1.

ANOTHER virtue, that belongs to a great mind, is conſtancy, or perſevering patience in afflictions. This quality hath ſo noble an appearance, that when it is exerciſed even by malefactors, it obtains our eſteem; and whilſt we cannot ſo much as excuſe their actions, we cannot but commend the manner of their ſuffering for them: calmneſs

Third fragment.

neſs of mind, in the midſt of outward ſtorms, being ſomething, that looks ſo handſomly, that crimes and gibbets cannot keep it from doing ſo; nor hinder thoſe, in whom it is found, from being both pitied and applauded.

THAT this part of greatneſs of mind is befriended by the Chriſtian religion, more than by any other inſtitution, will appear; if we conſider, what it contributes to conſtancy and patience, under outward preſſures and calamities, by precept, by examples, and by arguments.

CHAP. V.

HUmility is a virtue, that, at the firſt bluſh, ſeems ſo diſtant from greatneſs of mind, that ſome would think it improper to refer the former to the latter, under any other notion, than that of an oppoſite. But, whatever may be thought of humility, ſolitarily conſidered, yet, when we find it in conjunction with thoſe other qualities, that contribute to make up greatneſs of mind, it adds to their number; and though it does not perhaps ſhine as bright as ſome of them, is as amiable as any; and imparts ſomewhat of its own lovelineſs to all the reſt. And you will not much wonder, that I place this virtue among thoſe that conſtellate, if I may ſo ſpeak, an heroic mind, if you conſider, whence humility may in ſuch a ſoul proceed, and what difficulties it may ſurmount. For if wealth, honor, and other outward bleſſings exalt our hero's condition; to be humble, in the midſt of ſuch advantages, argues a mind elevated above the preſents of fortune, and ſpeaks a ſoul great enough to undervalue thoſe things, that ordinary ſouls admire; and which even men, that paſs for great, make the objects of their ambition, and, when attained, of their pride. And if our hero be ennobled with great virtues, or famous for great actions; his humility argues, that he has ſo raiſed an idea of virtue, and dares aſpire to ſuch a pitch of it, that he cannot reſt ſatisfied with greater attainments, than perſons, but ordinarily virtuous, aim at; and looks upon himſelf as obliged and born to an unwearied purſuit of heroic and ſtill increaſing degrees of excellency. And if a laudable practice, by being extremely difficult, is a mark of a great ſoul, humility muſt not be denied that character; for this is a virtue more difficult to excellent, than to ordinary, ſouls. In other caſes, a hero is to contend but with his vices, or his paſſions, or his open enemies; but to be humble, he muſt overcome his virtues too; and that, when they act unitedly as one body: ſince, though other virtues naturally aſſiſt one another, they all conſpire to ruin humility; which, having pride to contend with, is to deal with ſo ſubtle an adverſary, that ſometimes even by being foiled he overcomes. And as the torpedo poiſons his arm, that wounds it; ſo ſometimes in the beſt arguments we employ againſt pride, the very ſtrength and ſeeming ſucceſs of them tempts the maker of them to be proud; and I will not ſwear, that, at this very time, I exalt our hero's humility, without any diminution of my own. Fourth fragment.

To the attainment of an eminent degree of this lovely both virtue and grace the goſpel conduces, by furniſhing its embracers with expreſs injunctions, clear directions, high rewards, and other weighty motives, and the nobleſt patterns and perfecteſt examples, that ever were or can be given.

The Heads of the Diſcourſe, entituled, "Greatneſs of Mind "befriended by Chriſtianity."

The INTRODUCTION.

Fifth fragment.

1. OF the true notion of greatneſs of mind.

2. OF the tendency, that the Chriſtian religion has to promote greatneſs of mind in general.

3. THAT Chriſtianity gives men noble aims, ſuch as the glory of God, the pleaſing of him, the general good of men, perſonal excellencies in this world, and eternal happineſs in the next.

-THE virtues or qualifications, which, as ſo many conſtituent parts, make up greatneſs of mind, and are peculiarly befriended by Chriſtianity, are chiefly theſe,

4. COURAGE or valour.

5. CONSTANCY and patience in afflictions.

6. BOUNTY or liberality.

7. FORWARDNESS to oblige.

8. READINESS to forgive.

9. A JUST and impartial eſtimate of riches, and other things, that ordinary men covet and admire.

10. HUMILITY.

11. A CONTEMPT of all that is baſe.

The END of the FIRST PART.

GREAT-

GREATNESS of MIND
PROMOTED BY
CHRISTIANITY.

The SECOND PART.

THE former diſcourſe has, I hope, ſufficiently manifeſted, that, of the ſeveral virtues and noble qualities, that make up true greatneſs of mind, there is not any, that is not at leaſt conſiſtent with Chriſtianity, and that moſt of them are eminently promoted by it. But I expect your Φιλήδονος will pretend, that there are ſome qualities required by our religion, that directly and powerfully tend to debaſe the mind they poſſeſs; and hinder it from attaining, or even aſpiring, to ſuch great things, as it would reach to, if it were not detained or depreſſed by religion. Let us now therefore examine, whether, notwithſtanding the wings, which we have ſhewn that religion adds to the mind, the clogs, that it faſtens to her, be heavy enough to diſable her to raiſe herſelf above the pitch of vulgar ſouls, and force her, inſtead of ſoaring aloft, to flutter about the earth. Sixth fragment.

THE chief things, that, as far as I can learn, are alledged, either by *Philédonus*, or more conſidering adverſaries than he, to ſhew religion to be either quite inconſiſtent with, or very unfriendly to, greatneſs of mind, are theſe——

[But, in regard, that I find not the anſwers, that were drawn up to the objections; and it is not ſo convenient to let the latter appear unaccompanied by the former, it is thought the ſafeſt way to leave them both at preſent unmentioned; and only take notice, that to the laſt of the ſix objections, which, to deal candidly, were named and conſidered, theſe words were found ſubjoined.]

AND now, if it appear, that neither any nor all of theſe have ſuch an unfriendly aſpect on greatneſs of mind, as is pretended; and that at leaſt the impediments, they can bring, are much more than countervailed by the aſſiſtances, that religion affords heroic virtue; I hope it will appear, that greatneſs of mind is not incompatible with Chriſtianity, but rather promoted by it.

Experimenta & Obſervationes Phyſicæ:

Wherein are briefly treated of

SEVERAL SUBJECTS

RELATING TO

NATURAL PHILOSOPHY

IN AN

EXPERIMENTAL WAY.

To which is added,

A ſmall Collection of STRANGE REPORTS.

A LETTER that may ſerve for a Preamble.

To my learned Friend Mr. *H. Oldenburg*, Secretary to the Royal Society.

SIR,

BEING at length come to a reſolution, I have already done ſomething more than barely entered upon that way of writing, that you and I have more than once diſcourſed of together; and wherein you particularly (though not you only) among my learned friends have wiſhed to ſee me engaged.

IT is not, that I am inſenſible of the prejudice, which the things I deliver are like to ſuſtain, by the diſadvantageous dreſs, wherein they muſt appear, in the way of writing I have pitched upon; which being for the moſt part plainly hiſtorical, and ſet down in the order wherein they chanced to come to hand, denies moſt of them, not only the uſual ornaments of other books, but the allowable advantages, that method, elaborate diſcourſes, neat hypotheſes, and ſubtile diſputes, are permitted to bring even to philoſophical writings.

BUT theſe conſiderations were overſwayed by a ſad one, founded upon the (yet continuing) condition I was in, when I was debating this matter in my thoughts. For it having pleaſed God (to whoſe always moſt juſt diſpenſations men ought entirely to ſubmit) to afflict me with the ſtone and the palſy; as on one ſide, theſe added to a ſufficient number of avocations ſcarce permit me any great expectation of finiſhing in a ſhort time the tracts I had made a leſſer or greater progreſs in, according to my firſt deſign; ſo on the other ſide, my friends judging it unfit, that the materials provided for theſe more than begun treatiſes ſhould be quite loſt, or kept too long uſeleſs, it ſeemed expedient,

pedient, that as opportunity ſhould from time to time ſerve, I ſhould look over my memorials, and other ſcattered papers, to take notice, what experiments and obſervations were to be found in them.

Upon theſe and the like inducements, having picked up ſeveral of my diſperſed papers, ſome of them written many years ago, and ſome of a leſs ancient date, I began to refer the moſt part of what I found hiſtorical in them, together with ſome few things, that did ſeem neceſſary not to be ſevered from them, to certain heads or titles, which I called chapters; and made them the more numerous, that they might ſingly be the leſs prolix: and about theſe I muſt deſire your leave to repreſent ſome things by way of preface.

And firſt, ſeveral of the enſuing particulars, that I met with among my papers, being parts of eſſays, or other diſcourſes, and being for haſte tranſcribed for the moſt part verbatim, as they were couched there; I dare hope for your excuſe, if among ſuch tranſcripts you now and then meet with things, which, how pertinent ſoever to the tracts they firſt belonged to, might have been ſpared as needleſs, if not ſometimes foreign alſo, in the new form the diſcourſes are now put into; ſince I could not leave out ſuch unneceſſary clauſes (whereof yet I hope you will not find many) without too much mutilating the coherence, or obſcuring the ſenſe of what is delivered; and I could not alter them, and adapt others to ſupply their places, without ſpending more time, and taking more pains, than in the condition I am now in, I ſuppoſe you would be willing to condemn me to.

Next I deſpair not, but you will allow me the liberty I have taken, to vary the bulk and method of particular chapters, as my occaſions would permit, or the plenty or paucity of materials ſuggeſted, or the nature of the thing I treated of, and the ſcope I propoſed to myſelf in writing of it, ſeemed to require. But ſometimes my want of health and leiſure, and my deſire to haſten to other ſubjects, that either pleaſed me better, or ſeemed more conſiderable, made ſome of the following chapters, compared with others, but ſhort; eſpecially if I were ſupplied but with a number of things pertinent to that ſubject, by the papers I had then in hand, how much ſoever I may have written of it in other papers, which I hope hereafter to be maſter of.

And this advertiſement may render you a reaſon, why to the title of ſome of the chapters I have ſubjoined the firſt ſection, though it be not at preſent followed with a ſecond.

And as for my having employed very differing methods in ſome of the enſuing tracts, I did it with deſign, as judging ſuch a variety of methods more conducive to my purpoſe, than uniformity in it would have been. For beſides that ſome of the treatiſes, whence theſe chapters were taken, did by the ways, wherein they were already written, oblige me to accommodate myſelf to their method; I thought, that if you ſhould ſhew theſe papers to any, that are very unacquainted (which I have heard you complain, that too many are) with the way of accommodating, in ſome tolerable manner, his enquiries and his writings to the ſeveral ſubjects he applies himſelf to, he may be ſomewhat helped by the differing examples he may here meet with, to make variations ſomewhat ſuitable to the differing natures of the ſubjects he deals with.

But here I muſt beg you to take notice, that though in compliance with this deſign, as well as for ſome other reaſons, I have in ſeveral of the following chapters given intimations and hints of things, which I do not there proſecute; and now and then propoſe ſome conjectures and opinions, whoſe proof I do not inſiſt on; yet I am not willing you ſhould think, that however ſome of thoſe paſſages may be but occaſional

things, mentioned principally to excite, and give hints to the inquiſitive and ſagacious; yet all, or moſt of them, are of the ſame kind; and that I thought not on them, but as ſlightly and tranſiently as I mentioned them; and have no better and other reaſons to alledge for my ſuſpicions or intimations, or even for my conjectures or my opinions, than thoſe you will meet with in papers haſtily drawn up; eſpecially ſince, I think, I can ſhew you divers of the things delivered in thoſe paſſages, enlarged and rendered at leaſt probable or practicable in other diſcourſes, that for certain reaſons do not accompany theſe I now ſend you.

I EXPECT, that you ſhould think it ſomewhat ſtrange, to find many of the following experiments ſet down much leſs circumſtantially, than thoſe that are mentioned in the phyſico-mechanical experiments touching the air; in the continuation of them; in the hiſtory of cold; and in ſome other books of mine, that you have been pleaſed to peruſe. But on this occaſion give me leave to repreſent to you, that the nature of divers of the former experiments, eſpecially chemical ones, and my aims in mentioning them, being conſidered, it ſeemed not requiſite they ſhould be more fully treated of: and as for others, though the brevity and diſpatch, which divers reaſons made me propoſe to myſelf, had not forbidden me to amplify; yet I daily feel my leiſure, not to ſay my life too, ſo torn piece-meal from me by ſickneſs, viſits, buſineſs, and inevitable avocations, that I am frequently admoniſhed to haſten the ſecuring of as much as conveniently I can, by diſpatching particular ſubjects, and am quite hindred from dwelling ſo long upon them, as if I had more health and leiſure, I ſhould willingly do. To theſe things perhaps ſo favourable a perſon as Mr. *Oldenburg* will add, that the characters, which learned writers, Engliſh and foreign, though divers of them perſonally unknown to me, have been pleaſed to give of the intelligence and ſincerity employed in ſetting down the *phyſico-mechanical experiments*, and thoſe of ſome other writings of mine, may permit me to hope, that it will be thought, that after having been divers years verſed in making trials and experiments, I have made them with ſome care and warineſs, and mentioned them faithfully, where I have not done it amply, upon hopes it may be taken in good part from a perſon in my preſent condition, that was never a profeſſor of philoſophy, nor ſo much as a gownman; to have made ſhift to make the experiments and obſervations he communicates, and ſet them down truly and candidly, without fraudulently concealing any part of them, for fear they ſhould make againſt him. And though perhaps you will eaſily believe, that in divers of the experiments which I have but briefly mentioned, I have been as diligent an obſerver of circumſtances, as I was wont to be when I made thoſe, which have had the luck to be taken notice of for being fully related; and though it may be alſo, that ſome ſcruples or objections, which my brevity may in part occaſion, were not unforeſeen by me, and might have been avoided by a more copious and diffuſed way of writing; yet I purpoſely decline ſuch a way of delivering things, not only for the reaſons above mentioned; and becauſe I ſuppoſe them, that may peruſe theſe papers, to be acquainted with my formerly publiſhed writings, and to have either from them, or otherwiſe, underſtood the way of making ſuch experiments as mine; but alſo, becauſe, though I wanted time and health much leſs than I do, I ſhould not think it fit too much to prevent the induſtry of others about the trials I mention; and reap the field ſo clean, as not to leave them, not only ſtore of ears to glean, but ſome corners of ſtanding corn; I have therefore here and there purpoſely omitted both, ſome not abſolutely neceſſary practical directions about making of trials, that might prevent ſuch ſcruples or objections, as have the grounds of anſwering them clearly delivered in my printed books; and ſeveral, not only leſſer circumſtances, but conſiderable phænomena, and obvious applications, that may probably occur to others, as they did to me in making the trials, and reflecting on them.

Adverti-

Advertiſements about the Diſpoſition of the following Treatiſe.

YOU will quickly diſcern, that the following chapters could not be intended for complete tracts about the ſubjects handled in them. And indeed they were intended but for ſuch memoirs about the various particular ſubjects they treat of, as may be ſerviceable to the ſolid natural hiſtory, that has been nobly deſigned, and is ſtill proſecuted by the Royal Society. Wherefore ſince (at leaſt in our age) no writer, that I know of, has ſo early and ſo well, both urged the neceſſity of natural hiſtory, and promoted divers parts of it by precepts and ſpecimens, as the illuſtrious Lord *Verulam*; I ſhall not ſcruple in the way or manner of writing theſe ſhort collections of mine, to make uſe ſomewhat frequently of his authority and examples, but without confining myſelf to either.

I. AGREEABLY to this advertiſement you will find, that ſome of the particulars, that the following treatiſe conſiſts of, are ſingle, and as it were, independent ones; upon which account they reſemble thoſe, which in the *Verulamian Sylva*, or Natural Hiſtory, are called experiments ſolitary: and have for that reaſon induced me to give that title to each of the ſeveral chapters, that are made up of them.

II. ANOTHER ſort of chapters there is, wherein divers experiments and obſervations, all of them relating to the ſame ſubject or purpoſe, are ſet down together. Theſe, if they were ranged and ſorted in order to diſtinct theories, I ſhall call, in imitation of the mentioned author, experiments in conſort. But my backwardneſs to frame theories has made me chuſe to forbear as yet to methodize them; and therefore has made me think fit to call them only various experiments and obſervations, about this or that ſubject, which they belong to.

III. My haſte, though not that only, induced me to make one ſort of chapters more, that partly agrees with, and partly differs from each of the two that I come from mentioning: for in every one of theſe chapters, there are two or three, if not more, ſingle or ſolitary experiments; and there are alſo others, that have ſome kind of connexion among themſelves, as being referable to the ſame ſubject or purpoſe. On that ſcore the title, that is given to each of the chapters of this third ſort, is that of miſcellaneous experiments, and ſometimes (but ſeldomer) of promiſcuous ones. And all the particulars, that I refer to the three forementioned heads, are caſt into chapters, wherein the ſeveral kinds are diſtinguiſhed only by their titles, or not.

IV. THERE is one advertiſement, that regards all the ſorts of particulars, that are referred to the forementioned chapters; which is, that I have uſually comprehended obſervations, as well as trials, under the title of experiments; which I have done, not only upon the authority, and in following the example of our judicious chancellor, (as is every where obvious in his *Sylva Sylvarum*) but for other reaſons to. For both the ſorts of particulars may paſs for matters of fact, and ſo are hiſtorical, taking the word in a lax ſenſe; and the employing it in that ſenſe makes the articles or paſſages, whereof the chapters and other parts of our collection conſiſt, much more commodious for references and citations.

V. BESIDES the three forementioned kinds of chapters, you will meet, in the enſuing treatiſe, with another ſort of writings, whereof ſome are almoſt entire, and others fragments of larger diſcourſes. In neither of theſe did I confine myſelf ſo much to matters of fact, as in thoſe chapters, that conſiſt of experiments and obſervations; but took the liberty, as occaſion required, to enlarge in diſcourſes, and ſometimes to cite ſuch paſſages out of other mens writings, as I judged I could make ſome pertinent application or uſe of, perhaps unthought of by the author. And theſe papers

being moſt, if not all of them written in a more free and diſcurſive way, I thought fit to ſeparate them from the ſets of collections, that are almoſt merely hiſtorical, and accordingly I have not ſtiled them chapters, but titles; and have forborn to aſſign them, as I did the others, ordinal numbers; which I deſire likewiſe you would not prefix to any of them, becauſe I am not yet reſolved how I ſhall diſpoſe of them, either by ſupplying what is wanting to finiſh any one or more of them, or by taking to pieces, and employing thoſe pieces as materials for other tracts,

VI. PERHAPS I ſhall not be thought to need pardon, if to comply with their curioſity, who affect moſt thoſe experiments, that are either uncommon, or teach them to do or perform ſomething uſeful or pretty; I ſometimes prefix a title, declaring what it treats of, to a particular experiment (or obſervation) which for its importance, novelty, or uſefulneſs (theorical or practical) may deſerve to be diſtinguiſhed; ſince by this means ſuch particulars may be better impreſſed on the memory, to gratify thoſe, whoſe nicety or want of leiſure may make them well pleaſed by a tranſient view of the titles we ſpeak of, to find ſuch paſſages, as they chiefly looked for, with leſs trouble than that of peruſing an index.

VII. AMONG the experiments our collection conſiſts of, there is here and there one, to which it was thought fit to add ſomething, either by way of explication, or of illuſtration, or of confirmation, or of anſwer to objections, or of theorical reflection, or of practical application, *&c.* And theſe ſupplements or additions it was thought fit to call ſometimes annotations, but oftner ſcholiums, becauſe that term is freely uſed in a very comprehenſive ſenſe by mathematical writers. But though I readily acknowledge, that this term has been chiefly employed by mathematicians; yet the uſe of it has not been ſo confined to them, but that good authors in other parts of learning have not ſcrupled to employ it, as may appear by the ſcholiums, that ſome learned phyſicians have written upon *Hollerius*, an eminent perſon of their profeſſion; as alſo by the example of the famous and experienced *Foreſtus*, who has not ſeldom ſubjoined ſcholiums, even to his own medicinal obſervations.

VIII. THE mention of theſe ſcholia prompts me to tell you, I had almoſt forgotten, but yet muſt not leave unmentioned, that I thought fit now and then to premiſe to ſets of experiments, and ſometimes (though more ſeldom) to a ſingle obſervation, a ſhort preamble by way of introduction, which may often excuſe the need of ſubjoining a ſcholium, and may be warranted by the example of the Lord *Verulam*, in his centuries, wherein he often inſerts ſuch ſhort preambles, as things fitted to give light to the experiments they belong to, and to give ſome advertiſement, both of the nature and importance of the ſubject, and of the ſcope of the writer, or of other uſeful circumſtances.

IX. IF among my own experiments, namely, thoſe that I have made or ſeen, I have ſometimes inſerted experiments or obſervations that are not ſo; I have not done it without reaſon, and am authoriſed in that practice by frequent examples afforded me by the firſt, if not only author that I know of, that gave us a ſet of precepts of well writing natural hiſtory, our often cited *Verulam*, whoſe centuries do in great part conſiſt of borrowed experiments and obſervations; without which he was ſenſible, that his *Sylva* muſt be of too narrow a compaſs, or too thinly ſtocked with plants, eſpecially with trees. And indeed it is not to be expected, that as the ſilk-worm draws her whole manſion altogether out of her own bowels, ſo a ſingle man ſhould be able to write a natural hiſtory out of his own experiments and thoughts. And he, that will ſtrictly confine himſelf to thoſe, will be often reduced to omit things very pertinent, if not neceſſary to his ſubject, which is of practice ſtudiouſly declined by me, who prefer the reader's utility to the ambitioned glory of being thought to borrow nothing

nothing from any body. And I can add in my defence, at leaſt in my excuſe, that I have made uſe but of a ſmall part of the liberty allowed me by the example of ſo great a guide in the way of writing natural religion. For I have very much ſeldomer than he employed the trials of others, and have yet ſeldomer mentioned unverified reports or vulgar traditions, being careful, that the bulk of the matters of fact I deliver ſhould conſiſt of things, whereof I was myſelf an actor, or an eye-witneſs; and that the comparatively few borrowed experiments, that I added, (that I might not deprive my reader of ſome things very pertinent and uſeful to my ſubject) were received from perſons of very good credit; beſides that I do not only frequently give ſufficient intimation in the experiment or obſervation itſelf, but oftentimes, by placing the letter C in the margin, do give notice; nay, and ſometimes to a whole ſet prefix the title of communicated experiments or obſervations.

X. I HAVE nothing more to give you notice of here, ſave that, whereas you will find, that I write but on one ſide of the leaves, whereof this book * conſiſts; I did ſo for two reaſons. The firſt, that in caſe I ſhould have occaſion to employ any of theſe experiments in other treatiſes, for which I am more concerned than for this rhapſody, I might have room to ſubſtitute, if it ſhould be thought fit, one or more of my later experiments in its place. And ſecondly, that I might have room, if I can get leiſure, to write annotations, or make reflections, or illuſtrations, or corrections, or, in a word, ſuch additions and alterations of particular experiments and paſſages, as they ſhall be thought fit to deſerve or need.

I AM ſenſible, that this preamble, increaſed by the advertiſements, that it was thought neceſſary to annex to it, is of a length, that may ſeem diſproportionate to the book or tract it is prefixed to. But I may, in excuſe of this, repreſent to you, that the bundle of writings you now receive is but a part of the book; to which, if God vouchſafe me health and leiſure, this preface, enlarged by its appendix, is deſigned for an introduction. And in that caſe it is hoped, that theſe preliminaries, as many as they are, will not be thought impertinent, or needleſsly prolix.

Experimenta & Obſervationes Phyſicæ.

TOME I.

CHAP. I.

Containing Chemico-Magnetical Experiments and Obſervations.

THE loadſtone, *Pyrophilus*, is ſo admirable a body, and its uſefulneſs to mankind is already ſo great, without denying us hopes of farther improvements, that I think we muſt want curioſity or gratitude, if we neglect either to take notice of any experienced phænomena, that directly relate to ſo abſtruſe a ſubject, or, by

* This refers to the manuſcript that was ſent to Mr. O. and is left to ſhew the intention of the author.

conſigning them to paper, to preſerve them from oblivion. It is chiefly by this conſideration, *Pyrophilus*, that I am induced to mention to you the following experiments and obſervations, made moſt of them by the help of the fire. For though ſome of them may ſeem but ſlight, yet they may not prove unuſeful towards diſcovering the nature of a body ſo ſtrange and ſingular, that, for aught is yet manifeſt, any true magnetical phænomena may ſomewhat conduce to the knowledge of it. And I was the rather induced to make trials and obſervations of this kind, becauſe moſt of them are ſuch, as I have not met with in authors. And the few, that remain, I have not found ſufficiently taken notice of there; philoſophers and mathematicians aiming chiefly, in their magnetical writings, to proſecute and apply the attractive and directive, and perhaps the inclinatory, faculty of the loadſtone. Whereas, throwing into another paper what I obſerved of that kind, I did in the preſent enquiry mainly intend to make the loadſtone rather the object than the inſtrument of my trials; and, handling chiefly the very ſubſtance of the ſtone, endeavour not ſo much to advance or apply its faculties, as to weaken and deſtroy them, though in order to the better knowing of them. Having therefore procured a conſiderable number of, for the moſt part, naked (or uncapped loadſtones, moſt of them coarſe, but of differing ſizes, ſhapes, colours, and countries; I made upon them ſeveral trials, ſome of which I ſhould immediately proceed to give you a brief account of, but that it will be proper to premiſe this ſhort advertiſement; that I would not have the title of theſe experiments make you expect, that the fire ſhould be a main agent in every one of them; ſince, to preſerve ſome few of them, I refer them hither, though an actual fire was not employed to make them; ſince the commou rule, that *a potiori parte fit denominatio*, will ſuffice to warrant, or at leaſt excuſe my giving to this ſmall collection the title of *chemico-magnetical experiments*; becauſe the greateſt part were performed by the help of the fire, or bodies chemically prepared by the application of it. And becauſe it is uſual, with the beſt writers about magnetiſm, to reckon ſteel and iron among magnetical bodies; I ſhall not ſcruple to deliver in this paper ſome experiments made by the help of the fire upon thoſe ſubjects, with reference nevertheleſs to magnetiſm.

EXPERIMENT I.

HAVING ignited ſeveral loadſtones, and removed them from the fire till they grew cold again, I found a great diſparity in the viſible ſubſtance whereof they conſiſted, and the manifeſt ſtructure of the groſs parts that made them up. For ſome ſtones, upon refrigeration, either fell aſunder of themſelves, or grew very brittle, whereas others ſtill continued in their entireneſs: ſome of them, being broken, looked not unlike iron-ore, or ſtones which I have gathered near iron-mines in *Kent*; others, being broken after refrigeration, appeared to conſiſt of plates or flakes of ſeveral colours, and lying parallel to one another; and others again, which as I remember were Engliſh ones, did neither appear to be compoſed of any ſuch flakes, nor had their dark colours much, if at all, changed by the operation of the fire, nor did ceaſe to be ſolid bodies.

EXPERIMENT II.

WE could not, upon the burning of ſeveral ſmall loadſtones one after another, diſcern any ſuch blue ſulphureous flame as *Porta* in his natural magic relates himſelf to have ſeen, and judges to have been, as it were, the ſoul of the loadſtone, upon whoſe receſs, he ſays, it loſt its magnetic faculty, which is moſt commonly true as to any conſiderable degree of the coitive or attractive power, but not of the directive

rective faculty or virtue. But it may be, that *Porta* miſtook the ſmall flame, which is often emitted even by well-kindled and glowing charcoals, (on which ſort his loadſtone was placed) eſpecially when a little blown upon, for the exhaling ſoul of the loadſtone; or elſe, to be civil to him, we may ſuppoſe, that his ſtone was more rich in unctuous moiſture than others are wont to be; and, if we had had by us a very exact pair of ſcales, we ſhould have endeavoured to have by them diſcovered, whether the fire do deprive loadſtones of any ponderous parts. See Experim. II.

EXPERIMENT III.

THE ſolidity of ſome Engliſh loadſtones made me think it fit, though I looked upon them as a kind of iron-ore, to try whether they could not be brought to ſtrike fire. And accordingly, having made divers colliſions betwixt a rough piece and the ſteel of a tinder-box, I found, that with much ado it was poſſible to obtain ſome ſparks, (though they ſeemed but ſmall ones): but, having taken a large piece of ſmooth loadſtone, I found, that, by ſtriking it ſomewhat briſkly with the edge of a ſteeled hammer, we were able to produce good ſtore of ſparks, and ſome of them of a ſurpriſing bigneſs, for they were judged to exceed the ſize of thoſe, that are uſually afforded by common flints.

EXPERIMENT IV.

FOR certain reaſons I thought fit to make a further trial, being deſirous to ſatisfy myſelf, whether it were not poſſible to make loadſtones afford fire without the help of iron or ſteel. And being willing to comply with this curioſity, I made choice of two ſolid pieces of loadſtone, that were cut almoſt into the form of cubes; and found, that many colliſions being made between them, eſpecially at the edges, there were produced, from time to time, (though not frequently) ſome ſparks of fire, though neither ſo numerous, nor ſo great or vivid, as thoſe of the foregoing experiment, wherein the ſteel was employed.

EXPERIMENT V.

I HAVE (elſewhere) formerly related, that, if an oblong loadſtone (made glowing hot) be refrigerated perpendicularly, the lower extreme will thereby become its northern pole. And I ſhall now add, that yet if ſuch a loadſtone be refrigerated perpendicularly, not upon an ordinary terreſtrial body, but upon the northern extreme of a much ſtronger loadſtone; in ſuch caſe, this debilitated ſtone will receive its impreſſions, as if it were an iron, and its lower extreme will not be, as before, by the magnetic effluvia of the earth, made its northern pole; but it will be contrariwiſe animated by the pole of the loadſtone, on which it is cooled; and, according to the laws magnetical, the lower extreme of it will not be its northern (but its ſouthern) pole, nimbly attracting the north end of an excited and æquilibrated needle.

EXPERIMENT VI.

BY the forementioned way of refrigeration I alſo found, that a diſanimated loadſtone (if I may ſo ſpeak, may be reſtored to ſome degree of its attractive virtue; for I tried, that a ſmall loadſtone, which after its being made red hot in the fire, and cooled perpendicularly upon the ground, was not able to take up a fragment of a needle, being again heated, and not only cooled upon the pole of a ſtrong loadſtone, but ſuffered to reſt on it a while after, was ſoon grown vigorous enough to take up what formerly it could not move.

EXPERIMENT VII.

I FURTHER obſerved, that though a loadſtone, that had paſſed the fire, had not, by being immediately before made red hot, had its body opened, and fitted to take in plentifully the magnetical ſtreams; yet it would, like a wire of iron, acquire a new verticity from the vigorous loadſtone, but not be in many hours ſo vigorouſly impregnated with magnetic virtue, if it were applied cold to the pole of the animating loadſtone, as it would in a very ſhort time, if, being glowing hot, it were refrigerated thereupon.

N. B. IT has been obſerved, that, if a loadſtone be made red hot in the fire, it will ſcarce retain any ſenſible attractive virtue, ſave that it will be able, by being endowed with a magnetiſm from the earth, to drive away that pole of a needle well poiſed, which agrees in denomination with that pole of the loadſtone, which is applied to it. But I deſire, that it may be remembered, that I intimated, that this is not ſtrictly and univerſally true; for in ſome of our Engliſh loadſtones it has been obſerved, that ignition does not only leave them capable of a directive virtue, but leaves them alſo a conſiderable attractive power, ſo that they will ſuſtain a good weight of ſteel, as will appear hereafter.

EXPERIMENT VIII.

WE took three Engliſh loadſtones, that appeared to be of a very compact ſubſtance; two of them very ſmall, as not being of near half an inch in length; the other much greater, being about an inch long, and of a conſiderable breadth, but yet of ſmall thickneſs: theſe we made red hot in a fire of well-kindled charcoal, and, being thoroughly ignited, removed them one after another, and haſtily ſet each of them upon a plate of ſilver, (for neither wood nor iron would have been convenient) and applying the loadſtone (capped) to each of them, whilſt it was yet red hot; it ſeemed manifeſt enough, not only that, whilſt it was in that ſtate, the ſtone had not ſo ſtrong an operation on it, as if it were not red hot; but, which is remarkable, when it ceaſed to appear ignited, but yet was intenſely hot, (ſo that it was readily able to burn his fingers, that ſhould offer to take it up between them) the armed loadſtone had a more powerful operation on it, by way of what they call attraction and ſuſtentation, not only, as I ſaid, than it had, whilſt the ignited ſtone conſpicuouſly retained the colour of fire, but than it had after the ſame ſtone was grown cold.

EXPERIMENT IX.

THIS experiment was reiterated with the two ſmaller magnets, and the greater with the like ſucceſs; and when the magnets were grown cold, they did, notwithſtanding their having been twice ignited, diſcover ſome little magnetiſm, if applied to the end of a well-excited magnetic needle, nicely poiſed upon the point of an ordinary needle [or braſs pin] on which its center of gravity leaned. And I found, that the bigger of the three forementioned loadſtones, after the firſt (if not alſo after the ſecond) ignition, did not only move the magnetic needle more briſkly than one would have expected, but, (which may ſeem ſtrange) being thruſt into filings of Mars, and then taken out, it carried up with it (and ſuſtained) a conſiderable number of them. Whence we may conclude, that in ſome loadſtones of a very ſolid conſtitution, ſuch as this was, the magnetical virtue is more radicated (if I may ſo ſpeak) or permanent, than in the generality of other magnetics; this ſtone being the firſt, wherein I obſerved, after I had thoroughly ignited it, any attractive virtue able to take up filings of iron.

EXPE-

EXPERIMENT X.

ON occaſion of theſe trials I made another, which, though to ſome it may ſeem but ſlight, I thought the more worthy to be made, becauſe I remember not to have read or heard of it before: we took then the ſame loadſtone, that we employed about the laſt experiment, and, having again made it red hot in the fire, ſuffered it not to cool leiſurely in the air as before, but quenched it in a baſon of cold water, intending thereby to make a double variation of the experiment; firſt, by cooling it haſtily, and as it were abruptly; and next, by cooling it, not in the air, but in a fluid ſome hundreds of times more denſe or ponderous than the air. The event of the trial was, that, upon the immerſion of the red hot ſtone, there fell off ſome flaky matter, as if it had been ſcales of Mars; and the ſtone, when cold, would not take up any filings of iron, as before it did many; ſo that it appeared to have loſt much of the virtue it ſo lately had, though it retained the power to move a well-poiſed needle, if it were held near to either ſide of the point of it.

EXPERIMENT XI.

A BLACK oblong loadſtone, of a homogeneous ſubſtance, and weighing near three drachms, having been in a fire of well-kindled charcoals ignited, and continued ſo for ſome minutes of an hour; being weighed again as ſoon as it was cooled, was found to have loſt about $\frac{5}{8}$ of a grain of its firſt weight, and much of the blackneſs of its colour.

THOUGH the affinity between the loadſtone and iron might make one expect, that the fire might have a like operation upon this ſtone, and that out of which iron is commonly melted, both being indeed iron-ores; yet for ſome reaſons, that I cannot now ſtay to mention, I was induced to think, that the effect of ignition upon thoſe two bodies might be very differing, as I conceive their internal and unſeen texture to be. And therefore I made the following experiment.

A LUMP of iron-ore, which looked almoſt like a white ſtone, rather than a common ore, and was about the bigneſs of two eggs, being applied, in ſeveral of its parts, to an excited needle, did not appear to move it manifeſtly. But being afterwards made glowing hot, and kept ſo for a while, and then refrigerated, it did in thoſe parts, which ſeemed by their newly acquired colour to abound with metalline corpuſcles; it did, I ſay, manifeſtly attract the north end of the needle. And this was tried, both with a needle of our own touching, and by the mariner's needle of a ſun-dial, whoſe flower-de-luce the burnt ore did manifeſtly draw.

EXPERIMENT XII.

To confirm the former obſervation, and alſo what I elſewhere gave notice of, that divers bodies are of a magnetical nature, or have in them ſome parts that are ſo, which yet are not vulgarly believed to be referable to that ſort of bodies, I ſhall ſubjoin the following experiment.

A BRICK, that had not been uſed, was ſawed long-ways into two equal pieces, and each of theſe (one at one time, and another at another) was heated red hot in the fire for a pretty while, and afterwards ſuffered to cool north and ſouth: and, as I expected, it thereby acquired a magnetical verticity; and with that end, that in cooling reſpected the ſouth, did a little, though but faintly, draw the flower-de-luce (which pointed out the north) of the mariner's needle; and with the other end did ſomewhat more vigorouſly drive the flower-de-luce away, and a little attract the other extreme of the needle.

EXPE-

EXPERIMENT XIII.

We took a [black] loadſtone, and having by degrees beaten it ſmall, without ſuffering it to touch any iron or ſteel veſſel, or inſtrument, [which, becauſe of the hardneſs of the ſtone, was very troubleſome to do]; we ſet aſide the groſſer grains for other uſes, and upon ſome of the finer powder we poured the ſpirit of common ſalt, which had at firſt a ſenſible operation upon it, by producing fœtid fumes, and making a kind of ebullition, as that menſtruum is wont to do upon filings of iron or ſteel. But nevertheleſs, being kept a night or two in digeſtion, it drew a high tincture; and though this was not at all like the ſolutions of Mars in ſpirit of ſalt, green, but of a yellowiſh brown, not very remote from redneſs; yet a little of it, being dropped into a freſh and ſufficiently coloured infuſion of galls, turned it preſently into an inky ſubſtance, which in ſome poſitions appeared blueiſh, as a tincture or light ſolution of Mars would have done. I ſhall only add about the ſolution of loadſtone, that, having carefully made it with a good aqua regia, I obtained a ſolution, ſome of which you may yet command a ſight of, that by ſome virtuoſi, to whom I ſhewed it, was thought either a fine ſolution of gold, or little, if at all, inferior to it in kind or richneſs of colour. I choſe to employ the ſpirit of ſalt, rather than that of nitre or aqua fortis, in this experiment; becauſe I found the firſt named liquor to diſſolve iron very well, if not better, though leſs furiouſly, than aqua fortis itſelf; and alſo, becauſe I could by this means better judge of the tincture of its colour, having formerly found by trial, that ſpirit of ſalt makes a green ſolution of Mars, but aqua fortis, or ſpirit of nitre, a reddiſh one. And it was to judge of the tincture of the loadſtone, as well as for another purpoſe, that I was ſo careful to keep the ſtone from touching iron, when it was pulveriſing, leſt by the hardneſs of it, and the ſharpneſs of its angles, it ſhould grate off ſome parts of the metal, and ſo alter the ſolution; for want of which caution, I have known ſome experiments about artificial gems to miſcarry; the braſs mortar, wherein the hard ingredients were beaten, having communicated ſome particles to them, that altered the colour, which the maſs after vitrification would otherwiſe have been of.

EXPERIMENT XIV.

Some parts of the foregoing experiment may be confirmed by that which follows.

I caused a weak loadſtone to be heated red hot, to make it the more eaſy to be powdered; and, having cauſed it to be beaten very fine, I digeſted good ſpirit of ſalt upon it. (I afterwards found, that ordinary ſpirit would ſerve the turn.) This in a few hours acquired a tincture not greeniſh, but almoſt like that of a troubled ſolution of gold. It ſtrongly reliſhed of iron, and a little of it being dropped into infuſion of galls, it turned it immediately into an inky liquor: part of this ſolution, being gently evaporated, grew thick like an extract, but did not ſeem diſpoſed to ſhoot into cryſtals; yet another part of it did precipitate with ſalt of tartar, much like a ſolution of vitriol; and another, with ſpirit of fermented urine, gave a plentiful but yellowiſh red precipitate.

EXPERIMENT XV.

Meeting, among my looſe notes, with one, that may ſerve both for a variation and confirmation of what has been above delivered in the experiments; it ſeemed not improper to annex a tranſcript of it.

A red mineral, whoſe conſiſtence was between ſtony and earthy, was by me judged to be a kind of iron-ore; though, having powdered ſome of it, I could not find, that

that a good loadſtone would attract any part of it: therefore, to ſatisfy myſelf, and to confirm *D. B.*'s obſervation about the virtue of linſeed-oil, I cauſed this red powder, wetted with that liquor, to be kept about two hours ignited in a crucible, by which means it was turned blackiſh. This dark-coloured powder was taken out, and ſuffered to cool, and then would readily adhere to the ſame loadſtone, almoſt as if they had been a heap of filings of iron. But the operation of the fire perhaps contributed as much (or more) as the linſeed oil to this change. For a parcel of the red powder, being kept ignited in a crucible, though without the liquor, did afterwards appear magnetical.

After having ſaid thus much of the moſt uſeful of uncommon ſtones, the magnet; it will not, I preſume, be thought incongruous to ſubjoin ſome remarks about the moſt precious of them, that are known among us, *viz.* diamonds, which will be done in the next chapter.

CHAP. II.

Containing various Obſervations about Diamonds.

DIAMONDS being generally eſteemed the moſt noble and precious of gems, and even of inanimate bodies here below, (for of carbuncles the very exiſtence is diſputed); the opportunity I had of being one of the committee or directors of the Engliſh *Eaſt-India* company (whereto the deſire of knowledge, not profit, drew me) allowed me in ſome meaſure to gratify my curioſity about them, by adding, to ſome obſervations of my own, the anſwers I had to the queſtions I propounded to ſome *Eaſt-India* merchants and jewellers, that had opportunity to deal much with thoſe gems. Part of what I had learned about them I committed from time to time to ſome papers, which were the main things that ſupplied me with the following particulars.

These gems (to add that upon the by) may the rather deſerve our curioſity, becauſe the commerce they help to maintain between the weſtern and eaſtern parts of the world is very conſiderable. For, as ſmall as their bulk is, their properties and men's opinion do ſo much recommend them, that I remember one of the moſt famous and intelligent merchants of this nation (who has been governor of more than one trading company in it) being enquired of by me about the value of the diamond trade; he anſwered me, that year, according to his well-grounded eſtimate, there came from the *Eaſt-Indies* into *Europe*, one with another, to the value of about 350000*l.* ſterl. of which about 100000*l.* came into *England*, which at preſent, becauſe of the prudent indulgence of the government, and of the *Eaſt-India* company, is become the mart of diamonds.

I. To prove the great hardneſs of diamonds, even in compariſon of other bodies, that are thought wonderfully hard, a famous artiſt for cutting of diamonds, in return to ſome queſtions I put him, affirmed to me, that he could not either cut or poliſh diamonds, with any thing but with diamonds. And he further anſwered me, that if he ſhould employ ſo rough a way, and ſuch forcible engines, to cut rubies or any other ſtones, as he does to cut diamonds, it would preſently break them in pieces: which the inſpection of his engine made very probable to me.

II. A very ſkilful cutter and poliſher of diamonds (Mr. *L.*) being demanded by me, whether he found, that all ſorts of diamonds were of equal hardneſs, told me, that, having dealt in diamonds near twenty years in *Holland*, and divers years in *England*, he perceived, that there are, of later years, brought over worſe and worſe ſorts of diamonds; ſo that he judges thoſe of the old rock (as he calls them) either

to

to be quite ſpent in the *Indies* themſelves, or at leaſt to be ſeldom or never brought over to us. And he finds ſeveral of recent diamonds ſo ſoft and brittle, in compariſon of thoſe of the old rock, that he is oftentimes afraid, or unwilling, to meddle with them, leſt he ſhould ſpoil them in the cutting or poliſhing.

III. NOTWITHSTANDING the (lately mentioned) wonderful hardneſs of diamonds, there is no truth in the tradition, as generally as it is received, that repreſents diamonds as uncapable of being broken by any external force, unleſs they be ſoftened by being ſteeped in the blood of a goat. For this odd aſſertion I find to be contradicted by frequent practice of diamond-cutters: and particularly having enquired of one of them, to whom abundance of thoſe gems are brought to be fitted for the jeweller and goldſmith, he aſſured me, that he makes much of his powder to poliſh diamonds with, only by beating broad diamonds (as they call them) in a ſteel or iron mortar, and that he has that way made with eaſe ſome hundreds of carrats of diamond duſt.

IV. IT is an opinion received among many, that deal in gems, that as diamonds are the hardeſt of bodies, ſo the ſame compactneſs, and their great ſolidity, gives them alſo a proportionable gravity, and makes them extremely weighty, in reference to their bulk: and I ſaw, in the hands of a virtuoſo, a book (that I could not procure) not long ſince put out by a French jeweller, who, as he affirms, has dealt very much in diamonds; wherein the author aſſerts the great ponderoſity of theſe ſtones, in compariſon of other bodies. But this opinion agrees very little with the following experiment, that I find (among others, that I tried about gems) regiſtered to this purpoſe.

A ROUGH diamond, ſomewhat dark within, did, in a pair of ſcales that would turn either way with the 32d part of a grain, weigh eight grains, and eight ſixteenths. This ſtone being with care weighed in water, according to the rules of the hydroſtatics, its weight appeared to be, to that of an equal bulk of that liquor, as $2\frac{2}{3}\frac{2}{3}$ to 1. So that, as far as can be judged by this trial, even a diamond weighs not full thrice as much as water.

V. A FAMOUS and experienced cutter of diamonds, being aſked by me, whether he did not find ſome rough diamonds heavier than others of the ſame bigneſs, told me, that he did, eſpecially if ſome of them were cloudy or foul: inſomuch that, ſhewing me a diamond, that ſeemed to be about the bigneſs of two ordinary peas, or leſs, he affirmed, that he ſometimes found in diamonds of that bigneſs, compared together, about a carrat (or four grains) difference in point of weight.

VI. THE ſhape or figure of diamonds is not ſo eaſy to be ſecurely determined. For thoſe, that are ſeen in rings and other jewels, having been, by way of preparation, cut and poliſhed, have changed their natural figures for that, which the artificer thought fit to give them. And rough diamonds themſelves (which are not obviouſly met with) do oftentimes come to our hands broken, though unwillingly, by the diggers: and thereby unfit to acquaint us with their genuine ſhape, which we may alſo miſs of being able to diſcover, on account of the accidents, that the matter they conſiſted of was ſubject to, at their formation in the mine. For, to omit other proofs, having had a parcel of between 100 and 150 (if I miſremember not the number) put into my hands at one time in the Eaſt-India houſe, to gratify my curioſity, I found very few of them compleatly ſhaped; but moſt of them broken, and of very irregular figures, like thoſe of ſo much gravel taken up at adventures upon the ſea-ſhore. But ſome few I ſaw, that were pretty regularly figured, which probably were not much hindered from ſhooting freely in the wombs or cavities, wherein they were coagulated or concreted. And theſe ſeemed to conſiſt, in my opinion, of ſeveral triangular ſurfaces, that were terminated in (or compoſed) divers ſolid

ſolid angles. And one rough diamond I had of my own, wherein this ſhape was more conſpicuous than I remember to have ſeen in any other. Beſides having enquired of a very experienced artificer, who dealt much in fitting theſe gems for the goldſmiths uſe, whether he found rough diamonds to be of any conſtant figure, and if he did, what that figure was? he anſwered me, that he always found thoſe, that had any conſtant (or, as he meant, regular) figure, to be, in his own expreſſion, ſix cornered.

VII. Diamonds have in them a grain (or a determinate tendency of their fibres, or rather of the thin plates they are made up of) as well as wood, and may with eaſe enough be ſplit along the grain, though not againſt it; as I have ſeen a very large diamond, that was cut according to the grain into three pieces, whereof the middlemoſt, though large, and about the thickneſs of a ſhilling, was of an even thickneſs, and exactly flat on both ſides. I have myſelf a diamond ring, whoſe ſtone I would not have poliſhed, but cauſed it to be ſet rough as nature produced it, becauſe in that ſtate the grain is manifeſt to the naked eye, and much more to a glaſs moderately magnifying the ſeveral plates it conſiſts of, having their edges diſtinguiſhable, like thoſe of a book a little opened. A cutter of theſe gems, that has had ſtore of them to practiſe his ſkill on, anſwered me, that one good blow may ſplit even great diamonds, if it be given, as they ſpeak, with the grain; but againſt the grain, he affirmed to me, as dexterous and expert an artificer as he is, that he is not able ſo much as to cut or poliſh them.

VIII. The common colour of diamonds being generally enough known by ſight, it is not needful, as it would not be poſſible to deſcribe it by words; but the moſt uſual colour of theſe gems is not the only, of which they may ſometimes be found. A great traveller into the eaſtern parts of the world aſſured me, that he had ſeen ſome of them, that were of a pale bluiſh colour. That famous French jeweller as well as traveller, Monſieur *Tavernier*, gives an account of a fair diamond that he had of a very red colour; and that great ornament of our Engliſh court, the D. of *R.* told me, that ſhe was miſtreſs of a fair one, which, though not of a ruby, was of a red colour, but not having it at hand, ſhe could not then ſhew it me. A relation of mine, in the ſame court, uſed to wear a diamond ring; which though the ſtone was not great, he valued at a hundred pound, becauſe its colour was of ſo fine a golden yellow, that I ſhould have taken it for an excellent topaz, but that he had ſatisfied me it was a diamond, to which agreed its great hardneſs, which gave an uncommon luſtre. And I remember, that ſurveying attentively a parcel of rough diamonds newly brought from the *Eaſt-Indies*, I perceived among them, beſides ſeveral lighter variations of colour, one ſtone, that was all green, and that to ſuch a degree, that I doubted not, that if it were poliſhed and ſet, it might paſs for an excellent emerald; and I ſhould have ſuſpected this gem to have been really of that kind, but that I found it among diamonds, that belonged to merchants too ſkilful in thoſe gems to be impoſed upon; and, which was more, the ſtone being yet rough and uncut, I found it plainly to have the proper ſhape of a diamond.

IX. At the late return of the ſhips from *India*, being preſent at the delivery of the diamonds to the owners, I obſerved one belonging to a Dutch merchant, whoſe father was a cutter of diamonds, and bred him to the ſame trade. The diamond came from the king of *Cholconda*; it was ſhaped (like mine) with ſix triangular ſides, which yet were neither regularly figured nor truly flat, ſome of them being a little convex, and one of them having a manifeſt and oddly-figured cavity in it. But the diamond being fair and flawleſs, and ſo thick, that the merchant told me it would be too deep for one ring, and that therefore he meant to ſplit it into two; I had it weighed, and found

found it to amount to ten carats (or 40 grains.) I could eaſily perceive the grain of this diamond, which the merchant alſo acknowledged; who anſwered me, that he had never ſeen in diamonds any heterogeneous mixture encloſed. He further informed me, that there was brought him a large diamond from *Borneo*, that was much darker than one I ſhewed him, inſomuch that he compared it to ſoot; but when he had cut and poliſhed it, he and others were much ſurpriſed to find it a fair and clear ſtone, of very great value.

X. THE conjecture I have elſewhere propoſed, that divers of the real virtues of gems may be probably derived from the metalline or mineral tinctures, or other corpuſcles, that were embodied with the matter of the gem, whilſt it was yet fluid or ſoft, and afterwards concoagulated therewith: this conjecture, I ſay, may be much countenanced by the following relation, which deſerves a place in this chapter, by reaſon of its pertinency to the ſubject of it.

I HAVE long ſuſpected, that the matter, whereof diamonds mainly conſiſt was, whilſt it was yet *in ſolutis principiis*, impregnated with metalline, and more particularly with martial ones: but by reaſon of the dearneſs of thoſe gems, and ſome other impediments, though I have been maſter of differing ſizes, cut, and uncut, yet I could never make a trial capable of ſatisfying my curioſity, till having lately met with, among other curioſities that lay long neglected by me, ſome number of ſmall diamonds, that I had bought for experiments; I conſidered, that their being yet rough, and ſo in their natural ſtate, might make them more fit for my purpoſe, and ſo it might, that they were not ſo clear as thoſe, that we value in rings, which probably argued their having more of martial tincture in them than I ſhould expect in the more diaphanous: upon this account, I ſay, I took a moderately vigorous loadſtone, (for it was none of the ſtrongeſt I have had) and applied it ſucceſſively to five or ſix of theſe ſmall ſtones, without perceiving it had any operation on them. But when I came to apply it to one more, which looked ſomewhat duller than almoſt any of the reſt, I found, that it had in it particles enough of an iron nature to make it a magnetical body; and obſerved with ſurpriſe, that not only it would ſuffer itſelf to be taken up by the ſtrongeſt pole of the loadſtone, but when that pole was offered within a convenient diſtance, it would readily leap through the air to faſten itſelf to it.

I HAVE elſewhere mentioned ſome other qualities of diamonds, as beſides their electrical virtue, this, that it is poſſible, that ſome of them may without fire or intenſe heat be brought to ſhine; though among all that I have tried, I found but two, that I could ſo make luminous. One of theſe belongs to the king, and is deſcribed at the latter end of our *Hiſtory of colours*; and the other is a very ſmall one of my own; which either was quickly loſt among other ſtones of the ſame ſize, or quickly loſt its faculty of ſhining. But to avoid repetitions, I ſhall here only add, that ſome few other obſervations, of a more particular ſort than thoſe delivered in the two foregoing pentades, may be found in other writings of ours, to which they ſeem more properly to belong.

CHAP. III.

Many changes of colour produced by one ſimple ingredient.

I KNOW not any way more likely to convince the generality of men, (who are wont to be much more impreſſed on by ſenſible phænomena, than theories, though ſolidly founded) how great an intereſt the variable texture of bodies may have in making them appear of differing colours, than by ſhewing, how the addition of a ſingle ingredient,

ingredient, that either is colourleſs, or at leaſt is not of any of the colours to be produced, is capable (and that for the moſt part in a trice) by introducing a ſecret change of the texture to make the body, it is put to, appear ſometimes of another, according as the parts of the body wrought upon are diſpoſed to receive ſuch a change, as modifies the incident beams of light after the manner requiſite to make them exhibit a blue, a green, a red, or ſome other particular colour.

Upon this conſideration I thought of ſeveral liquors, ſuch as aqua fortis, oil (as they call it) of vitriol, or inſtead of it ſulphur, aqua regia, beſides other ſaline liquors, that I ſhall not now ſtay to name, becauſe it may here ſuffice to tell you, that amongſt them all I made choice of the ſpirit (not that, which chemiſts call the oil) of ſalt, as that which is very ſimple, and which, if it be not too much dephlegmed, may be had clear and colourleſs enough. With this ſpirit I proceeded to make the following experiments upon ſeveral bodies, whoſe differing textures made me ſuppoſe, they would be fit for my purpoſe. And though I could not, without much diſadvantaging my deſign, forbear to mention ſome trials, that may be found elſewhere ſcattered among my writings on other occaſions; yet the greateſt part, by odds, of thoſe laid together in this chapter, will, I preſume, be found new.

I. Some drops of well coloured ſyrup of violets being let fall together upon a piece of white paper, if a third or fourth part ſo much ſpirit of ſalt be with the tip of one's finger mixed with them, the ſyrup will preſently become of a red colour, uſually ſomewhat inclining to purple.

II. But if the liquor to be acted on be otherwiſe diſpoſed, it is poſſible with ſpirit of ſalt to turn it from a blue colour, not to a red, but to a green, as I have ſometimes done by letting fall into a deep ſolution of filings of copper made with an urinous ſpirit, as that of ſal armoniac, juſt as many drops of ſpirit of ſalt, as were requiſite and ſufficient to produce the change intended. I ſay juſt ſo many drops, becauſe a very ſmall error, either in exceſs or defect, may leave the mixture ſtill blue, or bring it to be all colourleſs.

III. Upon a quantity, not exceeding many drops of good ſyrup of violets, let fall two or three drops of good ſpirit of urine, hartſhorn, or the like, or of oil of tartar, *per deliquium*; and by mixing them well, the ſyrup has acquired a fine green colour, then by putting to it a little of the ſpirit of ſalt, and ſtirring it with the tip of your finger, you may turn the green ſyrup (as in the firſt experiment you did the blue) into a red.

IV. If you put a quantity of red roſe leaves well dried into a glaſs vial almoſt full of fair water, and ſoon after put to them as much ſpirit of ſalt, as will make the water pretty ſharp, you will quickly ſee, both that liquor and the contained leaves brought to a fine and lovely red, which ſcarlet colour it will retain for a great while. The like effect ſpirit of ſalt will have on ſome other vegetables of a ſtiptic or of an aſtringent nature.

V. But if by infuſing braſil in fair water, you make a tincture of it, which you may much deepen by dropping into it a little ſpirit of harts-horn, or of urine; if you then put to it a little ſpirit of ſalt, it will preſently change it from a deeply reddiſh colour, oftentimes like that of muſkadine, to a colour far more pale, or rather yellow, like that of the more dilute ſack; ſo that the ſame ſpirit acting upon two vegetable tinctures differingly diſpoſed, draws out and heightens redneſs in one, and deſtroys it in the other.

VI. If you make an infuſion of true lignum nephriticum in ſpring water, it will appear of a deep colour, like that of oranges, when you place the vial between the window and your eye; and of a fine deep blue, when you look on it with your eye

placed between it and the window. But if you ſhake into this liquor a few drops of ſpirit of ſalt, the ceruleous colour will preſently vaniſh and appear no more, in what light ſoever you look upon the vial, though the liquor will ſtill retain the orange colour.

VII. We took common writing ink, and having let fall ſeveral drops of it upon a piece of white paper, ſo that when it grew dry in the air, ſome parts of the ink lay thick and ſome thinner upon the paper, whereon it did ſpread itſelf, we put a few drops of ſtrong ſpirit of ſalt, ſome on one part of the blacked paper, and ſome (or perhaps a ſmall drop) on another, and obſerved, as we expected, that in theſe places, where the ſpirit had been put, or to which it reached, the blackneſs was quite deſtroyed, and ſucceeded by an unpleaſant kind of colour, that ſeemed for the moſt part to participate of yellow and blue, neither of them good in its kind.

VIII. If in ſpirit of ſalt you diſſolve filings of ſteel, and ſlowly evaporate the filtrated ſolution, it will ſhoot into a kind of vitriolum martis, that will be green, as well as that which chemiſts vulgarly make with oil of vitriol. And to add, that on this occaſion, if you take theſe cryſtals made with ſpirit of ſalt, and when they are dry, keep them in a crucible, you will find, that even a moderate fire, if duly applied, will make them in a ſhort time exchange their green colour for a red, like that of the finer ſort of crocus martis, as indeed this operation makes them referable to that ſort of medicines.

IX. We took ſome mercury precipitated, *per ſe*, (that is, by the ſole action of the fire, without any ſaline additaments) and though crude mercury is not, as far as I have tried, ſoluble in our Engliſh ſpirit of ſalt; yet this red precipitate (which is ſuppoſed to be mere mercury) with its own ſulphur extraverted, did readily enough diſſolve in that liquor, and, if I very much miſremember not, did not at all impart its own colour to it: and I alſo found, that red lead or minium being boiled a while in good ſpirit of ſalt, the redneſs did totally diſappear. So that the ſame agent, that produces redneſs in divers bodies, did in thoſe two, I have been mentioning, more than change it, ſince it quite aboliſhed it. Of which alſo I can give you an eaſier inſtance, by obſerving, that the reddeſt coral being diſſolved in our menſtruum, the redneſs vaniſhes, and the ſolution appears colourleſs.

X. Take filings of copper (the ſmalleſt are the fitteſt for this experiment), and having poured on them good ſpirit of ſalt till it ſwim about two fingers breadth over them; keep the vial in a pretty ſtrong heat (in a ſand furnace) till you perceive the menſtruum has diſſolved a competent part of the metal: then warily take out the vial, and holding it between your eye and the light, you will perceive the ſolution of copper to be not like that of ſteel formerly mentioned, of a green colour, but of a dark and troubled one, oftentimes inclining to a deep, but muddy red.

XI. But if you pour this ſolution into a wide-mouthed glaſs, and let it ſtand for a competent time (which ſometimes amounts but to a few hours, and ſometimes to very many) the expoſed liquor will appear of a green, much finer than that of the cryſtals of Mars.

XII. Take filtrated and limped ſolution of ſilver, or of mercury made in aqua fortis, and drop upon it ſome ſpirit of ſalt, by which you ſhall find the clear liquor turned white as milk, which after a while will let fall a precipitate of the ſame colour.

XIII. And if, inſtead of a ſolution of ſilver, or quickſilver, you take a red ſolution, or tincture of Benjamin, or of the reſinous part of jallap root, or you you will alſo have, upon the affuſion of ſpirit of ſalt, a white liquor and a precipitate of the ſame colour.

XIV.

XIV. Being deſirous to produce two differing colours at once by the ſame affuſion of ſpirit of ſalt, I infuſed ſome dried red roſe-leaves in fair water, till it had acquired a deep colour from them. To this infuſion, poured off warily, that it might be clear, I added a conſiderable proportion of the ſweet liquor, made by digeſting ſpirit of vinegar upon red-lead, by which I knew it would be turned of a blueiſh green. Upon this almoſt opacous liquor I poured ſpirit of ſalt, which, as I expected, precipitated the lead, that had been diſſolved in the ſweet liquor, into a very white powder, and gave the remaining liquor, well impregnated with particles of the roſe leaves, a very fine and durable ſcarlet colour. To which experiment I ſhall add on this occaſion, that, if it had been well made, you may barely by ſhaking very well together and confounding the white powder with the red liquor, make a carnation colour, which (when it is made as it ſhould be) appeared very fine and lovely whilſt it laſted, for in no long time the two ſubſtances, that compoſed it, would by degrees ſeparate, and re-appear each of them in its former place and colour.

XV. We took ſome ſpirit of ſalt, that having lain long upon filings of copper, had loſt the muddy tincture it had firſt acquired by being almoſt boiled upon them. This liquor, I ſay, that looked like common water, we poured into a ſmall, but wide-mouthed cryſtal-glaſs, about half an hour after 8 in the morning, and leaving it in a window, it appeared after 40 minutes to have there acquired a colour, much like that of a German amethiſt, and ſeemed to have no tendency to greenneſs. But being detained by the viſit of a virtuoſo till eleven a clock, I could not ſee what happened in the mean time: but then, as he was going away, I invited him to ſee the liquor, which he (not knowing what it was) told me it looked of a graſs-green colour; wherein, though I were not altogether of his mind, yet in a ſhort time after, it did to me alſo appear of a lovely green; in its paſſage to which it had in all been expoſed about three hours and a half.

XVI. Precipitate a ſtrong ſolution of ſublimate (made in fair water) with a ſufficient quantity (and no more) of oil of tartar *per deliquium*. Put the liquor and powder into a filter of cap-paper, and when the water is run thorough, there will remain in the filter the precipitate, which is to be ſlowly and well dried. Then take it out of the filter, in the form of a groſs powder, and having put it into a clear glaſs, let fall on it warily ſome drops of pretty ſtrong ſpirit of ſalt, and (if the experiment ſucceeds with you as it did with me) during the conflict that will be made, the little lumps of the precipitate will loſe all their former brick-duſt colour, and turn white, though afterwards they will appear diſſolved into a tranſparent liquor, wherein the orange colour is quite aboliſhed.

XVII. Having calcined copper without any additament, ſave fire and water (by the way we elſewhere mention) we took an arbitrary quantity of it, and having poured on it about 3 or 4 times the quantity of good ſpirit of ſalt, we obtained (what we looked for) both a muddy, but manifeſtly reddiſh liquor, and (ſomewhat to the ſurprize of the perſons I had a mind to ſatisfy) a white powder, whoſe quantity bore a conſiderable proportion to the part, that was diſſolved (but whoſe qualities belong not to this place.) In which part its ſelf (to add that upon the by) by the affuſion of common water, and the action of the air, we afterwards produced more than one change of colour.

XVIII. We ſometimes for curioſity ſake took a quantity, not exceeding a ſpoonful, of the dark brown or ſomewhat reddiſh ſolution of ☿, mentioned in the foregoing experiment; and having put it into a cylindrical vial, that the change of colour may appear the better, we poured on it 2 or 3 ſpoonfuls of totally ardent vinous ſpirit; and giving the glaſs a ſhake to mingle them, we preſently had (as ſoon as the

mixture

mixture became clear) a lovely green liquor, which, when it was well ſettled, was very fair, and looked almoſt as if it were a liquid emerald.

XIX. We took ſome green taffatee ribband, and having moiſtened one part of it, that was not great, twice or thrice with good ſpirit of ſalt, we ſuffered it to dry of its ſelf; which it did in a ſhort time, and then we found, as we expected, that the wetted part was no longer of a green, but changed to a blue colour. But the ſame ſpirit (to add that upon the by) preſently turned that part of a piece of black ribband, upon which we put 2 or 3 drops of it, to a colour not unlike that, which they call *fueille morte*, or, a fading leaf.

XX. It is uſual in paper-ſhops, and in divers other places, to meet with pamphlets and other thin books, that are covered with papers, that look ſometimes of a greeniſh blue colour, bordering upon purple, and ſometimes upon that of violets. Some of the deeper coloured papers of this ſort I have ſeveral times, to gratify ſome curious perſons, eſpecially of the ſex, held in my left hand, and with the other lightly and nimbly touched them here and there with the end of a feather (cut off from the reſt of the quill) dipt in ſpirit of ſalt, which almoſt in the twinkling of an eye, dyed the touched parts of the paper with a lovely red, that would ſometimes continue very vived for a good while, and be manifeſt at the end of divers weeks, if not months. And if inſtead of the forementioned quill, I took into my right hand (a bruſh, or) ſomewhat that was fit to ſprinkle with, and having dipt it in the ſaline ſpirit, made many drops at once fall upon the paper, it was pleaſant enough to behold, how ſuddenly and prettily it would be ſpeckled.

XXI. We took antimony well powdered, and poured on it three or four times its weight of good ſpirit of ſalt: we cauſed it to be boiled in this liquor (and that in a glaſs veſſel) wherein a part of it was diſſolved, and taken up into the menſtruum; where the antimony quite loſt its blackneſs. And this thus impregnated ſpirit of ſalt being dropped into fair water, the black mineral ſubſided immediately in the form of a very white powder or precipitate.

To theſe I might add other changes of colours, that I have made by the help of ſpirit of ſalt. But theſe being not of ſo quick and eaſy trial, (eſpecially becauſe ſome of them require ſkill in chemiſtry) I thought it not fit to annex them, ſuppoſing, that thoſe already delivered, amounting to above four pentades, may ſuffice for the purpoſe declared at the beginning of this paper. And alſo to afford us this reflection, that it may not be amiſs, if phyſicians, chemiſts, and others, that are wont to compound drugs or other ingredients, would be leſs forward, than they uſually are, to mingle, not to ſay to jumble ſeveral of them together, either unneceſſary, or without due regard to the friendly and incongruous qualities, (in reference to one another) that the ſeparate ingredients may have. For moſt of us are but too liable to be miſtaken, when we preſume before-hand, what changes the coalition, or other aſſociations, of differing bodies may produce, eſpecially if they be either ſaline, or plentifully partakers of a ſaline nature; ſince experience frequently ſhews, that by the action and re-action, that are conſequent upon untried ways of compoſition, there emerge in the mixture new conſiſtencies and other qualities or accidents, that were not looked for, when the ingredients it is compounded of were put together. And though it may ſometimes happen luckily enough, that theſe emergent qualities, whether of drugs, or other comparatively ſimple bodies, may prove advantageous; yet this may well be looked upon but as a lucky chance, and hinders not, but that one may juſtly fear, that ordinarily the newly produced quality of a medicine may prove to be either worſe than was expected, or at leaſt other than was deſigned, and conſequently leſs fit for the phyſician's or the artiſt's determinate purpoſe.

CHAP. IV.

An Advertiſement touching thoſe Paſſages, that in this Book relate to the Art of Medicine.

THE favourable reception the public was pleaſed to give two editions ſet forth in one year of *The Uſefulneſs of experimental Philoſophy*, having encouraged the ſtationer to ſolicit me for a new impreſſion, I was on the ſame ground invited to think of making additions to divers parts of that treatiſe. But afterwards obſerving, that notwithſtanding the thanks and acknowledgments I had the good fortune to receive from ſeveral phyſicians, ſome of them of great reputation, (and perhaps by that only known to me) yet others were not well pleaſed, that a perſon not of their profeſſion ſhould offer to meddle with it, though with a deſign of advancing it; I, whoſe condition exempted me from taking upon me their calling, and who conſequently muſt want many opportunities, that others enjoyed, of making obſervations about the phænomena of diſeaſes and of medicines, ſuffered myſelf without much violence to be diverted to other ſtudies more ſuitable to my inclinations, as well as to my condition; and accordingly I laid aſide the papers I had written in reference to the phyſician's art; nor were it eaſy, or perhaps poſſible for me to retrieve them, after they have lain ſo many years diſperſed and neglected, by which means perchance divers of them have been loſt.

BUT all this could not hinder me from being preſſed to retrieve and communicate theſe ſcattered and duſty papers by the ſecretary of the Royal Society, Mr. *H. Oldenburg*: for as this gentleman has been almoſt every where wonderfully ſolicitous to preſerve every thing from being loſt, that may any way contribute to encreaſe the ſtock of uſeful knowledge; ſo having got notice of theſe papers, and a ſight of ſome of them, his partiality for me made him much over-value them, and perſuaded him, that a collection of them, as incoherent and unfiniſhed as they were, might be of ſome uſe to the phyſician's art. And this ſeemed the more hopeful, becauſe natural philoſophy being a ſcience of far greater extent than phyſic, and ſupplying it with many of its principles and theories, it is very poſſible, that naturaliſts, though not profeſſed phyſicians, may propoſe ſome ſuch comprehenſive notions and methods, as may awaken and enlarge the minds of them that are ſo, and at leaſt afford ſome uſeful hints to conſidering and ingenious men. And in effect divers phyſicians, as well as many patients, have been pleaſed to declare (ſome in print, and ſome other ways) that ſometimes they found not uſeleſs aſſiſtances from ſome of thoſe papers, wherein I occaſionally touched on medicinal things. Such motives as theſe made Mr. *Oldenburg* ſo earneſt to procure the ſcattered fragments, that I might have yet remaining, about medicinal affairs; that though for the reaſons mentioned above, I could not think it fit to make a collection of papers ſo unlike in their ſubjects, ſo diſproportionate in their bulk, and ſo unfiniſhed and imperfect on divers ſcores; yet thus far I was content to comply with his deſires, that when theſe trifles came to hand, I would now and then inſert them among my *Experimenta & Obſervationes Phyſicæ*, (medicine being a part, or an application of natural philoſophy;) eſpecially if there were any great affinity between the paper I lighted on, and the ſubject I was then treating of; knowing well, that Mr. *Oldenburg*, and perhaps ſome others too, had rather I ſhould impart them at all adventures, than ſuppreſs what they judged might be uſeful; and that it was better to run the hazard of having them ſlighted, than loſt.

THIS advertiſement I thought fit to give in this place, once for all, that when hereafter

after there ſhall occur any thing among theſe *Experimenta & Obſervationes Phyſicæ*, that directly relates to the phyſician's art, you may not think it ſtrange, remembring upon what account I ventured to meddle with things of that nature, and alſo that you may readily underſtand what I mean, when you meet with any particulars delivered, as thoughts, or deſiderata, or wiſhes, tending to, or aiming at the improvement of medicine; which how ſlight or ſuperfluous ſoever they may be to experienced maſters, to whom I did not preſume to recommend them, I thought might probably be ſerviceable to a very ingenious, but yet young cultivator of that noble art, (whoſe name I concealed, after the way of the curious of *Germany*, under that of *Trallianus*) for whoſe uſe they were intended.

The firſt PENTADE.

EXPERIMENT I.

A VERY tall and well ſet gentleman, aged about twenty four years, by a fall from his horſe, had his ſkull broken in ſeveral places; and being a perſon of good eſtate, had ſeveral chirurgeons to attend him in the courſe of his ſickneſs; during which he was divers times trepaned, and had ſeveral pieces of his ſkull taken off, which left great chaſms (that I have ſeen and felt) between the remaining parts. Within about three days after his fall, this knight (for ſo he now is) was taken with a dead palſey on his right ſide, which did not equally affect his arm and his leg; the uſe of the latter being ſometimes ſuddenly reſtored to him in ſome meaſure, and (though ſeldom) after a while almoſt as ſuddenly loſt: but his arm and head were conſtantly paralytical, being wholly deprived of motion; and having ſo little ſenſe, that it would ſometimes lie under his body without his feeling it. But if his hand were pricked with a pin, he could take notice of it. This palſey continued during almoſt the whole time of the cure, which laſted twenty three or twenty four weeks. And when the chirurgeons were going to cloſe up his head, as having no more to do; one of them, who was an ingenious man, and tenant to this gentleman, oppoſed all the reſt, alledging, that, if they did no more, the gentleman would lead an uſeleſs and very melancholy life; and that he was confident, the palſey was ſome way or other occaſioned by the fall, which had left ſomething in the head, that they had not yet diſcovered. And the knight himſelf, agreeing to this man's motion, his head was further laid open; and at length, under a piece of proud fleſh, they found, with much ado, a ſplinter, or rather flake, of a bone, that bore hard upon the *dura mater*, and was not pulled out without a great hemorrhage, and ſuch a ſtretch of the parts, as made the patient think his brain itſelf was tearing out. But this miſchief was ſoon remedied, and his hurts ſecurely healed up; and he is now a ſtrong healthy man, and finds no inconvenience by having ſo broad and various a callus inſtead of the ſkull, ſave that he is a little obnoxious to take cold in his head. But the memorable circumſtances, for whoſe ſake I mention this narrative, were theſe: when I aſked him how big the bone was, that was laſt taken out? he told me, that it was leſs than half the nail of one of his fingers (not his thumb) and that it was almoſt as thin, being in ſize and ſhape like the ſcale of a fiſh; but that it did not in his head lie flat, but bore hard upon the *dura mater*. When I aſked him, how long after it was taken out, he began to feel ſome relief, as to his paralytic diſtemper? he replied, that in leſs than five hours he found himſelf, to his great joy, able to move his little finger; and (though this happened in the evening) he was the next morning able to move all his fingers, and within two or three days after to lift up his arm: by which it ſeemed manifeſt, that ſo little a body, as the ſplinter lately mentioned, produced in ſo robuſt a perſon

ſon a palſey of the whole ſide it lay on. For when I particularly aſked him, whether, after the taking away of the proud fleſh, that encompaſſed the little bone, he did not find, if he found none before, ſome relief as to his palſey? he anſwered, that he found none at all, till the bone had been pulled out, which was not till a good while after the chirurgeon had been by degrees eating off the proud fleſh, that grew about it. But there was in this caſe another phænomenon, that I thought little leſs conſiderable than the former. For, remembring the important controverſy that is agitated among modern phyſicians and anatomiſts, about nutrition by the nerves; and having thereupon aſked this knight, whether he did not find an atrophy in the limbs of his body, that were affected? he told me, that when he began to be paralytic on that ſide, it by degrees much waſted, and the paralytic leg was very much extenuated; but the arm and hand much more, ſeeming nothing but a ſyſtem of bones, with the ſkin paſted on them. And when I further aſked, if upon the removal of the bony ſplinter abovementioned, the atrophy of the parts did not alſo begin to leſſen; he anſwered affirmatively, and told me, that in no very long time his leg and arm recovered their wonted dimenſions; and in effect I (ſome days ſince) ſaw the reſtored arm well plumped up with muſculous fleſh, though the weather were exceeding cold. And he further told me, that he found no difference between the limbs that had been paralytic, and the others, except that they would grow ſooner and more ſenſibly cold in ſharp or froſty weather.

This gentleman anſwered me, (to add that upon the by,) that during the courſe of his cure, he was very frequently (almoſt every ſecond day) let blood; that he wanted not appetite to his meat; that for the moſt part he ſlept indifferent well; and, which was more remarkable, upon ſo great a hurt of the head he did not vomit, nor had afterwards any convulſions.

II. Among other inſtances I have met with, that ſhew the great power, which ſudden paſſions of the mind may have upon the body, I remember, that a woman of middle age, complained ſadly to me of the miſchief, a fright had done her; for ſhe related to me, that, having taken along with her to a meadow by a river-ſide, a little boy, that ſhe was dotingly fond of, whilſt ſhe was buſy about the work ſhe came thither for, the child ſtole away from her, and went along the bank, to delight himſelf with the view of the ſtream; but being heedleſs, it ſeems, by circumſtances, that he ſet his foot upon ſome piece of ground, that the water had made hollow; upon which account, the earth failing under the weight of the boy's body preſſing it, that and he fell together into the river: in the mean time, the poor mother caſually miſſing her child, haſtily caſt her eyes towards the brink of the river, and not being able to ſee him there, ſhe preſently concluded him to be drowned, and was ſtruck with ſo much horror upon the ſudden accident, that tore from her a favourite ſon, that, among other miſchiefs, ſhe fell into a dead palſy of her right arm and hand, which continued with her, in ſpite of what ſhe had done to remove it, till the time ſhe complained of it to me, who had not opportunity to know what became of her afterwards.

III. On the other ſide, to ſhew, that violent paſſions, and even frights, may ſometimes, though very ſeldom, do good, as well as harm; I ſhall here add a relation, that was circumſtantially made me by the learned perſon himſelf, to whom the accident happened. I familiarly knew a gentleman, that lived to be an eminent virtuoſo, and to oblige many by his uſeful writings, who, when he was a youth, fell into a violent and obſtinate ſciatica, which continued with him ſo long, that it left him little hope of recovery; but the devotion of this young man's friends invited them to make him be carried, ſince he could not go, to church upon ſundays; and there it happened, that the town being a frontier garriſon, the guards were ſo negligent, that there was occaſion

given to a very hot alarum, that the enemy was got into the town, and was advancing towards the church to maſſacre all that were in it. This ſo amazed and terrified the people, that in very great and diſorderly haſte, they all ran out of the church, and left my relator in his pew upon a ſeat, that they placed him, and whence he could not remove without help: but he being no leſs frighted than the reſt, as they forgot him, he forgot his diſeaſe, and made a ſhift to hamper off the pew, and follow thoſe that fled: but it quickly appearing, that the alarum had been a falſe one, his friends began to think in what a condition they had left him, and haſtened back to help him out of the pew, which, whilſt they were going to do, they, to their great ſurpriſe found him in the way upon his feet, and walking as freely as other men. And when he told me this ſtory, he was above forty years elder than when he was thus ſtrangely reſcued, and in all that time never had one fit of the ſciatica.

ADVERTISEMENT.

It is eaſy to be obſerved, that of the two kinds, into which chemiſts may be conveniently enough ſorted, the number is greater of thoſe, that are not profeſſed phyſicians, than of thoſe that are: and yet ſeveral of the former ſort are led by their more free curioſity, or their particular deſigns, to allow a large ſcope to their trials; and ſo in their experiments upon various bodies, to operate upon ſome of thoſe that may be reduced (either directly, or by fit applications) to the materia medica, and afford uncommon preparations: which, though deſigned for other purpoſes, may, by a ſkilful phyſician, with a light variation, and perhaps without any, be made to afford good medicines: and therefore I think it may be no inconſiderable ſervice to the public, if, by the leave and aſſiſtance of the authors, divers chemical experiments, that are not directly uſeful to their immediate purpoſe, were not (as is uſual) thrown away, but put into the hands of ſome ſagacious phyſician.

Upon theſe grounds, I thought myſelf little leſs than obliged, to ſet apart now and then an experiment, that contained ſome uncommon preparation, which ſeemed applicable to medicine; and to try whether, though, being in the country, or in ſome other inconvenient circumſtances, I had not opportunity to prove it myſelf, the notice given of it might not happen to be of uſe to a ſkilful phyſician.

I shall therefore partly in this chapter, and partly (if God permit) in ſome following chapters and other writings, tender to ſuch a one ſome few of the experiments of this ſort, that I lately lighted on among my adverſaria, and that ſeemed not uncapable to be made of ſome ſervice to the phyſician's art.

Of the good and bad effects of theſe I ſhall be glad to be informed, that they may be either uſed more freely and improved, or corrected and quite laid aſide; and I deſire that this ſhort preamble may ſerve for a general one to all the other deſigned chemical medicines, that I ſhall venture to propoſe hereafter.

A deſigned chemical medicine.

IV. I know how much men are prejudiced in ſome whole countries againſt vomitive medicines; and I remember we have had here in *London* a phyſician of great fame and practice, that would turn over a patient to another doctor, if the caſe were ſuch, that the patient would needs make uſe of emetics. And I readily acknowledge, that they are edged tools, that require a ſkilful hand, to employ them without danger of doing more harm than good. But ſince experience ſhews, that where the patient can bear them, and the diſeaſe requires them, they act more ſpeedily and effectually than other evacuating medicines; and ſince the generality of our phyſicians, not excepting ſome,

ſome, that are juſtly reputed very cautious, do not ſcruple frequently to make uſe of the infuſion of crocus metallorum, though it do not ſeldom prove a remedy harſh enough; I ſhall venture, in compliance with ſome ingenious phyſicians, and others, that have often made uſe of a medicine, that goes under the name of my emetic drops, to communicate the preparation of them; without preſſing the uſe any otherwiſe, than by confeſſing, that divers practitioners of phyſic, of differing ſentiments, agree in aſſuring me, that they have not yet found any emetic to work ſo effectually, nor with more eaſe and ſafety, than this liquor; which ſome of them prefer by much to other antimonial vomits; and eſpecially to the infuſion of crocus metallorum.

In preparing my vomitive liquor, I have not always employed the ſame proportion of the ingredients it is made of, nor did I find it neceſſary to be nice in that matter. But the proportion I ſomewhat prefer, is to take two parts of well choſen and finely powdered antimony, and on theſe to pour three parts of the menſtruum, *viz.* ſp. ; which ought to be rather moderately ſtrong, than too much rectified. Theſe are to be diſtilled together in a glaſs retort, fitted with a receiver not very ſmall, till there come over a great part of the menſtruum, which will uſually, towards the cloſe, be accompanied with red flores (ſometimes copious enough) which being ſeparated by filtration through cap-paper, the clear tranſmitted liquor is to be put into a glaſs, not newly waſhed, but dry on the inſide, and to be kept cloſe ſtopt from all intercourſe with the air.

The doſe is uſually to a man or woman, eſpecially at the firſt time, from four or five, to ſeven or eight drops: but I know an ingenious phyſician, that gives to ten or twelve, or a few more drops, if the caſe be urgent; and by that means, he told me, that with a ſmall button-bottle, that I chanced to give him a little before, he did, in two or three hours, reſcue three gentlemen, that, by a very bad ſurfeit with very bad circumſtances, were ſuddenly brought into great danger of ſpeedy death, and carried to a neighbouring tavern, as being too ill to be carried home.

The vehicle may be a ſpoonful or two of wine, or black cherry-water, or (which divers perſons chuſe rather) of ſpring-water, drinking up the liquor immediately after, becauſe there will ſome precipitation be made; and then taking two or three ſpoonfuls of the ſame vehicle to waſh it down. It uſually begins to work early, and does it without cauſing near ſo much ſtraining as vulgar emetics; and yet makes copious evacuations, and ſometimes ſo eradicative of the morbific matter, that the phyſician lately mentioned, who cured the three gentlemen, having a poor patient, who had conflicted for above three years with an ague in ſeveral types, but moſt commonly quartanary, perfectly cured him with two doſes of theſe drops, and a julap made chiefly of the diſtilled water of a common vitriolic mineral. And this cure ſeemed therefore to me, when the phyſician gave me an account of the drops he had from me, the more conſiderable, becauſe the patient had made uſe of great variety of remedies; and particularly he devoured great ſtore of the Jeſuits bark, or cortex peruvianus (perhaps becauſe it was not well conditioned, or ſkilfully adminiſtered,) which ſometimes altered the type of his ague, turning it to a ſingle or a double tertian, and ſometimes kept off the fits for a while, when it was a quartan, but never cured him quite; and left him in a deplorable eſtate, wherein the emetic drops found him.

Though I ſent this medicine to ſeveral patients, in whom, thanks be to God, it ſucceeded more than ordinarily well; yet I durſt not venture to give it to children, or to very young perſons; but having gratified an ingenious ſurgeon, of good practice, with a ſtock of it, the trials he made upon divers perſons, with great ſucceſs on other patients, imboldened him to give it to boys and girls, and afterwards even to ſeveral children; whereof he gave me good account, only he diſcreetly took care to propor-

tion his doſes to the age and ſtrength of his patients, and not to give the whole doſe at once, but divide it into two or three parts, that if the firſt ſhould work within half an hour, or leſs, the ſecond ſhould not be given, or leſſened in quantity. And if neither the ſecond did work within about an hour, he added the third. And by this cautious method, he aſſured me, that he had ſuddenly relieved ſeveral children in bad caſes, and found not any miſchief or danger enſue upon the adminiſtration of it. But children being tender creatures, this is to be further and cautiouſly tried.

POSTSCRIPT.

HAVING had occaſion to keep by me ſome vials furniſhed with the emetic drops, longer than I thought I ſhould need to do ſo; I obſerved, that, in tract of time, there began to ſubſide a white powder, wherein a good part of the emetic faculty of the medicine may be ſuppoſed to reſide: therefore it will be beſt either to employ the liquor in no long time after it is made, or if one has not leiſure or conveniency to do ſo, to ſhake the vial well (that the powder may be raiſed and well diſperſed through it) juſt before it be adminiſtered.

A deſigned chemical medicine.

THERE are many, that having a high eſteem for chalybeat waters, ſuch as thoſe of the *Spa* and *Tunbridge*, which yet in many places are not to be had at all, and in few to be had well conditioned, are very ſolicitous to find ſuccedaneums to them. To gratify ſome ingenious perſons of this ſort, (and improve a caſual hint taken from a book of a ſomewhat like preparation propounded for another purpoſe,) I remember I employed a way of emulating ſuch waters, that anſwered the outward phænomena of colour and taſte, and ſeem by the paucity and harmleſſneſs of their ingredients like to be innocent medicines. I had no opportunity to make trial of them in phyſic, but finding, that ſome inquiſitive cultivators of that art valued them more than I did, I committed the experiment to paper, and now ſuffer it to come abroad, that it may be tried by phyſicians, and either rejected or made uſe of as ſucceſs ſhall direct. The experiment as I made it was this.

WE took one part of very good filings of ♂, and ten parts of good diſtilled vinegar. Theſe we put into a bolt-head, and ſtopped it well; and then in a mild heat of ſand we digeſted them for about three days, and afterwards augmented the heat till the liquor appeared of a deep orange colour, but yet tranſparent. Part of this tincture we poured off, and kept well ſtopped by its ſelf, becauſe though by a longer digeſtion, and a greater heat, we obtained a very red tincture, yet we did not ſo much value it, becauſe when the menſtruum is over impregnated, the metal uſually precipitates, and the fine colour is deſtroyed. Of the firſt reſerved tincture, we let fall four drops into ℥viiiß. (℥ß.) of clear common water, whoſe colour was not thereby ſenſibly altered; and the vial containing this mixture being well ſhaken, that the tincture might diffuſe itſelf the more thoroughly, we kept it carefully ſtopped for uſe, as being our fictitious or counterfeit *Spa*. A ſpoonful or ſomewhat more of this, with about a quarter of a grain, or leſs, of good freſh powder of galls, would preſently afford a purpliſh tincture, like that of natural ſprings impregnated with Mars, ſuch as the water of the *German Spa*, or of *Tunbridge* in *Kent*: if one's mouth were waſhed with it, it was found to have, like thoſe natural chalybeat waters, a manifeſtly ferruginous taſte. *N. B.* Theſe artificial acidulæ are to be adminiſtred in no long time after they are made; for experience has informed me, that (at leaſt ſometimes)

times) when I kept them too long, within not many days after they were made, they would loſe much, if not moſt of their briſkneſs and force. And I ſometimes perceive, that there would ſubſide to the bottom a certain red or reddiſh ſubſtance, as it were oker, which was a token of the degeneracy of the liquor; and ſome ſuch thing I have obſerved in ſome natural chalybeat waters too long or negligently kept. But our acidulæ may be ſo ſoon and ſo cheaply made freſhly, that the above mentioned inconveniency will ſcarce to the ſkilful ſeem conſiderable.

The ſecond PENTADE.

EXPERIMENT II.

BECAUSE it may be on ſome occaſions of uſe to a phyſician, to have ways of diſcovering the adulterateneſs of bezoar ſtone, which for its dearneſs is often counterfeited, and not eaſily diſcerned to be ſo by the common ways of exploring, which uſe to be uncertain enough; it may not be amiſs to communicate a new way of trial, which it is unlike that impoſtors have dreamed of, or, if they ſhould know it, can eaſily elude. And this I am the rather willing to do, becauſe the propoſed way may afford an uſeful hint to the ſagacious enquirers into the nature, and ſome of the preparations, that may be made of the bezoar ſtone; which though it be a drug too much magnified by ſome phyſicians, eſpecially thoſe that depend on it againſt the true plague; yet a phyſician of great experience, and rather a ſevere than any ways a partial judge of it, allows it to be an excellent remedy even in malignant and ill-conditioned fevers, at leaſt if they be not truly peſtilential. One of the ways I employed in treating the bezoar ſtone may be eaſily gathered from the enſuing tranſcript of one of my regiſtered experiments.

WE took forty or fifty grains of choice oriental bezoar ſtone reduced to powder, and in a bolt-glaſs poured on it ʒvi. of good ſpirit of nitre, as well to try, whether this liquor would prove a fit menſtruum for this ſtone, as we found it to be for the calculus humanus, as for other purpoſes. And though, this affuſion being purpoſely made in the cold, the liquor did not ſeem at firſt to work on the ſtone; yet ſoon after it fell violently upon it, and diſſolved the greater part of it, not without noiſe and a notable effervеſcence. The ſolution was almoſt red, and the glaſs being put in a digeſtive furnace, the whole powder was not only diſſolved, but, being left a night or two in a north window, it afforded divers ſaline concretions, much larger than could well have been expected from ſo ſmall a quantity of matter; and theſe cryſtals, whilſt they were yet in the glaſs, might eaſily be taken for cryſtals of ſalt-petre, ſo great was their reſemblance.

TO manifeſt, how much the faculties of looſening and binding are relative things, and depend upon the diſpoſition of the body to be wrought upon, and ſo upon the congruity betwixt the agent and the patient, I know an ingenious gentlewoman, on whom cinnamon, which generally is a conſiderable aſtringent and ſtomachic medicine, has a quite contrary operation, and that in a ſtrange degree; inſomuch that (having found, by two or three accidental trials, that a very little cinnamon ſeemed to diſorder her ſtomach, and prove laxative) ſhe reſolved once to ſatisfy herſelf, whether thoſe diſcompoſures came by chance, or no; and having ſtrewed ſome powdered cinnamon upon a toaſt, ſhe was going to put into her ale, upon eating the toaſt ſhe was copiouſly purged for two days together, and that with ſuch violence, that it put her into convulſion fits, and a kind of ſpaſmus cynicus, which ſhe could never be perfectly freed from being troubled with from time to time for three years, as was the other day averred to me, and divers others that know her, by her huſband, who is himſelf a learned man and a profeſſed phyſician.

A PROS-

A PROSPEROUS phyſician, to whom I had recommended ſome things relating to his profeſſion, whilſt he practiſed it with ſucceſs in the capital city of *Ireland*, where at that time there raged a new and violent fever, whereof multitudes died, very few patients recovering of it, happily lighted on a method, that proved, through God's bleſſing, very proſperous. This doctor, returning into *Ireland*, ſome time before having been deſired by me to ſend me an account of ſome things relating to natural philoſophy and phyſic, that I named to him, wrote to me, in anſwer to ſome of my enquiries, a letter, out of which I thought fit to make this extract, becauſe I know not, but that it may give good hints towards the cure of ſome other ill-conditioned fevers.

Dublin, Feb. 27, 1682.

I HAVE employed ens veneris for the removal of a ſubſultus tendinum, in a perſon dangerouſly ſick of a febris petechialis, (a diſeaſe fatal to very many here for theſe twelve or fourteen months); and found, that it anſwered my hopes in three or four hours after I gave it in conſerve of borrage flowers.

I HAVE, ſince I came from *England*, thought of a method of curing the aforeſaid fever, which has not once failed me, though I made uſe of it for ſixteen or eighteen ſeveral perſons, many of which would certainly die, if treated after the uſual manner in this caſe. If I ſhould tell you, from what obſervations and reaſonings I came to alter the method of cure, I ſhould be very tedious. I ſhall therefore at preſent wave that, and proceed to tell you, that when firſt I come to any ſick of this diſeaſe, if I find coſtive, (as generally they are) I preſcribe a gliſter, and after that an epiſpaſtic plaiſter, ſix or ſeven inches broad, and eight or nine inches long, to be applied between the ſhoulders: the bliſter being well raiſed I order to be dreſſed carefully, ſtripping off the cuticula. This continues running till the fever is gone off, which is moſt commonly in ten or twelve days, if they have not kept up too long with it, and then we cannot certainly foretel the time of the fever's declination: for the whole time till the going off of the fever, I preſcribe emulſions of *aq. aronis, card. bened. citrij totius & ſyr. granatorum cum aceto.* I allow of orange and butter-milk poſſets, of roaſted apples, flummery, or any other light and cooling thing they call for.

BY this method I keep the genus nervoſum and brain from being affected, and conſequently ſecure my patients; for as many as I have ever known of them die, that were troubled with this diſeaſe, died of a diſorder of thoſe parts. I do not defer the bliſtering plaiſters, as others do, till I find my patients delirious, lethargic, convulſive, or otherwiſe affected in their heads and nerves, finding by the experience of others, that then they moſt commonly prove ineffectual, becauſe of ſome morbific matter's being too deeply lodged in theſe parts. I do not preſcribe, except upon ſome extraordinary occaſions, any volatile ſalrs or ſpirits, or any thing too apt to quicken the already over-briſk circulation of the blood, having experimentally learned, that by theſe often uſed the brain and nerves become ſooner than ordinary affected, foraſmuch as they deeply inſinuate themſelves, and drive with them ſome morbific matter into the brain and nerves. I find bleeding bad, being generally fatal. If I doubt of the recovery of any of my patients ſick of this diſeaſe, it is only when I find, that they have been let blood, or lain for eight or nine days before I came to them; though I have brought through it even perſons in thoſe circumſtances.

A deſigned chemical medicine.

I SHALL not, becauſe I need not, diſcourſe of the medicinal virtues of ſteel, in a city, where many learned phyſicians do ſo much eſteem and employ chalybeat medi-

cines as they do in *London*; and therefore I ſhall content myſelf at this time to offer you a couple of preparations of ſteel, that poſſibly you have not met with or thought of.

1. Considering, that moſt of the ways made uſe of by chemiſts to prepare ſteel tend, by dividing it into very minute parts, to make it more liable to be wrought on by the liquors of the ſtomach, and ſome other parts of the body; and that the generality of theſe chalybeat preparations are wont to be made only with acids, whether manifeſt, as oil of vitriol, ſpirit of vinegar, *&c.* or occult, as brimſtone, which though inſipid in its natural ſtate, when it comes to be melted diſcloſes its hidden ſalt, and works on ♂ by a ſharp acidity: conſidering this, I ſay, and that men have confined themſelves to acids in working on ſteel, becauſe they ſuppoſed inſtruments of that kind were neceſſary to diſſolve that metal, I thought it might do you, and ſome ingenious men of your profeſſion, ſome little ſervice, if I propoſed to you a way of opening the body of ſteel, that, though I gave a hint of it divers years ago, is, for ought I know, yet unpractiſed.

We took then ſeveral ounces of highly rectified ſpirit of fermented (or putrified) urine *per ſe*, and conſequently without quick-lime, and poured it upon as much filings of ſteel freſhly made, to be ſure not to have any ruſty ones, as we gueſt would at leaſt ſuffice to ſatiate it fully. Theſe we put in a moderately warm place, where the menſtruum wrought on the metal for divers hours together, and diſſolved a conſiderable part of it. This ſolution we ſet to filter, and found it of a taſte conſiderably ſtrong, but very different from any of the chalybeat preparations, we remembered, that were ſeen made with acids. The liquor, being kept in a ſtopt vial for ſome days near a window, did in the cold let fall by degrees a conſiderable quantity of powder of a deep green colour, which ſurprized ſome virtuoſi, to whom I ſhewed it, eſpecially becauſe the liquor itſelf was not of that colour; though at leaſt the ſuperficial part of what remained (in plenty) in the filter did alſo in the air acquire a green colour. But though our ſolution, poured off from the ſubſided powder, was warily and ſlowly evaporated, yet we did not find it would well cryſtallize. What uſe may be made in phyſic of preparations of this kind, I leave to you, whoſe profeſſion, as well as curioſity, will engage you to conſider. I do not preſume to tell you, but in general it ſeems, that ſteel prepared with volatile ſpirits of the animal kingdom, that are wont to be friendly to nature, and are very contrary to acids, may have new qualities very differing from thoſe of ſteel prepared with acids, and may be more ſafe in ſome caſes and to ſome patients. With what other volatile menſtruums I have diſſolved Mars, and what phænomena ſome trials I made with that metal opened by ſuch ſalts, you may command an account of, if you thing it worth deſiring.

A deſigned chemical medicine.

Another experiment, that I made on ſteel, was deſigned to make as much of it volatile, as I could with a menſtruum, not ſo corroſive or dangerous to the body as oil of vitriol, or ſpirit of nitre, which, eſpecially the former, are employed by divers chemiſts to make chalybeat preparations, that yet are not volatile. The medicinal ſcope I had in my eye (for I had alſo a chemical one, that belongs not to this place) was to try, if I could by it obtain any ſulphur of Mars, which the commendations, that ſome, even of thoſe chemiſts, whether adepti or not, whoſe authority I moſt regard, repreſent as an excellent medicine, eſpecially in caſes that require anodynes, and which the others or the ſame ſpeak of as a graduatory ſubſtance (as to ſome metals) or both. If you ſhould aſk me, why I did not make uſe of the common vitriolum martis, which is eaſy to be had in the ſhops of chemiſts? I anſwer, that my

my deſign being to try whether or no I could obtain a ſulphur, that might properly enough (though not in the utmoſt rigour) be called ſulphur of Mars, that which is made the common way would not anſwer my end, ſince though I ſhould be able from this vitriol to obtain a real ſulphur; yet I ſhould not think it ſafe thence to conclude, that it came from the metal, and not from the menſtruum; becauſe I have ſeveral times, from oil of vitriol itſelf obtained no contemptible proportion of yellow and combuſtible ſulphur. To which I add, that the acquiſition of a metalline ſulphur, though it was not the only thing that I aimed at in this preparation, for I preſumed, that at leaſt I ſhould make a very great commination of the parts of ſteel, which is one of the main things aimed at by the more rational phyſicians in the preparations of that metal.

Upon theſe and the like grounds, I pitched upon good ſpirit of ſea-ſalt, as a menſtruum, much fitter for my purpoſe than either oil of vitriol, or the acid part of ſulphur; and accordingly, in a good many ounces of this menſtruum, we diſſolved as much as we eaſily could of choice filings of fine ſteel; and, having filtered the green ſolution, we very ſlowly evaporated it in a glaſs veſſel, and took ſuch care not to ſpoil the matter, that we had ſtore of fine green cryſtals, that were not very ſmall, and looked prettily: moſt of theſe we put into a ſtrong (but ſmall) retort, and by degrees of fire, and a ſtrong one, for the laſt hours, we obtained divers ounces of a liquor, that came over in white fumes, like miſts driven by the wind, and afforded a ſulphureous ſmell: this liquor we rectified, and had a yellow ponderous ſpirit, that ſeemed to be much more of kin to the ſpirit of ſea-ſalt, than to the common oil of vitriol; eſpecially ſince, being mixed with aqua-fortis, it would, like ſpirit of ſalt, make it a menſtruum, that would even in the cold diſſolve gold in thin leaves. Which laſt words I add, becauſe, having put into a little of it already made yellow, by having diſſolved leaf-gold a very thin plate, but a pretty deal thicker than a leaf of hammered gold, the menſtruum made it look all over white, almoſt like ſilver, which ſeemed to argue, that this vitriolate menſtruum differed from common ſpirit of ſalt. And however, it may be worth taking notice of by the by, that not only vitriols blue, as is well known to chemiſts, but that vitriols of one of thoſe colours, and whereof the ſame metal is the baſeſt, may differ much from one another on the ſcore of the various (and to us, perhaps, unknown) menſtruum, that diſſolves the metal, ſince our green vitriol yields liquors very different from common Engliſh vitriol of Mars made with oil of vitriol, though all the three be green. Which may give us ſome reaſon of the uncertainty, whereof vitriol is mainly employed; and it is perhaps worth remarking, that though we did not find the vitriol of Mars made the common way, nor even Roman vitriol to diſſolve in a vinous ſpirit totally inflammable; yet it would eaſily enough diſſolve our ſaline vitriol (if I may ſo call it), which ſolution (to hint that in *tranſitu*) you may perhaps ſee cauſe to employ as a medicine in ſeveral caſes, and particularly as a ſtyptic in wounds, ſince its taſte is very aſtringent, its parts very ſubtil, and made fit by the vinous ſpirits to prevent corruption; eſpecially in thoſe climates, where chirurgeons complain, that they can ſcarce prevent the breeding of worms in wounds, unleſs they do betimes dreſs them with ſpirit of wine or brandy.

But that which we chiefly aimed at in this operation was the dry part, of what was elevated by the force of the fire. This we found to be diſtinguiſhable, partly by its ſituation, and partly by more durable accidents, into three kinds of ſubſtance; whereof one was almoſt like a powder, which, after the contact of air, did in a while come over to be of a yellow colour, almoſt like ſulphur, but it was not indeed truly combuſtible ſulphur. The other ſubſtance conſiſted of larger parts, and was of a deep colour, between

red and brown. But the third, which ſeemed the moſt copious of all, was made up of fine parts, larger than the former, of a deep reddiſh colour, and adorned with a fine gloſs, like that of ſcales of fiſhes, that looked very prettily.

THE caput mortuum was found to be of a texture, that would have ſurprized moſt men; for a great part of it appeared to be turned into a talky ſubſtance, conſiſting of pretty broad and very thin plates, ſmooth and gloſſy, that lay upon and againſt one another, like thoſe that make up Muſcovia-glaſs, when the pieces are more thick than large.

CHAP. V.

Containing Experiments and Obſervations ſolitary; in two Pentades.

The firſt PENTADE.

EXPERIMENT I.

A notable comminution of gold into powder, that will ſink in water.

TO manifeſt into how great a multitude of corpuſcles, groſs and heavy enough to ſink to the bottom even of a ſaline liquor in the form of precipitate or powder, I thought of this expedient. We took a grain of refined gold, and having diſſolved it without heat in a competent quantity of good aqua regia, we put to it by gueſs about two ſpoonfuls of water; and then by a thread we hung in the mixture a little bit of clean metalline body, and kept it ſuſpended in the liquor for many hours (or ſome few days.) By this means we obtained, as we expected, a precipitate of a fine and deep colour, ſo copious and ſo light, that it was a long time before it would all ſettle at the bottom. Then looking upon the remaining part of the ſuſpended metalline body, we found it ſo very little leſs than when the whole was firſt put in, that the diminution of it was not judged to amount to near a grain. By which experiment it appeared, that one grain of gold, not ſwimming in parts ſeparately inviſible, as it is in ſolutions, but reduced to a manifeſt powder, ſeemed to make a conſiderable quantity of precipitate at the bottom of the cylindrical vial, whoſe diameter was about an inch, that we kept it in. And this glaſs being a little ſhaken, the precipitate would riſe like a mud, and be ſo thoroughly diſperſed in the form of a powder through the whole body of the liquor, and a greater quantity of water added to it, that at firſt it would ſeem opacous, and after ſome time it would appear like a high and lovely purple ſolution. So that one grain of gold (for the colour argued, that there was ſome of that metal, in every corpuſcle of the precipitate) was reduced into as many grains of powder, as ſufficed to lodge themſelves in all the particles of ſpace great enough to be viſible, that were contained in a maſs of ſixteen drachms (i. e. two ounces) of water.

EXPERIMENT II.

A proof of the metalline nature of granates.

I HAVE elſewhere endeavoured to ſhew, that divers, if not moſt, of the real virtues of ſome gems (for there are too many fabulous ones aſcribed to them) may in probability proceed from the particles of mineral juices, that were admitted whilſt the matter was yet in *ſolutis principiis*, or at leaſt ſoft, and afterwards coagulated with the lapideſcent part of the ſtone. In confirmation of this conjecture, I ſhall now obſerve,

that having, upon ſome grounds not neceſſary to be here mentioned, ſuſpected, that granates contain (ſome of them) beſides ſome other metalline ſubſtances, divers corpuſcles of a martial nature; I made choice of ſome ſmall ones, which by their deep and almoſt dark colour (to name no other ſigns) I gueſſed to contain ſomewhat of iron or ſteel; and applied to them a pretty vigorous loadſtone, which, as I expected, readily took them up, and to which they conſtantly ſtuck afterward, till I forcibly ſeparated them from it. But though I tried this upon more parcels of granates than one or two, yet I found, that there was not many in one heap, that would eaſily adhere to the magnet.

EXPERIMENT III.

A GENTLEMAN eminent for his travels into eaſtern parts, and for his ſkill in jewels, told me, in confirmation of my opinion about the origin of gems from fluid materials, that he had ſeen a white ſapphir, that was a tableſtone, as they ſpeak, *i. e.* flat and not cut in facets, about the middle of which there was a cavity about the bigneſs of a large pin's-head, or ſmall fitch, that contained in it a drop of liquor, that it ſeems could not be coagulated into ſtone with the reſt of the matter: which liquor, he ſaid, was very eaſily diſcernible by its ſhifting places in the cavity, when the ſtone was put into differing poſtures. And when I aſked, whether there was no flaw or commiſſure in the ſtone, at which the liquor may be ſuſpected to have got in; he aſſured me, that there was none, but that the cavity was every way encompaſſed by the ſolid ſtone, and was about the thickneſs of three barley corns beneath the upper ſuperficies of it.

SCHOLIUM.

IT may be here fit to give notice once for all, about the experiments, that are in the following collections ſtiled ſolitary, that though moſt of them are delivered nakedly as matters of fact, without any ſuch introduction or ſubſequent reflection, as may be met with ſometimes expreſsly, and oftener by intimation in divers others; yet that it ſhould not be thence inferred, either thoſe, that are ſimply recited, were lighted on by chance, or made at all adventures; or that they are of no uſe, becauſe for the moſt part there is not any expreſly aſcribed to them. For as they were not written without a particular occaſion and ſcope too, ſo that many of them may be applied to good purpoſes, will, perchance, be found here and there in our other writings. And to make it probable in general, that moſt of them may not be uſeleſs, it may perhaps ſuffice, that we refer to what we have elſewhere purpoſely diſcourſed about the uſes of experiments (even) to ſpeculative philoſophy.

THIS may paſs for a general ſcholium applicable to moſt of thoſe experiments, that are not attended with any particular ſcholium, nor any thing in the experiment or obſervation itſelf, that may eaſily, by an attentive reader, be made to ſupply the place of a ſcholium. Which laſt clauſe I add to intimate, that beſides my haſte, another reaſon, why ſo many ſcholiums, as may be expected in the following collection, will not be found in it, was, becauſe the proœmial part did, on ſeveral occaſions, make it needleſs to ſubjoin annotations.

EXPERIMENT IV.

AN ingenious and credible perſon (Mr. *W.*) aſſured me, that in one of the fine gardens near *Genoa*, that he delighted to viſit, there was a pond, which being made on the ſide of a hill, the wall next the bottom of the hill was ſo high, that men could not

not look over it into the pond, nor be at all ſeen over it by the fiſhes in the pond; and yet he has ſeveral times obſerved theſe fiſhes to be called together by the gardiner as he pleaſed, with a certain noiſe, that the gardiner made to aſſemble them, though neither he nor any man elſe could be diſcovered by the fiſhes, that readily obeyed their ſummons.

THIS relation may be of uſe in the controverſy, whether fiſhes hear under water.

EXPERIMENT V.

UPON occaſion of what is elſewhere ſaid of the production of vivid apparent colours by the breaking of the beams of light, on corpuſcles extraordinary minute, though ſolid; I took a globe of rock cryſtal, which being for a certain uſe ſawn in two by a cutter of gems, and having looked upon the flat ſurfaces, obverted to the ſun beams, the little particles, that (notwithſtanding their ſeeming ſmoothneſs in the ſhade) aſperated their ſurfaces, did ſo refract and reflect the light, as to make them exceed the vivid colours of the rain-bow, (but in a ſomewhat interrupted manner) ſometimes on one part of the ſurface, ſometimes on another, as the ſurface happened to be ſituated in reference to the ſun.

AND having cauſed a choice and fine grained touchſtone to be likewiſe ſawn aſunder by the ſame artificer to make two of it, I obſerved upon the new ſurfaces made by this action, that to the touch felt ſmooth and poliſhed, ſuch vivid colours, as I lately mentioned to be when theſe ſurfaces were put into various poſitions in reference to the ſun and eye; ſo that notwithſtanding the great tranſparency of the cryſtal, and great opacity of the touchſtone, their ſuperficial corpuſcles were found fit to exhibit (in due poſitions) the vivid colours we admire in the rain-bow.

The ſecond PENTADE.

EXPERIMENT I.

HAVING for leſs than two hours borrowed an *oculus mundi*, whoſe colour was white, whoſe figure was round and plain convex, and whoſe diameter I judged to be about a third part of an inch (rather leſs than more) I put it into a very ſhallow glaſs veſſel almoſt filled with fair water, and obſerved within one minute, or thereabout, with the minute-watch, that one part of the edge began to appear ſomewhat diaphanous, and the whole ſtone did by degrees loſe its whiteneſs, appearing of a dark browniſh colour: when this change had reached the whole ſurface, I looked upon my watch, and found, that the ſtone had lain nine minutes in the water; out of which having taken it, I perceived the body was grown ſemi-diaphanous, and the parts near the edge being leſs thick, appeared to have loſt much more of their former opacity, than the innermoſt part had. Then putting the ſtone preſently into the water again, I let it lie there ſo long till the time effluxed, ſince the beginning of the experiment, amounted juſt to half an hour. Then taking it out, and wiping it, I found it was grown much more clear, ſince being held againſt the light, it looked almoſt like yellow amber, but not quite ſo diaphanous. Then I expoſed it to the contact of the air, in the ſcales of a very good balance, (where it weighed four grains and about a quarter) and left it for a quarter, or near half an hour in that balance, to try if by the receſs of any imbibed aqueous moiſture it would become lighter; but want of time hindred me from compleating the experiment, but did not deter me from making another obſervation, which was, that within about a ſingle minute of an hour, a portion of the ſtone, near one part of the edge, was manifeſtly grown opacous and whitiſh, and within not many 10 Cent. 12.

minutes after the whole ſtone began to appear in a changing condition, but did not change in every part at once, nor did the alteration make an uniform progreſſion; but here one might ſucceſſively diſcover divers white arches, or as it were zones, that were parallel enough to one another; and being quite opacous, intercepted between them other little zones, which being yet ſemi-opacous, appeared of a brown colour, and concurred to make the ſtone look like a very pretty agate, wherein the whiteneſs made a continued progreſs as long as the time permitted me to obſerve it: and the poſſeſſor aſſured me, that within an hour or two it would be all of a cream white (as he expreſſed himſelf) which I thought the more credible, becauſe I ſaw one part of it that was pretty broad, to have obtained already a whiteneſs, little, if at all inferior to that of ivory.

EXPERIMENT II.

Remarkable obſervations about hurricanes.

The late governor of the *Bermudas* iſlands, (very much ſubject to hurricanes) in anſwer to my queſtions about the preſages of thoſe hideous tempeſts, informed me, that theſe were of the principal forerunners. Firſt, that the ſea would manifeſtly ſwell at ſome diſtance from the ſhores, inſomuch that the fiſhermen would divers times make to land, and warn the inhabitants, upon confidence of that preſage, to provide againſt that diſmal ſtorm, though the ſea were then ſmooth enough. Secondly, that the ſea would beat with great noiſe againſt the ſhore, eſpecially the rocks, though there appeared no manifeſt cauſe, as upon the account of the wind or tide, why it ſhould do ſo. And this ſign would ſometimes not appear till many hours, or perhaps a full day after that forementioned. And ſometimes it was obſerved, that the ſea would now and then ſuddenly invade the ſhore, and gain further upon it than could be accounted for by the wind or tide, and then quickly ebb away beyond the uſual low water-mark, and after return again with more fury, and fall back further than before. Thirdly, that ſometimes there would be perceived an ungrateful ſmell in the air, before the hurricane began to blow. And fourthly and laſtly my relator affirmed to me, both he and others had ſeen many bundles, as it were of long ſtreaks of differing colours, ſome whitiſh, ſome reddiſh, and ſome bluiſh, or greeniſh, which by reaſon of their figure are uſually called in thoſe parts horſe-tails: and theſe were ſeen in parts of the ſky, where the air was troubled indeed, but yet no formed clouds did appear to the eye.

EXPERIMENT III.

A monſtrous pearl.

Yesterday a curious perſon came to ſhew me a monſtrous pearl, if I may ſo call it, becauſe it was very irregularly ſhaped, and of an enormous bigneſs. For though it were ſo artificially ſet in gold, that by the help of a little of that metal fitly placed here and there, the whole jewel repreſented a lion; yet I made ſhift to meaſure it exactly enough with a pair of calapar compaſſes, (as they call thoſe, whoſe legs are made archwiſe) and found the length to be juſt an inch and an half, and the greateſt breadth (where yet it was of a proportionate thickneſs) to be $\frac{8}{10}$ or $\frac{4}{5}$ of an inch. The colour was orient enough, all but one dark ſpot, which by its ſize, figure, and ſituation, I gueſſed to be the remains of that part (whether like an umbilical cord or no) whereby it was faſtened to the naker or ſhell of the fiſh that produced it.

EXPE-

EXPERIMENT IV.

An odd obſervation about the influence of the moon.

I KNOW an intelligent perſon, that having, by a very dangerous fall, ſo broken his head, that divers large pieces of his ſkull were taken out, as I could eaſily perceive by the wide ſcars, that ſtill remain; anſwered me, that for divers months, that he lay under the chirurgeons hands, he conſtantly obſerved, that about full moon, there would be extraordinary prickings and ſhootings in the wounded parts of his head, as if the meninges were ſtretched or preſſed againſt the rugged parts of the broken ſkull; and this with ſo much pain, as would for two or three nights hinder his ſleep, of which at all other times of the moon he uſed to enjoy a competency. And this gentleman added, that the chirurgeons, (for he had three or four at once) obſerved from month to month, as well as he, the operation of the full moon upon his head, informing him, that they then manifeſtly perceived an expanſion or intumeſcence of his brain, which appeared not at all at the new moon, (for that I particularly aſked) nor was he then obnoxious to the forementioned pricking pains.

EXPERIMENT V.

An uncommon experiment about heat and cold.

To confirm what we have elſewhere delivered about the mechanical origin of heat and cold, we deviſed the following experiment: we took a ſmall and hermetically ſealed thermoſcope, whoſe ſtem was divided into parts, equal enough as to ſenſe, by little ſpecks of amel, that ſharp liquors might not eat off or ſpoil the marks. The ball of this inſtrument we put into a ſlender cylindrical veſſel, (called in the ſhops a muſtard glaſs) and more than covered it with ſtrong oil of ⊖, and left it there a while to be reduced to the temper of the ſurrounding liquor. Then we caſt upon it by degrees, groſly powdered, * which preſently was wrought on furiouſly by the menſtruum; and by this conflict, was produced a ſeeming effervеſcence, with great noiſe and ſtore of froth, which more than once was ready to run out of the veſſel. But for all this ſeeming ebullition, the mixture inſtead of growing hot, did really grow colder and colder, as appeared not only when the veſſel was touched by the fingers on the outſide, but by a ſurer mark, which was the deſcent of the coloured ſpirit of wine. How much further it would have deſcended, (for the liquor was not near ſatiated with the ⊖) we were hindered from diſcovering, by an unlucky accident, that broke the thermometer, and put an end to that firſt part of our experiment. But this was no hindrance to the ſecond part, which for its novelty we mainly deſigned. For when we poured this actually and conſiderably cold mixture into three or four times its weight (by gueſs) of as much common water, that was likewiſe actually cold; this ſecond mixture did, as I expected, immediately grow ſo hot, that I did not like to keep my finger for a minute or two upon the outſide of the glaſs. Novem. 9. 89.

CHAP. VI.

Containing two Pentades of Chemical Experiments.

An Advertiſement about the nature and ſcope of the chemical experiments contained in the following pentades.

BEFORE you enter upon the peruſal of the following pentades, I think myſelf obliged to give you notice, that you will be deceived, if you expect to find them conſiſt, either ſolely or mainly, of ſpagirical ſecrets, or difficult and elaborate proceſſes.

proceſſes. I do not indeed deny, that I am not altogether unfurniſhed with ſuch, as in probability moſt readers would refer to experiments of that nature; and you may find divers of them ſcattered upon fit occaſions in ſeveral of my writings: but in the preſent tract, though I have not forborn to mention here and there as many particulars of that ſort, as I thought neceſſary to excite and maintain the curioſity, and ſuſtain the attention of a reader, that reliſhes nothing, that is not ſeaſoned with ſomewhat that is not common; yet in this treatiſe, wherein I aimed not to appear a chemiſt, ſo much as to make my reader a naturaliſt, it was more ſuitable to my deſign, though not more conducive to my credit, that the following pentades (which, God permitting, may, in tract of time, much encreaſe in number) ſhould mainly conſiſt of experiments, rather uſeful than ſpecious; my deſign being to contribute ſome ſound materials towards the erection of a ſolid and uſeful natural philoſophy. In making choice of which materials, I uſually prefer thoſe experiments, that afford the more light, to thoſe that appear with the moſt luſtre; and thoſe that are proper to encreaſe the reader's ſkill, to thoſe that make an oſtentation of the writer's. On which ground it is, that whatever I may do, where I purpoſely recommend chemiſtry, I make this ſmall collection conſiſt mainly of ſimple and not intricate, or elaborate experiments; thoſe that are ſimple being not only more eaſy to be tried, and if need be, reiterated without much trouble, or danger of erring; but (which I more regard) more eaſy to be judged of as to their cauſes, phænomena and effects, and conſequently more fit to ground notions and reaſonings upon: divers of which may probably in the applications, that ſagacious perſons may make of them, prove to be of practical as well as theorical uſe. Thus though a wedge of gold and a diamond be, one more rich and finely coloured, and the other more precious and ſparkling, than a piece of ſteel and a flint; yet on many occaſions the two latter are far more ſerviceable to mankind than the former: ſince not thoſe, that are more prized for themſelves, but thoſe, that in compariſon ſeem deſpicable, afford ſparks, which do not only give light, but are fit to kindle fires, which both afford incomparably more light, and in the application are of excellent and neceſſary uſe in the kitchens of families, the forges of ſmiths of all ſorts, the furnaces of mine-men, and the laboratories of chemiſts.

The firſt PENTADE.

EXPERIMENT I.

To diſſolve crude gold with dry bodies.

Because the generality of chemiſts make ſo great a matter of *aurum potabile*, though they cannot deny, but that by their preparations it is not made irreducible; and becauſe alſo I am willing to grant, that even ſome preparations, that leave the metal reducible, may yet be of conſiderable uſe in phyſic, (the grounds of which opinion I elſewhere declare, and ſhall not here repeat) I will in this place ſet down a proceſs, which though I do not overmuch value, ſerved me well enough on ſome occaſions, to vie with thoſe, that much vaunted their particular ways (as they thought them) of making *aurum potabile*. I then told them, I could make one in an hour or two's time without a furnace, and that without any other diſtilled liquor whatſoever than common ſpirit of wine well dephlegmed.

This I did ſeveral times after the following manner. I prepared a ſaline mixture, conſiſting of one part of ſal armoniac, two parts of roch alum, and four parts of pure nitre. This being well pulveriſed and mingled, I rubbed diligently in a glaſs or marble mortar, with 15 or 16 parts in weight of the whole mixture of leaves of gold, ſuch

ſuch as apothecaries and book-binders uſe. Then I put this into a ſmall new crucible, and putting a few, and but a few kindled coals round about it, and at a little diſtance from it to neal the veſſel; I ſoon after approached them, till the heat made the matter melt, and ſo with that gentle fire I kept it in fuſion, till it viſibly emitted no more fumes, but grew dry again.

This ſign appearing, I preſently took it off from the fire, and while it was yet warm, dug it out, as clean as I could; and having ſeaſonably pulveriſed it, that it might not attract the moiſture of the air, I put upon it ſome highly rectified ſpirit of wine, which within an hour or leſs time was enobled with a rich golden colour. And accordingly I found it to be a real ſolution of gold, by divers trials, that I purpoſely made to evince it to be ſo.

Of this and ſome other leſs common preparations of ☉ more may be met with hereafter.

EXPERIMENT II.

Luna cornea by diſtillation.

There was taken ℥iii. of well refined ſilver, thinly laminated, and ſix of common ſublimate. This was put firſt into a retort, and the ſilver cut into ſmall pieces was put in after, that the matter lying uppermoſt might be penetrated by the aſcending fumes: but the fire having not been made ſtrong enough, the ſublimate was elevated to the uppermoſt part of the retort, and left the ſilver ſcarce at all changed in the bottom of the glaſs Wherefore we put the ſame ſublimate and metal into another retort, and adminiſtering a ſtronger fire, that the ſublimate might be thoroughly melted before it could flee away, we obtained no running mercury at all, but the greateſt part of the ſublimate was elevated in its uſual form, leaving behind it the ſilver in a lump, which ſtuck hard to the bottom of the glaſs, and appeared much altered. For beſides, that there was acquired ℥i. in weight, many of the pieces of metal ſtuck together, and ſeemed at leaſt half melted, and were of a kind of horny and ſemidiaphanous ſubſtance, which would readily enough melt almoſt like ſealing-wax, when I held it to the flame of a candle, at which yet I could not perceive it manifeſtly to take fire.

SCHOLIUM.

It is here to be noted once for all, that in this and divers other chemical experiments, there is ſometimes much more delivered, than is neceſſary to make good the title, or the thing mainly intended. But it was thought fit, not to diſmember or mutilate the entire memoir as it was regiſtered, becauſe that of the other particulars ſome may be, though indirectly, referred to the principal part; and others may be looked on as phænomena, which may be of uſe at leaſt to me, by keeping me from forgetting them, and probably tend to the main deſign of all theſe experiments, *viz.* to contribute to a natural hiſtory, which may reſpect practice, as well as theory.

EXPERIMENT III.

Mercury grown warm with ſilver.

We took ℥ii. of animated (or antimonial) quickſilver, and put it into the palm of one's hand: we put to it by degrees a drachm and an half of powder of fine ſilver, made by precipitation with copper the ordinary way (but with more than ordinary care.) Whilſt this mixture was making with one's finger, he, that held it in his hand,

hand, confeſſed he found it grow ſenſibly warm; and I, whoſe finger was conſiderably warm; could not with it perceive any coldneſs in the amalgame. This in a very ſhort time became of a ſoft, and (as to ſenſe) uniform conſiſtence, and ſo ſoft, that it was like almoſt melted butter, inſomuch that we added half a drachm more of the calx of ſilver, without rendering the amalgame at all too ſtiff; and perhaps we might have added the other half drachm, without overcharging that penetrant mercury; in which caſe it had ſwallowed up full its own weight of ſilver, ſo different it was from common mercury; and when we left off, it had reduced into a very yielding form three quarters of its own weight of ſolid metal. This $\overline{aaa}$ we put into a ſmall vial, and ſtopped the glaſs with a cork, to obſerve, whether the amalgame would harden without intercourſe with the free air. Next morning it appeared to be concreted in the glaſs; and the next morning after that, we broke the glaſs to take out the matter, which we found conſiderably hard, but brittle enough.

EXPERIMENT IV.

The durableneſs of the faculty of a certain prepared mercury to grow hot with gold.

To convince thoſe, that treat the incaleſcence of prepared mercury and of gold, as a chemical chimera; I ſent, in a concealed way, to the Royal Society ſome mercury laboriouſly prepared in my furnaces, whereof ℥i. being put upon a due proportion of a calx of gold made by the common way, (quartation) they grew preſently, and very ſenſibly hot in the palm of one's hand. I ſhall now add, that to try, whether this ſurpriſing faculty of growing hot immediately upon gold, will continue any long time in the mercury; I lately took ſome, that I had (for a certain purpoſe) kept hermetically ſealed in a glaſs egg for divers years, (if I miſtake not, ten or twelve at leaſt) and having reiterated the forementioned trial with it, firſt alone, and then in the preſence of a cultivator of chemiſtry; it preſently grew hot with the ☉ in the palm of the hand. And having diſtilled off the mercury, and tried it again, as well as ſome that was undiſtilled, if I much miſremember not, it did again heat with gold.

EXPERIMENT V.

An uncommon way of operating upon ♁.

When chemiſts expoſe antimony, for inſtance, and divers other conſiſtent, but not fixed bodies, to the action of the fire, they are wont to do it in veſſels, either open, as when they make calx, or glaſs of antimony; or at leaſt in veſſels, that are not ſo cloſe, but that there is air included with the matter, as when they ſublime it in glaſſes, or in earthen ſubliming pots: and though they regard not this included air, becauſe uſually there is not much of it in the veſſel, yet it may have a not inconſiderable influence on the effects of the fire's operation, not only as it contributes to the aſcenſion and ſuſtentation of diſſipated parts of the mineral, but as it affords theſe corpuſcles room to fly to and fro in it, and thereby make aſſociations, or coalitions, and concretions, that otherwiſe would not be produced. Upon this account I gueſſed, that it may be, on divers occaſions, a thing of uſe for diſcoveries, and perhaps too for practice, to employ a method, that the body expoſed to the action of the fire may be kept from the contact of the air, at leaſt as to any ſenſible portions of it, and being as it were included in bodies almoſt equivalent to ſolids; and one may ſuppreſs the free emiſſion and aſcent of exhalations, and ſo to make an operation, not only in cloſe, but as it were in ſolido, and reduce the parts of the body expoſed and perhaps the

igneous

igneous corpuſcles, to act reciprocally upon one another, without any notable diſſipation, or avolation of parts.

To apply now what hath been ſaid to antimony, I ſhall briefly ſet down an uncommon way, that came into my mind of operating upon it. We took well powdered ♄, and well dried (white) chalk reduced likewiſe to powder: with theſe in a large earthen pot or crucible, we made SSS. having a care to make the lowermoſt and uppermoſt bed of chalk, and the laſt thicker than any of the reſt, as alſo that none of the antimonial layers were but of a moderate thickneſs, that the heat might penetrate them the better: then the veſſel being covered, was put among the kindled coals of a good digeſtive furnace, (not becauſe ſuch a one was neceſſary, but becauſe it was at hand) where it was kept for a competent time; which according to the bigneſs of the pot, and the ſtrength of the fire, may be ſometimes twenty or twenty four hours, ſometimes a day and a half, and ſometimes two days or better.

The ſecond PENTADE.

EXPERIMENT I.

A very uncommon way of making a calx of gold.

It is known, that moſt chemiſts, and many phyſicians, have a ſuperlative eſteem for the medicinal virtues of gold, and the preparations of it. And upon this ground, divers of them have long been, and ſtill are ſolicitous to make calces of gold by differing ways, moſt of them laborious, and ſome of them ſcarce to be ſafely wrought and uſed in phyſic. Wherefore I ſhall I preſume, be eaſily pardoned, if I here ſet down a way, that came into my mind, and that I have ſometimes uſed to make a preparation, wherein gold is reduced to very minute parts, without the help of mercury, or of any precipitation made by ſharp ſalts, whether acid or lixivial.

We took then refined gold, and diſſolved it in clean and ſpirituous aqua regia; and inſtead of precipitating the clear ſolution with oil of tartar *per deliquium*, as is uſually done, or with ſpirit of ſal armoniac, or other volatile urinous ſpirits, we firſt with a very modeſt heat drew off the ſuperfluous liquor; whereby the gold, with the remaining part of the menſtruum, was left in the appearance of a thick and oleous liquor. This done, we poured upon it a treble weight of vinous ſpirit totally inflammable, and in a ſhort time we had, as we expected, a very ſubtil powder, or high coloured calx of gold, that ſubſided at the bottom; the menſtruum being ſtrangely dulcified as to taſte, and become fragrant in point of ſmell. When a very few days were paſt, we decanted the liquor, and put on it freſh ardent ſpirit, and leaving them a while together, there ſubſided the like well coloured calx more plentifully than the firſt time.

I know not, (to add that upon the by,) whether it may or may not be worth while to try to diſcover, whether this dulcified A. R. ſpirituoſa being drawn off from the ſubſiding gold, may have acquired any virtue from the opened metal; ſome trials ſeeming to argue, that the openneſs of this calx made it fit to be eaſily wrought upon by a menſtruum, that would not touch water-gold, as they call the common calx made by quartation, nor yet leaf-gold, ſuch as the apothecaries employ; but however the menſtruum has acquired ſuch qualities, as make it ſeem likely to prove an uſeful medicine, which yet I refer to trial.

By the way we pitched upon to make this powder of gold, it ſeemed probable, that it would not (at leaſt) be leſs ſubtil, and yet would be more mild than common preparations; and neverthleſs we thought it might, perhaps, make it yet more ſecure, if we ſhould, as we did, put upon it a totally ardent vinous ſpirit, and burn it off once, twice, or thrice, to carry off with it any little corroſive or ſaline particles, that may have ſtill adhered to the metalline ones.

N. B. The ſpirituous aqua regia, mentioned in the proceſs, is ſo called by me, partly to diſtinguiſh it from the common aqua regia, and partly becauſe it is indeed of a more ſpirituous nature than the common, being compoſed without any groſs ſalt, ſuch as *, but only of ſpirits. This menſtruum I made for ſome particular uſes: and though it works more ſlowly than the common chryſulca, yet I often prefer it to this, as that which I can employ to ſome uncommon purpoſes; and as it may probably be a more innocent menſtruum in making preparations of Sol, deſigned for medicinal uſes. I make it very eaſily, by mixing one part of good ſpirit of ſalt with two parts of ſtrong ſpirit of nitre, or (when it is not to be uſed for medicines) of common, but clean aqua fortis.

SCHOLIUM.

The above recited trial was made as it is delivered; but ſome circumſtances, that I took notice of, and particularly ſome grains of powder, that, though mingled with the reſt, were ſhining, as if they had been extremely minute, and bright filings of gold; theſe circumſtances, I ſay, made me ſuſpect, that the ſucceſs might much depend upon particular and nice circumſtances, that may need more exact trial, than I had then occaſion to make; and therefore it may be fit, that the experiment be heedfully repeated. It may alſo be tried, whether the employing common A. R. inſtead of ſpirituous, will much vary the experiment.

EXPERIMENT. II.

To try how much volatile ſalt an aſſigned quantity of water would diſſolve, we took ℥iii. of diſtilled water, and put into it by degrees ſome dry ſalt of ſal armoniac, (that was very white, and compact enough) keeping the liquor in digeſtion for a pretty while, that it might have time to diſſolve as much as it could. When we found it would diſſolve no more in a moderate heat, we took it off, and found, that after ſtanding ſome hours in the cold, there fell to the lower part of the glaſs, and ſettled there a pretty quantity of ſalt, which we gueſſed to be about ʒii. which being deducted from ℥ii. that had been in all put in, there remained ℥i. and ʒvi. in the liquor, which by this account had diſſolved at leaſt half its weight of ſalt.

SCHOLIUM.

I desire it may not be thought ſtrange, if, among our chemical experiments, ſome few ſhall be here and there met with, that are much leſs elaborate or promiſing than others, that I could eaſily have inſerted in their rooms; for I did it on ſet purpoſe, partly becauſe oftentimes (as was intimated at the beginning of the chapter) ſome more ſimple or ſeemingly leſs valuable experiments, may be fitter materials, than more curious ones, for the natural hiſtory we would promote; and partly to give an example, if mine can ſignify any thing, of not diſdaining to regiſter ſome things, that ſeem mean, if by the light they afford, or the uſes they may be applied to, they compenſate the want of luſtre, and of immediate utility. And the ſubſtance of this ſcholium I deſire may be mentally transferred, as occaſion ſhall require, to thoſe following chapters, that treat of chemical experiments.

EXPERIMENT III.

Perhaps ſome chemiſts will think, that the following memoir may give hints, that may be of uſe on ſeveral occaſions, both for other purpoſes, and for theirs, that would draw tinctures from ſeveral bodies, that will not afford them in ſimple ſpirit of wine though well rectified.

The ſimple ſpirit of good French verdegreas, being once or twice abſtracted from as

as much ſalt of tartar as it would diſſolve in the cold, left the ſalt eaſily fuſible, and diſſoluble in highly rectified ſpirit of wine.

EXPERIMENT IV.

I HAVE not been unacquainted with ſome curious and elaborate preparations of that noble flower the roſe; and experience hath convinced me, that it is poſſible, whatever moſt chemiſts think of it, to obtain from roſes a true eſſential oil, that mixes not with water, and is exceeding fragrant: but there are ſeveral, that are ſo far from believing, that an eſſential oil may be obtained from roſes, without being in the form of a butter, but in a liquid one like oil of cloves, or wormwood, that they doubt, whether a true ſpiritus ardens can be obtained from them, without addition of wine, or ſome ſuch inflammable liquor. I ſhall here tranſcribe the following note, as containing a more ſimple and eaſy preparation (than any of thoſe before mentioned) of the ardent ſpirit of thoſe flowers, and therefore more ſuitable to the deſign of the whole chapter.

To make an inflammable ſpirit of roſes.

Two buſhels of damaſk roſes (together with a good number of red roſe-buds) being beaten, and put into a veſſel with water, amounting to about four gallons, were mingled with about a quart of ale-yeaſt, and kept in fermentation for about five or ſix days (the weather being cold for the ſeaſon) and then being diſtilled *per veſicam*, afforded us a ſpiritus ardens.

EXPERIMENT V.

An experiment about the chemical analyſis of pearls.

WE took ℥ii. of ſeed pearl, that were carefully bought for oriental, and without breaking them, put them into a retort, and diſtilled them in a ſand-furnace by degrees of fire, giving a ſtrong one at the laſt. By this means we had a little black oil ſwimming upon the ſpirit, which was alſo dark and muddy, as if incorporated with ſome more oil. The weight of both theſe liquors was twenty three grains, beſides which there ſtuck to almoſt all the upper part of the retort a thin film of oil, which together with a ſtreak of the like reaching to the bottom of the receiver, we eſtimated at three grains more, and ſo reckoned twenty ſix grains for the weight of the whole aſcended matter. The caput mortuum amounted to full the remaining weight of two ounces. The empyreumatical liquors, that came over, ſmelled much like thoſe of harts-horn, and the ſpirit was found to belong, as we expected, to the tribe of urinous ones, or, as many now call them, volatile alcalies. For it readily hiſſed and produced bubbles, with good ſpirit of ſalt, turned ſyrup of violets green, and being dropped into ſolution of ſublimate, turned that white; to omit another way or two, by which I examined it. The oil, that ſtuck to the retort, and which was fœtid, like that of harts-horn, did eaſily diſſolve in dephlegmed ſpirit of wine, and afforded a reddiſh brown ſolution. The caput mortuum was very black, and ſome grains of it were found readily enough diſſoluble in ſpirit of vinegar. Being calcined in a well covered crucible, with a ſtrong fire, (for a moderate one will not do it, unleſs it be long) we reduced them to be purely white, and to a weight leſs by ſome grains than an ounce and ℥iii. and we found, as we expected, that being pulveriſed, this calx taſted hot and bitteriſh upon the tongue, like good calx vive, and was not only of an alcaliſate, but a lixivial nature: for beſides that it preſently turned ſyrup of violets green, it quickly afforded an orange coloured precipitate, with ſolution of ſublimate.

STRANGE REPORTS,

In TWO PARTS.

Addreſſed to a Virtuoſo, Friend to the AUTHOR.

ADVERTISEMENT.

I PRESUME, Sir, you may yet remember, what I wrote about the nature and ſcope of my collection of *Strange Reports*, in an eſſay, which takes its title from them; and which I was encouraged to make by the example of *Ariſtotle* *. And therefore I ſhall deſire, that to ſave your trouble and my own, that paper may ſerve for a preface to that which follows. About which, ſuppoſing this requeſt to be granted, I ſhall need to give you at preſent but this ſhort advertiſement; that for diſtinction's ſake, I thought fit to divide the enſuing particulars into two parts, becauſe they are indeed of two ſorts; one relating to things purely natural, and the other conſiſting of phænomena, that are, or ſeem to be, of a ſupernatural kind or order.

THE firſt ſet of particulars belonging to each of the two forementioned parts has prefixed to it the title of the firſt ſection, though it be not at this time attended by a ſecond; becauſe it is deſigned, that, God permitting, it ſhall be ſo hereafter, when I ſhall get time to pick up out of my *Adverſaria*, and other memoirs, particulars fit to have placed in the liſt of *Strange Reports*.

I MUST likewiſe give you notice, that you are not to expect the ſecond part at this time; diſcretion forbidding me to let that appear, till I ſee what entertainment will be given to the firſt part, that conſiſts but of relations far leſs ſtrange than thoſe that make up the other part.

STRANGE REPORTS.

PART I.

SECTION I.

RELATING to a judicious virtuoſo, that a phyſician of *Bruſſels* a while ſince affirmed to me, that he himſelf had prepared three or four reſuſcitable plants, one of which he had preſented to the marquis of *Caſtel Rodrigo*, now governor of the Spaniſh Netherlands, where this virtuoſo had not long ſince been: relating this, I ſay, to this gentleman, and enquiring of him, whether he had ſeen this reſuſcitable plant; he anſwered me, that he had never ſeen nor heard of it; but told me on this occaſion, that coming to *Deal* with an apothecary of *Namier*, if I miſremember not the

* This famous philoſopher in his little tract, whoſe title ſome render *De Mirandis Auditionibus*, ſcrupled not to compriſe without method divers reports, uncertain or fabulous, nor to inſert ſeveral, that were not ſo cautiouſly admitted, as thoſe recited in the following collection.

the name, much eſteemed for his extraordinary ſkill in chemiſtry about ſome choice preparations, wherewith this man's ſhop was furniſhed, the apothecary told the virtuoſo, that he had really prepared reſuſcitable plants, a different way from that which others pretended to, and that he could prepare a great variety of them. And when having enquired of the virtuoſo, whether he himſelf had ſeen any of theſe prepared plants, he aſſured me, that he had ſeen not only ſome, but many. I then upon farther enquiry, how they appeared, learned, that the chemiſt had divers of them in diſtinct glaſs bottles; that the apparitions, that were exhibited, ſhewed not the peculiar colours, but only the ſhape of the plant; but this ſo genuinely, that he could perfectly diſtinguiſh, and eaſily know it to be ſuch or ſuch a plant, inſtancing particularly in carduus benedictus, and camomile.

AND the difference betwixt this way of exhibiting plants, and that which is mentioned by *Quercetan*, and pretended to by others, I found by this gentleman's anſwers, to conſiſt chiefly in theſe two things: the firſt, that the apothecary's plants did not, as the others, ſeem to grow up into the air included in a ſealed vial, but were ſeen as growing in a clear liquor, wherewith the bottle that contained it was almoſt filled; and the next, that whereas to make the apparition, mentioned by *Quercetan*, and others, the application of an actual heat (as that of a lamp, or the ſun-beams, or the like) is affirmed to be requiſite, upon the abſence of which the phantaſtical plant relapſes into its aſhes; in the formation of the apothecary's vegetables, he doth not employ any actual heat, but (which may ſeem more ſtrange) only the ſhaking of the bottle; for upon that agitation, the prepared aſhes or powder being raiſed from the bottom, and diſperſed quite through the liquor, when the glaſs is ſet by in a quiet place, the ſcattered particles by degrees ſo convene, as to compoſe a model of the plant they once belonged to. And heat not being requiſite to their formation, theſe plants do not quickly, as the Polonian phyſician's fantaſtic vegetable, recorded by *Quercetan*, fall back into a powder; but, if let alone, continued a great while, until the preparer think fit by a gentle agitation of the bottle, to diſſolve the looſe contexture of it.

RELATION II.

I met the other day with a very intelligent perſon, well verſed in chemiſtry, not credulous, and in a word very well worthy of credit, who aſſured me, that he had himſelf ſeen a few years ago at *Mentz* in the hands of one monſieur *P——r*, a gentleman of *Switzerland*, and a virtuoſo, a piece of glaſs about the bigneſs of a ſhilling, or ſomewhat bigger, which was red and pretty tranſparent like glaſs of antimony made *per ſe*, and which this monſieur *P.* affirmed to the relator, that he hammered before the preſent elector of *Heidelburg*, (to whom, I told him, I had the honour to be known, and) by whom the relator was about that time employed. And this monſieur *P.* being his intimate acquaintance, and perceiving, that he was (as he well might be) indiſpoſed to believe ſo ſtrange a thing, after he had confeſſed the glaſs to have been given him by an excellent chemiſt in his country (*Switzerland*); this gentleman, I ſay, at the relator's earneſt requeſt, gave him leave, for his ſatisfaction, to lay the piece of glaſs upon an anvil, and to ſtrike ſeven or eight ſtrokes with a hammer upon it; by which means he found, that though it was not malleable (at leaſt in the ſtate it then was) like nealed ſilver, ſince it began to crack at the edges like ſilver, that is over-hammered; yet it did really ſtretch under the hammer, growing more thin on the beaten part, and having viſible marks or impreſſions made on it by the edge of the hammer.

RELA-

RELATION III.

A PIOUS and learned ſchoolmaſter, that ventured to ſtay in *London* in the great plague 1665, and was much employed, as ſome friends of mine, that knew him, and commended him, aſſured me, to viſit the ſick, and diſtribute alms and relief to them, went indiſcriminately to all ſorts of infected, and even dying perſons, to the number, as he told me, of nine hundred, or a thouſand; and being aſked by me about the infection of other things than walls, he told me, that being once called to adminiſter ſome ghoſtly comfort to a poor woman, that had buried ſome children of the plague, he found the room ſo little, that it ſcarce held any more than the bed whereon ſhe lay ſick, and an open coffin, wherein he ſaw her huſband lie dead of the ſame diſeaſe, whom the wife ſoon after followed. In this little cloſe room they affirmed to him, that the contagious ſteams had produced ſpots on the very wall; and when I aſked, whether he himſelf had ſeen them, he anſwered, that he had not; but yet was inclined to believe the thing to be true, not only upon the ſcore of the relators, but becauſe he had obſerved the like in his own ſtudy; which being divided only by a wall from ſome rooms of a houſe, which the owner had turned into a kind of a peſt-houſe, and in which numbers had died in a ſhort time, he took notice, that the white wall of his ſtudy was (ſince the ſickneſs raged, without any other cauſe that he could imagine) blemiſhed in divers places with ſpots, like thoſe of infected perſons. When (to add that upon the by) I enquired what antidote he uſed, he replied, that next the protection of God, which ſo many ſad objects made him the more fervently implore, and a conſtant fearleſſneſs, the only preſervative he uſed, beſides good diet, were half a ſpoonful or a ſpoonful of brandy five or ſix times a-day, eſpecially when he went into infected places, and the bigneſs of a ſmall nut, or leſs, of a root of Spaniſh angelica, of which he held in his mouth the quantity of a pepper-corn, or ſomewhat leſs, as often as he thought there was need.

RELATION IV.

January 25. AN ingenious perſon, and very worthy of credit, informed me the other day, in anſwer to ſome queſtions that I propoſed to him, that he was employed ſome years ago by a German phyſician (whoſe name he told me) to diſtil a certain mineral not unknown to me, which he performed in a naked fire, with ſo good ſucceſs, that he had from about half a pound of the mineral, near ʒiii. of the liquor: this he included in a glaſs with a bubble, and a ſlender neck like one of my weather-glaſſes; but though the liquor at firſt reached not above the bubble, but only filled it to the bottom of the pipe; yet as the moon increaſed, this liquor, as the doctor expected, by degrees expanded itſelf in the glaſs; ſo that about the full-moon, it reached about an inch into the pipe, and upon the decreaſe of the moon, it ſubſided by degrees to the bottom of the pipe. And when I aſked, whether the veſſel were carefully ſtopped; he anſwered, that it was not only ſo, but hermetically ſealed like one of my thermometers with ſpirit of wine, which he had ſeen. This the relator averred to me upon his own obſervation; and being deſired, he readily gave me a deſcription of the mineral, and a direction where to procure it, (which I am now endeavouring to do) adding, that the ſame doctor made the like trial with another mineral akin to this, with which my having heard, that ſuch an experiment had been done, gave me occaſion to propoſe him the queſtion.

RELATION V.

AN inquiſitive traveller, that not long ſince waited on a German prince addicted to chemiſtry, and was employed by him in his private laboratory, being aſked by me ſome queſtions about ore of biſmute or tin-glaſs, whereof there is ſaid to be a mine in that prince's territories, and in particular, whether he had obſerved any thing of the varying

varying bulk of a ſtrange liquor obtainable from it; he anſwered me to this effect, that he had had occaſion to make many trials upon this mineral, and that particularly, by his prince's command, he had diſtilled a conſiderable quantity of a certain ſort of it, (becauſe it yields but very little ſpirit) and that he thereby obtained a liquor, which being by rectification freed from its ſuperfluous phlegm, amounted to about half a pint. This liquor was put into a vial, which it almoſt half filled. This vial being exactly ſtopped, was ſet aſide in a quiet place, where, (as the prince expected) as the light of the moon increaſed, from the new moon towards the full, ſo this liquor gradually ſwelled, and that not in a hardly perceptible degree, but very manifeſtly and conſiderably; ſo that when the moon was full, the liquor reached almoſt to the top of the glaſs, and during her wane, as the light decreaſed, ſo did the bulk of the liquor, which was always leaſt at the new moon. I aſked him, if any trial had been made, whether the weight of this ſpirit varied with the bulk, and he frankly confeſſed to me, that it had not come into his mind; but for what is above related of the increment and decrement as to quantity he affirmed to me, that himſelf, as well as his prince, had ſeveral times obſerved it; and he alſo readily told me the way he uſed in making the diſtillation, which, he ſaid, exacted an intenſe degree of fire.

RELATION VI.

AN inquiſitive perſon, that having gone through his ſtudies in the univerſity, travelled through divers countries, to make himſelf the more fit for the profeſſion of phyſic, anſwered me, that having reſided for ſome time in *Pruſſia*, he had more than once or twice (and that in differing places) obſerved, as others in his company alſo did, that the fiſhermen in breaking the ice of long frozen places, and taking out thence conſiderable maſſes of ice, did ſeveral times find in them ſwallows, ſometimes numerous enough, that were ſo incloſed in the ice, that unleſs by breaking, or thawing it, they could not be gotten out of it. And he further anſwered me, that when theſe lumps or maſſes of ice came to be thawed in their German ſtoves, the ſwallows, that lay as dead before, would revive, and perhaps fly about the room, but did not long ſurvive their recovery out of their inſenſible ſtate, ſome dying again in few hours, others the next day, or perhaps the third; but few or none, that he obſerved, living beyond the fourth or the fifth; which immature death my relator judged to be cauſed by their having no appetite to eat, which inappetency made them die ſtarved. But as the conjecture may be true as to thoſe, that lived for ſome days, ſo it ſeems not like, that thoſe that periſhed in few hours died merely of hunger; and as for them, that were ſtarved to death, I ſhould ſuſpect, that they were ſtarved, not ſo much for want of appetite, as for want of ſuch animals as they uſed to feed on, eſpecially flies, which they could not get in winter.

RELATION VII.

AN inquiſitive gentleman lately returned from *Jamaica*, where he was employed by the governor to make diſcoveries of natural things, anſwered me this morning, that he had ſeen in that iſland great number of trees, that bear the ſilken cotton; that he found many of them to ſurpaſs in bigneſs and height the larger ſort of our Engliſh oaks; and that on a mountain, that many went to viſit, out of curioſity, to view a ſtupendous ſilk cotton tree, he ſaw its bulk, and many affirmed to him, and it was the general tradition of the country, which he ſaw no cauſe to diſbelieve, that this prodigious tree was in the body no leſs than twenty one yards about, that is, more than ſixty foot in compaſs.

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THE ſame curious traveller told me, he ſaw a canoo made of the hollowed trunk of one of theſe ſilk-cotton trees, which, after all that had been taken off, to give it the ſhape of a veſſel fit for ſervice, was thirty foot about, and of at leaſt a proportionable length.

RELATION VIII.

A MERCHANT, rich and judicious, and more addicted to letters than is uſual to men of his calling, being returned into *England* from ſome of the remoter parts of the *Eaſt-Indies*, to ſatisfy my curioſity about a ſtrange tradition of ſeveral navigators about a more than one way extraordinary in-draught of the ſea on the coaſt of a great iſland of the ſouthern ocean, ſent me the enſuing relation, which though it contains ſomething manifeſtly fabulous, but eaſily diſtinguiſhable from the reſt, I give you in the relator's own words, being unwilling to alter any thing, till I can ſee him again, and propoſe my ſcruples to him.

AT *Campar* and *Racan*, on the eaſt coaſt of *Sumatra*, is in the river's mouth (to a certain diſtance) at each new and full moon, a violent in-draught of the ſea (called Bunna) which approacheth with an hideous noiſe, and mountain high, ſo that whatſoever oppoſeth it, periſheth. Its approach is in three parts; the firſt high, but not ſo terrible; the ſecond is high, black and horrid; the third is low, and of gentle motion: before its approach, it giveth ſo fair warning, that the people may eat, and bathe themſelves, before they weigh anchor; but when they weigh, they muſt row hard againſt it, and when its fury is paſt, follow with it, till they return to their anchor place. The true reaſon whereof the inhabitants cannot diſcover: but (as if *Greece* only were not the mother of fabulous traditions) theſe poor natives fabulize, that at *Campar* (where is the greateſt Bunna) in former ages, there was a princeſs, who, to ſhun the rape of an inſolent *Caffree* ſlave, ran into the ſea's mouth; but the ſlave ſtill purſuing her, and after him the princeſs's little dog, all periſhed; and thus (by a new metamorphoſis) theſe three waves perpetuate their commemoration. That afterwards a bold fellow, hoping to divert this Bunna from *Campar* (by advice of ſome wizards) rowed up againſt that firſt part of the torrent, and filling a bottle of its water, which he immediately ſtoped up cloſe, he betook himſelf to *Rakan* (not far diſtant) and poured it out into that river's mouth, which brought the Bunna thither alſo, though it left not *Campar*; but that fellow ſuddenly after dying, none durſt ſince attempt the like, elſe the natives fancy it may ſtill be done.

MY humble opinion is (adds my relator) that the mouths of thoſe rivers being choaked up with their ſand-banks, and ſo rendered very ſhallow; when the great ſpring-tides come roaring over thoſe ſhoals (at the new and full moons) out of the *Malacca* ſtreights, the firſt influx is irreſiſtible by ſuch ſmall veſſels as uſe that port (eſpecially if attended with dark weather, or ſtormy guſts) ſo that they are forced to weigh and bear up againſt it, for fear of being ſtranded and ſplit. In which ſentiment I reſt, till I can attain a more prevalent reaſon.

RELATION IX.

A GENTLEMAN, that had travelled far, and obſerved much, related to me, that, being off the coaſt of *Moſambique*, between the 20th and laſt days of *September*, the captain of the great Portugal ſhip they were in, walking to and fro upon the deck, ſpied, a great way off, a very little dark cloud, or blackiſh ſpot in the ſky: whereupon, though the weather were fair, he made all the haſte he poſſibly could to provide for a great ſtorm, by taking in the ſails, *&c.* And though for a while the ſky continued clear, and they had no ſigns of an imminent change; but that, when the

cloud approached, the wind, that had till then filled their ſails, ceaſed, and the ſea became calmer than before: but preſently after they had a furious hurricane, which turned their ſhip quite round many times one after another, as if it were an aerial whirl-pool, which laſted for above two hours, and then left them, ſeeming to have a progreſſive motion, as whirpools in rivers often have.

RELATION X.

AN ingenious practitioner of phyſic, accompanied by one of the ſame profeſſion, aſſured me with great aſſeveration, that ſome while ſince, being at a place in the country near *Amſterdam*, where there lived a kind of a farmer, who (though illiterate enough) was reputed very curious; this perſon ſhewed him, among other things, a conſiderable quantity of quickſilver, that was altogether of the colour of gold. And, to anſwer my ſcruple, this relator added, that the colour did not belong only to the ſurface of the whole maſs; but having purpoſely (with water) divided it into many globules, each of them retained the ſame rich colour. And he further told me, that the poſſeſſor of this yellow mercury having put ſome of it over a fire in a convenient veſſel, it quickly loſt its fluidity, and was precipitated into a red powder; about which he hoped to learn ſome notable things at his next viſit to the author: but that having been too long delayed, when he came to the place again, he found, to his great grief, that the maſter was dead, and his relations were, or pretended to be, ignorant of his ſecrets.

A VERY learned and experienced phyſician made me a viſit to give me notice, that a few days before he had received one in the night from a couple of ſtrangers, one of whom, by ſome things that he ſaw him do, he judged to be (what they call) an adeptus, who, beſides a thing far more rare and valuable, ſhewed him, as a curioſity, a running mercury of a lovely green. And when I aſked my judicious relator, whether he had broken the fluid maſs into drops, to obſerve, whether the colour were that only of the ſurface, or of the whole maſs? he anſwered, that he purpoſely laid it upon a rough body, as a carpet, and found the globules, whereinto it was by this means divided, to be of the ſame fine green, that had beautified the whole maſs.

THESE relations, though they had come to me from leſs credible perſons than thoſe I received them from, I ſhould not haſtily have rejected, becauſe of ſome odd and fine colourations of running mercury, that I have myſelf obſerved, but here forbear to mention, becauſe they belong to another paper.

THE GENERAL HISTORY of the AIR DESIGNED and BEGUN.

Advertiſement of the Publiſher to the READER.

THE deſign of the following papers the author's own preface will acquaint thee with. And though, as thou wilt there ſee, his expectation of aſſiſtance (in a work too great for one ſingle man's undertaking) from others failed him, yet I doubt not but his own experiments and collections would have made this treatiſe much

larger, before it had been publiſhed, had his health allowed him opportunity: but that permitting him not ſo much as to review theſe papers, or range them into that order, which would be moſt advantageous, thou art not to wonder, if thou findeſt ſome defects, ſome diſlocations, and other faults, in this publication, which the author's laſt hand would have prevented. The negligence of tranſcribers has let ſlip the characters of relators, and names and places of authors, from whom ſeveral of the particulars in the following papers were taken: nor could it be hoped that the author's own memory (were he in a ſtate of health fit to be troubled with it) ſhould, after ſo long a time as this collection has been making, and in that variety of men and books he has had to do with, be able to retrieve them. But this will be no great loſs to the learned world, which is ſufficiently acquainted with his great caution, and will make no difficulty confidently to rely upon his unaffected candor and ſincerity. I know not how much ſome other parts of his noble (and always buſy) deſigns for the advancement of knowledge, and the benefit of mankind, may ſuffer by that tenderneſs of his conſtitution, which the importunity of his friends can hardly prevail upon him to withdraw from philoſophical cares. But this he has ordered ſo, that, imperfect as it is, one cannot call it deficient; ſince, the foundation being here laid, and the draught made, every one may, if he pleaſe, add towards the compleating of the building, I will not ſay with materials equal to what his ſagacity and laboratory uſed to afford; for we muſt not expect to find in every age a man able and ready to lay out ſo much coſt, pains, and ſkill, frankly, for the improvement of natural philoſophy, and the information of the world, as he has done. The ſcheme of titles, under which theſe materials for the hiſtory of the air are ranged, is ſomewhat different from that printed by him ſeveral years ſince, and diſtributed amongſt his friends. But this is without any prejudice to the main deſign, ſince whatſoever any one hath collected under thoſe heads, will be eaſily reducible to theſe, which in a more natural order are more comprehenſive. In that firſt draught he followed my Lord *Bacon*'s advice, not to be over-curious or nice in making the firſt ſet of heads, but to take them as they occur. But now that thus much comes to be publiſhed, which perhaps may ſerve to ſome men as a common place for the hiſtory of the air, the titles have been a little more increaſed, or methodized, to which any one may add as he finds occaſion: only in theſe the reader is deſired to obſerve,

I. That under the title of mineral ſubſtances are comprehended earth, and all other foſſils, to avoid multiplying of articles.

II. That when any mixed body is ranked under animal, vegetable, or mineral ſubſtances, it is put under that of the three, which either it partakes moſt of, or to which moſt is owing in the preſent experiment, or which in its own nature it moſt reſembles.

III. That it is not by an over-ſight, that lightning is put under two different titles; for in one it is conſidered only in reference to the ſight; in the other it is conſidered as the product of ſulphureous or inflammable effluviums taking fire, with the ſtrange effects it produces; which may be an example of putting the ſame thing, with different views, under different heads.

What is above ſaid, was written whilſt the author was living, to which it is neceſſary now to add, that the titles, as here printed, and the order of the papers, as now ranged under them, were ſhewn to the author, and approved by him, as fitter for the general hiſtory of the air, than thoſe he had formerly printed. So that, reader, thou haſt theſe papers as they were prepared and ordered to be publiſhed in his lifetime, and they had then gone to the preſs to be printed, juſt as thou now receiveſt them, had not the publiſher the laſt winter been haſtily called out of town.

The PREFACE.

THE continual uſe of the air is ſo abſolutely neceſſary to our life; the good or bad temperature of it is ſo important to our health; and the ſcarce evitable preſence and powerful preſſure of it, has ſo great an intereſt in many of the phænomena we meet with here below, and even in divers, where its agency is not ſuſpected; that among mere bodies there are perhaps few ſubjects, that more deſerve our curioſity, whether as we are animals, or as we are naturaliſts. Upon which account I can ſcarce think that any thing, that conduces to the fuller knowledge of a body ſo diffuſed, ſo neceſſary, and ſo powerful, is fit to be deſpiſed, or is unworthy to be preſerved in writing.

AND therefore, though I have formerly had occaſion to treat, in diſtinct tracts, of ſome of the qualities or affections of the air, as its gravity, ſpringineſs, *&c.* yet I found myſelf inclined to contribute further to the knowledge of that vaſt and uſeful ſubject, by ſetting down ſome memorials, partly out of my own obſervations and trials, and partly out of thoſe I had from perſons of good credit, concerning ſome cauſes and effects of the changes of the air, and conſequently concerning ſeveral of its qualities, that were requiſite to be taken into conſideration in a work of that nature. And not content with this, though my own ſtudies and affairs would not permit me to proſecute myſelf the deſign I am going to mention, yet, thinking it might be a very uſeful thing, in reference both to philoſophy and phyſic, that a natural hiſtory of the air (though at firſt it ſhould prove but a very imperfect one) were faithfully compiled, I propounded the deſign to ſome virtuoſi, that ſeemed to reliſh it, and undertook to be aſſiſtant in it.

AND, to facilitate their work, I drew up a ſet of heads and inquiries of that ſort, which in another paper I call titles of the firſt claſſis or order; which, though purpoſely ſet down without any anxious method, were comprehenſive enough to have a good number and variety of particulars conveniently referred to them. But afterwards finding the perſons, to whom I had committed theſe ſchemes, to have been for many years very unmindful of their promiſes; I did, on this diſcouragement, lay aſide, not only the hopes of a general hiſtory of the air, but what I had already written about the changes of that body.

AND, upon the ſame accounts, thoſe ſcattered notes lay many years in looſe neglected papers, till at length the curioſity and deſires of ſome virtuoſi, that knew I had gathered ſome remarks, though few and incoherent, touching ſome qualities of the air, obliged me to draw together thoſe, that without a troubleſome ſearch I could retrieve, offering themſelves to promote the deſign, that others had abandoned. The deſire to gratify theſe inquiſitive men, and the conviction I am brought under, by ſuch reaſons as are mentioned at the beginning of this paper, that ſcarce any truth, whether hiſtorical or doctrinal, that relates to ſo important a ſubject as the air, is unfit to be preſerved, prevailed with me, rather to chuſe a very diſadvantageous way of ſetting down what I have to deliver about it, than ſuffer the looſe obſervations I had occaſion to make about ſome phænomena and qualities, and eſpecially the changes of the air, to be loſt. And therefore, though I have not the leiſure to methodize my incoherent notes, and much leſs to weave them into continued diſcourſes; yet, rather than let them periſh, and diſappoint thoſe that will have them ſuch as they are, I am content to refer to ſome of the titles prefixed to this treatiſe, as to a kind of common places, what my memory, or ſome old notes about divers

things relating to the air, and eſpecially to the cauſes and effects of its changes, ſupply me with in reference to that body.

And, upon the like account, I have not ſtrictly confined myſelf to the mention of my looſe obſervations, and thoſe that I have been furniſhed with by anſwers to the queſtions I put to divers travellers and navigators; but I have alſo caſt in ſeveral pertinent paſſages, that chanced to occur to me in the reading of ſome voyages, and other books, eſpecially ſuch as are either out of print, or are but in few hands, or elſe are not extant in thoſe that are called the learned languages. And that thoſe virtuoſi, that are willing to contribute their induſtry to carry on the deſign, that was at firſt propoſed, might have ſome heads whereunto to refer what ſhall occur to them; I thought fit to premiſe to my papers the abovementioned ſcheme, or rough draught of the general hiſtory, (which after many years I chanced to recover.) I have alſo thought fit, that, under three or four titles, my collections of particulars ſhould be ſomewhat large and methodical, to afford the ſame perſons ſome ſpecimens of what I ſhould have thought requiſite to do upon particular ſubjects, if I would have ventured upon ſuch a taſk, as to write a natural hiſtory of the air.

I am not ignorant, that I expoſe myſelf to cenſure, for ſuffering to paſs out of my hands memoirs ſo maimed and imperfect, that ſeveral of the ſubjects mentioned in the ſcheme of titles are left altogether untouched; and thoſe, that are particularly mentioned, are for the moſt part touched upon but lightly. But the chief (though not perhaps the only) reaſons, that kept me from being ſilenced by theſe conſiderations, though I confeſs them to be weighty, were theſe: firſt, that, not pretending to write the hiſtory of the air, but only ſome memoirs of it, I might, without incongruity or indecency, contribute what had occurred to me in reference to ſome of the titles, though I left the others to thoſe, that had made experiments or obſervations about them. Next, that having, through the fraud or negligence of ſome perſons, loſt ſundry looſe papers, that I had provided for the hiſtory of the air, my unwillingneſs, that the reſt ſhould undergo the ſame fate, invited me to impart them to many, as the beſt expedient to ſecure them. To which I, thirdly, add an inducement, which, though laſt named, was the firſt in efficacy, as that which made the other two ſignificant; namely, that I had more than once obſerved, that when a work of this nature has been once begun and taken notice of, in ſuch an inquiſitive and active age as this of ours, it ſeldom fails to excite the curioſity and induſtry of others, whom, if the deſign be any thing well laid, the utility, that it promiſes, will invite to carry it on.

THE

GENERAL HISTORY of the AIR:

DESIGNED and BEGUN.

TITLE I.

What we underſtand by the Air.

BY the air I commonly underſtand, that thin, fluid, diaphanous, compreſſible and dilatable body, in which we breathe, and wherein we move, which envelops the earth on all ſides to a great height above the higheſt mountains; but yet is ſo

ſo different from the æther [or vacuum] in the intermundane or interplanetary ſpaces, that it refracts the rays of the moon and other remoter luminaries.

TITLE II.

Of the conſtant and permanent Ingredients of the Air.

A ſhort Anſwer to a Queſtion about the Nature of the Air, given by Mr. Boyle *to Mr.* H. Oldenburg.

AS to your queſtion, what I think the air to be? I ſhall in the firſt place take it for granted, that by the air you mean not, either the pure element of air, which ſome, nor that etherial or celeſtial ſubſtance, that others (upon what grounds I muſt not here examine) aſſert; but that, which I am wont to call the atmoſpherical air, which is that common air we breathe and move in.

BUT though I know you too well to ſuſpect, that you deſign any ambiguity in your queſtion; yet I ſhall not adventure to anſwer it, till I have premiſed a diſtinction that is not uſual: for, according to my thoughts, the air may be taken either for that, which is temporary, (if I may ſo call it) or in a tranſient ſtate; or that which is laſting, and in a permanent ſtate. This diſtinction, which perhaps you looked not for, I ſhall illuſtrate by this example, that if you ſufficiently heat an æolipile furniſhed with water, and ſtay a pretty while to afford time for the expulſion of the aerial particles by the aqueous vapours, you may afterwards obſerve, that theſe laſt named will be driven out in multitudes, and with a noiſe, and will emulate a wind or ſtream of air, by blowing coals held at a convenient diſtance, like a pair of bellows, and by producing a ſharp and whiſtling ſound againſt the edge of a knife, held in a convenient poſture almoſt upon the orifice of the pipe, whence they iſſue out. But this vapid ſtream, though in theſe and ſome other things it imitates true air, whilſt the vehement agitation laſts, which the vapours it conſiſts of received from the fire; yet in a very ſhort time, eſpecially if the weather, or the veſſels it enters into, be cold, loſes the temporary form it ſeemed to have of air, and returns to water, as it was at firſt.

THIS premiſed, I come to ſpeak directly, but dare not do it confidently, to your queſtion: for though poſſibly I may have made as many trials as another about the nature of the air; yet I freely confeſs to you, that I much ſuſpect there lies yet ſomething concealed in it, that needs a further diſcovery, which may perhaps be made by further trials. But in the mean time (not wholly to baffle your curioſity, ſince it is ſo modeſt, as to deſire to know of me, not what the true nature of the air is, but what I gueſs concerning its chiefeſt property or attribute) I will acquaint you with ſome of the thoughts I long ago had, and which I yet took upon myſelf, and deſire to have them looked upon by you but as conjectures, entertained only till farther diſcoveries confirm them, or ſuggeſt better in their room.

IT ſeems then not improbable to me, that our atmoſpherical air may conſiſt of three differing kinds of corpuſcles. The firſt is made of that numberleſs multitude and great variety of particles, which, under the form of vapours or dry exhalations, aſcend from the earth, water, minerals, vegetables, and animals, &c. and, in a word, of whatever ſubſtances are elevated by the celeſtial or ſubterraneal heats, and made to diffuſe themſelves into the atmoſphere. The ſecond ſort of particles, that make the air, may be yet more ſubtile than the former, and conſiſt of ſuch exceeding mi-

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nute parts, as make up the magnetical ſteams of our terreſtrial globe, and the innumerable particles, that the ſun and other ſtars, that ſeem to ſhine of themſelves, do either emit out of their own bodies, or by their preſſure thruſt againſt our eyes, and thereby produce what we call light; which, whether we explicate it by the Epicurean or Carteſian hypotheſis, argues a great plenty of a celeſtial (or ſome other very ſubtile matter, to be diſperſed through, or harboured in, the intervals of the ſtabler or groſſer corpuſcles of the atmoſphere.

But becauſe you expect from me a diſtinguiſhing (and as it were characteriſtic) quality, which may put a difference between the parts already named of the atmoſphere, and thoſe, to which moſt of the phænomena of our engine, and many other pneumatical experiments ſeem to be due, I ſhall add a third ſort of atmoſpherical particles, compared with which, I have not yet found any, whereto the name of air does ſo deſervedly belong. And this ſort of particles are thoſe, which are not only for a while, by manifeſt outward agents, made elaſtical, but are permanently ſo, and on that account may be ſtiled perennial air.

Of the ſtructure of the elaſtical particles of the air, divers conceptions may be framed, according to the ſeveral contrivances men may deviſe to anſwer the phænomena: for one may think them to be like the ſprings of watches, coiled up, and ſtill endeavouring to fly abroad. One may alſo fancy a portion of air to be like a lock or parcel of curled hairs of wool; which being compreſſed by an external force, or their own weight, may have a continual endeavour to ſtretch themſelves out, and thruſt away the neighbouring particles, and whatever other bodies would hinder them to recover their former ſtate, or attain their full liberty. One may alſo fancy them like extremely ſlender wires, ſuch as thoſe of gold and ſilver, that tradeſmen unwind from ſome cylindrical bodies of differing ſizes, on which they were rolled; which pieces of ſpiral or curled wire may be, as of differing ſubſtances and conſiſtencies, ſo of very differing lengths and thickneſſes, and have their curls greater or leſſer, nearer each other, or more diſtant, and be otherwiſe diverſified, and yet all have ſpringineſs in them, and (notwithſtanding) be, by reaſon of their ſhape, readily expanſible on the ſcore of their native ſtructure, as alſo by heat, girations, and other motions, and compreſſible by an external force into a very little room. I remember too, that I have, among other compariſons of this kind, repreſented the ſpringy particles of the air like the very thin ſhavings of wood, that carpenters and joiners are wont to take off with their plainers; for, beſides that theſe may be made of differing woods, as oak, aſh, fir, *&c.* and thereby be diverſified as to their ſubſtance, they are uſually of very various breadths, and lengths, and thickneſſes. And perhaps you may the rather prefer this compariſon, becauſe it may ſeem ſomewhat to illuſtrate the production of the ſpringy particles of the air: for, to make theſe ſhavings, there is no art nor curious inſtruments required; and their curls are no ways uniform, but many ways differing, and ſeemingly caſual; and, which is chiefly conſiderable, theſe ſhavings are producible out of bodies, that did not appear, nor were ſuſpected, to be elaſtical in their bulk, as beams and blocks, almoſt any of which may afford ſpringy ſhavings, barely by having ſome of its parts ſo taken off, as to be thin and flexible enough, and commodiouſly ſhaped; which may perhaps illuſtrate what I tried, that divers ſolid (and even mineral) bodies, not ſuſpected of elaſticity, being put into corroſive menſtruums, devoid of that quality, there will, upon the convenient comminution of parts enſuing the action and re-action that paſſes between them in the diſſolution, reſult or emerge a pretty quantity of permanently elaſtical fire. But poſſibly you will think, that theſe are but extravagant conjectures: and therefore, without adding any thing in favour of them, I ſhall proceed, and willingly grant, that

that one may fancy ſeveral other ſhapes (and perhaps fitter than theſe we have mentioned) for theſe ſpringy corpuſcles, about whoſe ſtructure I ſhall not now particularly diſcourſe, becauſe of the variety of probable conjectures, that I think may be propoſed concerning it. Only I ſhall here intimate, that though the elaſtical air ſeem to continue ſuch, rather upon the ſcore of its ſtructure, than any external agitation; yet heat, that is a kind of motion, may make the agitated particles ſtrive to recede further and further from the centres of their motions, and to beat off thoſe, that would hinder the freedom of their gyrations, and ſo very much add to the endeavour of ſuch air to expand itſelf. And I will allow you to ſuſpect, that there may be ſometimes mingled with the particles, that are ſpringy, upon the newly mentioned account, ſome others, that owe their elaſticity, not ſo much to their ſtructure, as their motion, which variouſly brandiſhing them and whirling them about, may make them beat off the neighbouring particles, and thereby promote an expanſive endeavour in the air, whereof they are parts. And though ſome of theſe may, in very cold climates and ſeaſons, prove to be of thoſe, which I not long ſince referred to temporary air; yet others of them may be ſo minute and agile, and ſo advantageouſly ſhaped, that, at leaſt in our climate, the air will ſcarce be ſo cold, but that the cauſes, which entertain the agitation, and keep it fluid, may alſo give a competent motion to particles ſo well diſpoſed to be kept in it.

And now, Sir, it will be time to endeavour to proceed to ſome particulars, that may countenance the conjectures I have hitherto been propoſing.

Having not now the leiſure to proſecute this diſcourſe uninterruptedly, till it be completely finiſhed, I thought it not unfit, not only to ſet down, in this paper, ſome of thoſe occurring thoughts and obſervations of my own, upon this ſubject, that were the likelieſt, unleſs this way preſerved, to vaniſh out of my memory, and which may ſerve to recal divers others into it; but alſo to annex ſome paſſages referable to the ſame purpoſes, borrowed from ſuch books, as probably I may not have at hand, when I ſhall reſume this treatiſe. Theſe two ſorts of paſſages make up the following notes, and are therefore to be looked upon but as materially here laid together to be preſerved, not ſo much for themſelves (though ſome of them perhaps deſerve not to periſh) as in order to the finiſhing of the deſigned ſtructure. And though, for that reaſon, they may often appear very confuſedly placed, yet they may ſeem more incoherent than they are, there being certain tranſitions, and other things, by which ſome of them may be ſo connected, as to be fit to make diſcourſive parts and paragraphs of the treatiſe they belong to; upon which account it is, that they are put at divers diſtances one from another, that, if hereafter I have leiſure, there may be room for the tranſitions, *&c.* by which they are deſigned to be connected into coherent diſcourſes.

What is above ſaid, in reference to this tract in general, is applicable to thoſe particular parts of it, whether chapters or ſections, or other diviſions, that follow a line of aſtericks, ſuch as the enſuing * employed to ſeparate the unfiniſhed part of the diviſion it belongs to, from the foregoing.

TITLE III.

Of the Æther in the Atmoſphere.

TITLE

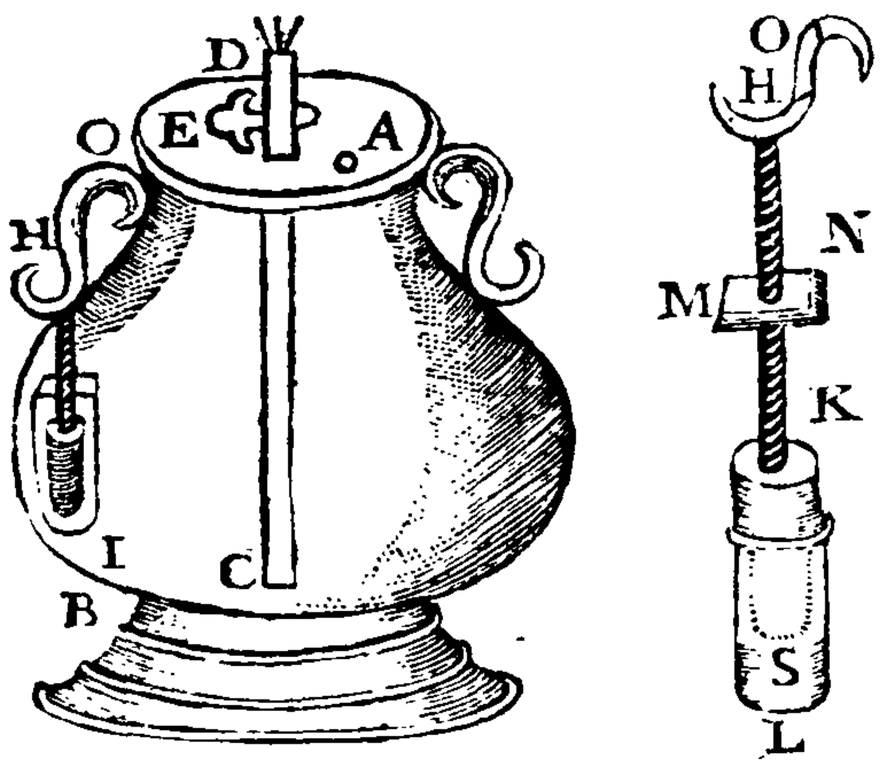
TITLE IV.

Of the springy Particles of the Air, and the Spring of the Air.

Aerem validè comprimere, aut dilatare.

Caſati Mechanicor. lib. VIII. c. 5. p. 792, 793, &c.

FOllibus luſoriis aerem pyulco ingerentes majorem ſubindeat que majorem difficultatem percipiunt; quo enim magis aer concluſus à naturali raritate recedere cogitur, etiam majore niſu reſiſtit, neque ſolùm magis denſari renuit, ſed & ſe latiùs explicare molitur. Hinc didicimus & pneumaticos fontes conſtruere, qui ſpiritu interno urgente aquam in altum evibrant, & plumbeas glandes fiſtulis ejaculari, non pulvere nitrato ignem concipiente, ſed aere per vim denſato ad antiquas dimenſiones recuperandas erumpente. Quoniam verò ingeſta jam in conceptaculum non exigua aeris copia difficiliùs comprimitur novâ aeris acceſſione, quàm ut manus valeat truſillum rectâ impellere; idcirco truſilli haſtulam deformatam in helicem, & ſuæ matrici inſertam, adhibere operæ pretium erit: dum enim manubrio agitante contorquetur cochlea, ſenſim deprimitur embolus, aeremque ingerit. Ne autem morâ longiore opus ſit perpetuâ verſatione manubrii, ita cochleæ matrix externam vaſis faciem contingat, ut illi adnecti, atque ab eo disjungi valeat: initio enim, quando adhuc levis eſt aeris modicè compreſſi reſiſtentia, lamella illa ſuo foramine interiùs claviculatim ſtriato cohærens haſtulæ emboli, ſi à vaſe disjuncta fuerit, unà cum haſtulâ movebitur: deinde verò, quando jam truſillis ægrè impellitur, lamella illa cum vaſe connectatur, & non niſi verſato manubrio adduci atque reduci embolus poterit, id quod ſatis lentè perficietur. Rem claritatis gratia in fonte pneumatico explicemus.



Sit vas A.B. *ex materiâ metallicâ, in cujus ſuperiore parte labrum, ex quo per foramen* A. *immittatur in vas aqua, ita tamen, ut non impleatur; aqua enim in vas modicè inclinatum deſcendens, aerem expellet per tubulum* C.D. *ubi ſatis aquæ immiſſum fuerit, occludatur foramen* A. *diligentiſſimè cochleolâ congruente, & convoluto epiſtomio* E. *tubus* C.D. *ſit acri impervius ad vaſis latus ſtatuatur modiolus cum embolo congruente* H.I. *& emboli haſtula ſit connexa cum mobili vaſi anſa* H.O.

Porrò haſtula H.K. *perforata ſit, & continuo ductu uſque ad emboli* K.S. *fundum pateat aeri ingredienti via* H.S. *ſed foramini* S. *adjecta ſit valvula, quæ aeri regreſſum obſtruat. Similiter modioli fundo in* I. *valvula exteriùs appoſita aperiatur ingeſto aeri tranſitum præbens; ſed aeri intra vas compreſſo cum nuſquam exitus pateat, valvula ipſa modioli foramen* I. *occludit. Haſtulæ verò* H.K. *exterior facies ſit in helicem ſtriata, &* lamellæ M.N. *tanquam matrici congruat, quæ in* M. & N. *cochleolis adnecti queat exteriùs vaſi, quaſi eſſet anſæ fulcrum.*

Ubi immiſſum fuerit quantum ſatis eſt aquæ, cochleolis M. & N. *revolutis disjungatur matrix à vaſe: tum attractâ anſâ* H.O. *unà cum lamellâ* M.N. *attrahitur embolus* K.S. *& per apertum ductum* H.S. *ingreditur aer, modiolum implens. Impulſo deinde embolo, valvula ad* S. *clauditur, & aer ex modiolo per patentem valvulam* I. *ingeritur in vas; ex quo*

quo nequit exire, neque aquam propellere, clauſo ſcilicet epiſtomio E. *& foramine* A. *qua propter comprimitur, & denſatur; ideoque attracto denuo embolo* K. S. *incluſus vaſi aer ſe latius explicare connitens valvulam* I. *valide applicat foramini modioli, ſibique exitum obſtruit. Toties adducitur atque reducitur embolus, & aer ingeritur, quoad magna premendi difficultas percipiatur; ubi eò ventum fuerit, tunc lamella* M. N. *iterum vaſi adnectatur ſuis cochleolis; nec jam embolus rectâ adduci poteſt; ſed arreptum in* O. *manubrium verſatur, & embolus intrà modiolum circumactus ſenſim attollitur, qui deinde revoluto in contrarium manubrio deprimitur, & multâ vi aer in vaſe comprimitur. Laxato demum Epiſtomio* E. *compreſſus in vaſe aer aquam exprimit per tubum* C. D. *primùm quidem vehementius, ſubinde remiſſius, prout aeris vis elaſtica ſenſim longueſcit.*

Hoc idem quod de aere intra vas comprimendo ad aquam evibrandam comminiſci placuit, ſervatâ analogiâ, dicendum eſt de aere, tum conatu manûs rectà truſillum impellentis, tum ope cochleæ ſimiliter conformatæ, intrà conceptaculum comprimendo, ut ex fiſtulâ deinde multâ vi emittatur plumbea glans, ubi reſeratus aeri exitus illum ſubitò dilatari permiſerit. Quin & pneumatica hujuſmodi tormenta citrà conceptaculum aeris compreſſi conſtruere non inutile accidat, ſi, quemadmodum noſtrates pueri ſurculos ſambuceos fungosâ medullâ exhauriunt, & utraque tubuli extremitate papyraceis globulis obſtructâ, alterum globulum congruo cylindro propellunt, atque incluſum aerem denſant, quoad aeris vim elaſticam & impellentis manus conatum non ferens extremus alter globulus edito ſcloppo expellatur; ita ferream fiſtulam longiorem paraveris, cujus alteri extremitati immittatur plumbea glans obducta papyro, aut ſimili materiâ, ut exquiſitè tubi oſculum implens demum univerſam aeris vim excipiat, alteram extremitatem aliquot ſpiris ambiat cava cochlea, quam impleat cylindrus ferreus in congruentem cochleam deformatus; ſi enim hujuſmodi cylindrus vix brevior fuerit, quàm fiſtula, & apto manubrio convolutus in fiſtulam ſenſim immittatur, totum aerem, quo fiſtula replebatur, ad exiguas ſpatii anguſtias adiget, ex quibus magnâ vi demum quà data porta, erumpens ejaculabitur plumbeum globulum.

TITLE V.

Of the magnetical Particles in the Air.

TITLE VI.

Of the Deſtruction, Generation, Abſorption and Extrication of the Air.

New Experiments about producing of Air, and examining the Bodies produced.

THAT the air has a great intereſt in the production of many phænomena of nature, either not formerly known, or not formerly aſcribed unto it, as the chief agent, if as any at all, has been, I ſuppoſe, ſufficiently manifeſted by our own experiments, as well as by thoſe publiſhed by abler writers.

THAT alſo the air is neceſſary not only to the well-being, but to the very being and motions of the generality of animals, will be eaſily deduced from thoſe trials, whereby we have made it appear, that animals, whoſe blood is hot, may be killed in our engine by the withdrawing of the air in about one minute of an hour; and that even thoſe minute creatures, whoſe blood or analogous juice is cold, will, for the moſt part, without excepting cheeſe-mites themſelves, preſently loſe all their viſible motions, upon the receſs of the air, may appear from our experiments about reſpiration.

WHEREFORE the air being a body ſo important in our ſpeculations of nature, and ſo neceſſary to the continuance of our lives, I could not but think it deſerved, that we ſhould ſolicitouſly enquire, whether it may or may not be produced by art: for if it can be ſo by any, not very uneaſily practicable ways, the diſcovery may not only help us to explicate ſome difficult phænomena of nature, but may afford us, among ſeveral other uſes, that of enabling us to ſupply divers, if not alſo ſubmarine navigators with freſh air produced under water, and thereby lengthen their ſtaying in places, where the continuance of it may be of great uſe, both ſpeculative and practical.

UPON theſe and the like motives, I reſolved, notwithſtanding the difficulties I foreſaw my curioſity would meet with in ſo new an attempt, to try what I could do. But before I relate the ſucceſs of this attempt, I muſt premiſe a couple of neceſſary adverti ſements.

AND firſt, when I here ſpeak of production of air, I deſire to be underſtood in a familiar ſenſe, meaning, by that expreſſion, the obtaining a ſenſible quantity of air from bodies, wherein it did not appear, before they were handled after our way, that ſo much air, if any at all, was pre-exiſtent. This I ſay, becauſe I would not in this place needleſly engage in the controverſy about the ingenerability (as they ſpeak) or the mutual tranſmutation of the bodies, that are called elementary: for though I am not ſure, but that ſome of our experiments may argue a new and real production of air, or a generation of it in the ſtricter ſenſe, yet I ſhall now employ the words generation and production, in the large and popular acceptation, and would ſignify by them, as I lately intimated, the obtaining of a ſenſible quantity of aerial ſubſtances from bodies, that did not appear to have it; whether this obtained ſubſtance were due to an extrication and union of aerial particles latent in the pores of the bodies, that afford it, or to a real production or generation of air, no where exiſtent antecedently to our experiments. And this is the firſt of my two advertiſements.

THE ſecond is this, that among the difficulties I foreſaw, in making experiments ſuited to my deſign, I looked upon it as one of the greateſt, though the leaſt obvious, that to ſatisfy ſuch a diſpoſition as mine, that is naturally prone enough to queſtion things, it would be requiſite for me to conſider, and, if I could, to determine, by appropriated trials, whether the fluid ſubſtances my experiments might afford me, deſerved the name of air or not. Wherefore I ſaw myſelf obliged to increaſe my taſk, and ſo direct my enquiries, that in the firſt place they may afford me ſenſible portions of ſuch a ſubſtance, as in a popular ſenſe may be ſtiled air, whether theſe obtained ſubſtances ought to be looked upon as true air or no. So that my intended diſquiſition would naturally conſiſt of two parts, whereof the former was to contain the ways of producing that, which ſeems air; and the other to propound thoſe of examining, how far the produced ſubſtance is endowed with the qualities, that are judged to belong to air as ſuch.

BUT in regard, that I thought it moſt convenient ſo to contrive my experiments, as to make ſuch of them as I could to ſerve me, both to produce air, and to examine it, I ſhall be more than once obliged to mingle the two parts of my diſquiſition, and reſerve for the latter of them only thoſe few trials, that concern purely the examen of the produced air.

AND upon this ſcore it will be ſeaſonable to take notice in this place, that foraſmuch as there are divers qualities aſcribed to air, which to me ſeem but accidental, and not univerſally to belong to air as ſuch; I have not obſerved any one attribute, that I think, to be ſo much the property of air, and ſo fit to diſtinguiſh its true particles from aqueous vapours, earthy exhalations, and the effluvia of other bodies, as a durable elaſticity or ſpringineſs. And therefore I ſhall henceforth employ that as the

the chief criterion, whereby to conſtitute a portion of matter aerial, and diſcriminate it from other flying and fluid ſubſtances, and conſequently to allow or deny it the title of air.

Now among the ſeveral ways I thought of, whereby to produce air, thoſe I judged fitteſt to put in practice were theſe. 1. By fermentation. 2. By corroſions and diſſolutions of bodies. 3. By boiling of water and other liquors. 4. By the mutual actions of ſome, eſpecially ſaline bodies, upon one another. 5. By the analyſes and reſolutions of certain ſubſtances.

EXPERIMENT I.

On *January* 17 we conveyed into a long and large tube ſome filings of ſteel, and as much water as was thought convenient to dilute the oil of vitriol, which we alſo conveyed in a peculiarly ſhaped glaſs, ſealed at both ends, but with a hole opened near one of them; the external tube, and the water in them being exhauſted, and the mercury in the gage, which we had alſo included, being ſo far impelled up into the open leg, that there was ſcarce any at all left in the ſealed leg: this, I ſay, being done, the external tube was by our way exactly cloſed; and then the oil of vitriol being by little and little, and at good intervals of time, poured out of the internal tube, to actuate the water, there were produced exceeding large bubbles by the action of the ſolvent upon the metal, which alſo produced a ſenſible heat, though not a great one. When this conflict had laſted a while, we obſerved, in compliance with the chief ſcope of this experiment, whether there would be any ſpringy air produced by all thoſe bubbles; and we perceived, that there ſeemed to be ſo much of it generated, that at length the mercury in the gage was impelled to the very bottom of the open leg, and the air included in the other ſeemed to be more compreſſed than it had been, when it was put in by the weight of the atmoſphere. But to try, whether this ſpring (wherein the warmth formerly mentioned might be ſuſpected to have for that time ſome intereſt) would continue, I removed the tube into another room, where was no chimney; and coming to look on it the next day, did not take notice of any ſenſible alteration in the gage; and with the like ſucceſs I viſited it for three or four days. But then coming one day to look upon it, I found the mercury in the gage to have aſcended about an inch and an half, and about that quantity of water to have got into the ſealed leg; which inclined me ſo much the more to ſuſpect, that this change in the gage might have been accidental, a boy having unknown to me removed the tube from its wonted ſtation, to place ſomewhat elſe there, without doing it heedfully enough. And this conjecture ſeems the more likely, becauſe I have not ſeen any notable change to have happened in the gage from that to this, (which is the 25th of *January* at night) the mercury in the open leg being about one inch and an half.

EXPERIMENT II.

March 8. A glaſs vial holding about a pint (by gueſs) was filled with wheat flower, and as much water as was ſufficient to drench it well. Afterwards the orifice was exactly and ſtrongly cloſed with a cork, and an excellent cement: the glaſs was ſet in a warm place of the laboratory, becauſe of the coldneſs of the ſeaſon; and having ſtood there a fortnight bating one day, it this morning broke by the mere dilatation of the included matter, whoſe viſible part was laſt night obſerved to leave a conſiderable part unfilled beneath the cork. Notice was taken by the laborant of the event of this trial by a noiſe, which was no louder than one made upon the burſting of the glaſs

into ſeveral pieces. To my taſte the included matter was but a little ſouriſh, but another afterwards judged it to be manifeſtly acid.

EXPERIMENT III.

MARCH 9. Having on the 23d of *February* put into a pretty large bolt-head a convenient quantity of bruiſed raiſins, with as much water as I thought neceſſary to make them ferment; and having cauſed the air to be carefully pumped out, and taken ſufficient order to keep any from forcing or ſtealing into the glaſs, I ſet it in the laboratory, that the warmth of the air might facilitate the fermentation. At the end of four or five days, it did not appear by a mercurial gage, (which had been purpoſely incloſed together with the raiſins) that there was generated any ſpringy ſubſtance. But being hindred by ſeveral occaſions from looking after this glaſs from time to time, it ſeems the contained liquor fermented more violently than the time of the year would have made one expect: for about four of the clock in the afternoon, no body being in the laboratory, the glaſs flew in pieces with a loud noiſe like the report of a piſtol; which alarming a domeſtic of mine, that was in a chamber not far off, made him haſten to the laboratory, where he found the raiſins thrown all about, and the middle part of the bolt-head (for the bottom and the pipe were entire enough) ſcattered into ſuch little pieces, that they ſeemed almoſt to be vaniſhed.

EXPERIMENT IV.

ON the 22d of *February* I filled a glaſs, that had a ſomewhat wide mouth, and might hold by eſtimation three pints (or pounds) of water; to which that liquor, and a convenient quantity of bruiſed raiſins upon the orifice of the glaſs, were tied to the neck of a pretty large bladder, out of which the air having been diligently expreſſed, it was ſtrongly faſtned to our glaſs with one of our cloſe cements; ſo that by ſqueezing the bladder, we could not perceive, that any air could get in or out. Then, this done, we left the glaſs in a convenient place in the laboratory, till the 8th or 9th of *March*; and then finding the bladder to be plumped up, we would have tied up the contained air, but could not do it by reaſon of an imperceived hole, perchance made with the point of a pin, by ſome one of them that handled it. Wherefore taking off this bladder, we cauſed another, that was very limber, to be put on after the manner newly deſcribed; and yeſterday morning we found it, though by eſtimation it may hold about two pounds of water, to be ſo full of air, that we could not without difficulty, and loſing a pretty deal of the contained air, tie the bladder very cloſe near the neck of it.

AND to try, whether this ſame mixture would continue to produce air, (whether fermented or not, I muſt not here diſpute) I cauſed another bladder to be faſtned to the ſame glaſs as before, and found it this morning, *March* 11, as full as if it were diſtended with a pair of bellows.

EXPERIMENT V.

APRIL 28. Into the bottom of a widemouthed vial we put ſome good ſpirit of ſalt, and filings of ſteel, and whelmed over it a R^r. fitted with an eel-ſkin and a wire, to the latter end of which was tied a thin glaſs-veſſel, hermetically ſealed at the bottom, though it was but ſlender, and furniſhed with a competent quantity of filings of copper: then we exhauſted the R^r. well with our engine, and afterwards thruſting the glaſs, that held the filings, againſt the bottom of the vial, we broke it off; upon which the filings fell into the menſtruum, which acting upon them, there enſued good ſtore of bubbles,

bubbles, that made a froth much deeper than was the liquor, and the ſucceſſive generation of theſe bubbles continued a good while, and appeared ſome of them large enough, though in the free air they would ſcarce have been viſible, or at leaſt would not have been taken notice of; the vial having been kept in our vacuum for a quarter of an hour longer, and no greenneſs to be ſeen in the liquor, the R^r. was taken off, and the vial left open to the air.

EXPERIMENT VI.

A BUBBLE of air, whoſe diameter was near in length to that of a middle ſized pea, was left at the top of a round vial with a long narrow neck, whoſe cavity was filled with fine oil of turpentine, and then being inverted into a vial filled with the ſame liquor, was ſet aſide in a quiet place, and left there for a competent time. Another vial ſhaped like the former, but a pretty deal leſs, was filled neck and all with alcohol of wine, ſave a bubble of air about the ſame bigneſs with the former: this vial being inverted into another furniſhed with the ſame liquor, was ſet aſide in the ſame window with it, and at the ſame time: the event was, that about the end of the 6th day, the bubble diſappeared in the glaſs, that contained the oil of turpentine. And the like abſorption, if I may ſo call it, I obſerved to have been made of the air by the contiguous ſpirit of wine the next day after.

EXPERIMENT VII.

MAY the 23d. WE opened another exhauſted receiver, wherein was an unſtopped vial more than half full of an opacous and blackiſh liquor, which we gueſſed (for we found no inſcription belonging to it) to have been frog's ſpawn, and were ſure to have been included at leaſt three years: by the mercurial gage, that was put up with it, it appeared to have afforded ſome air, but not very much. Its ſmell was ſtinking, much like that of the pump of a ſhip, but yet it had produced no inſects, nor had any appearance of mouldineſs.

EXPERIMENT VIII.

A GENTLEMAN of my acquaintance, an induſtrious digger for mines, and owner of a good one, informs me, that when the miners meet with running water under ground, they are thereby ſupplied with air enough for free reſpiration: and when I aſked, whether he thought, that air was produced or extricated by the motion of the water, or elſe were only concomitant to the ſtream? he anſwered, that it ſeemed to him more like to proceed from the water itſelf: and further anſwered me, that ſtanding waters did not afford air to the diggers; and that running waters did it even at conſiderable depths, amounting to many fathoms.

Experiments about the Production of Air, and the examining thereof propoſed.

SECTION I.

TO produce air by fermentation in exactly cloſed receivers.
To produce air by fermentation in ſealed glaſſes.
To ſeparate air from liquors by boiling.
To ſeparate air from liquors by the engine.
To produce air by corroſion, eſpecially with ſp. aceti.
To ſeparate air by animal and ſulphureous ſolvents.

To

To obtain air in the exhauſted receiver by burning glaſſes, and red hot irons.
To produce air out of gun-powder, and other nitrous bodies.

SECTION II.

EXAMINE the produced aerial ſubſtance by its preſerving or reviving, 1ſt, Animals. 2dly, Flame. 3dly, Fire. 4thly, The light of rotton wood, fiſh.
To examine it by its elaſticity, and the duration thereof.
As alſo by its weight.
AND by its lifting up the ſmoke of liquors.

TITLE VII.

Of the accidental or leſs conſtant Ingredients of Air.

TITLE VIII.

Of aqueous Particles in the Air, and of the Moiſture and Drineſs of the Air.

I SHALL not here determine, whether in all the inſtances, that are referred to this title, the phænomena be produced by the mere moiſture of the air as ſuch, or by ſome other agents, whoſe corpuſcles are accompanied and aſſiſted by the moiſt air as a vehicle and a concurrent cauſe. But without nicely diſtinguiſhing the grounds of particular operations, we ſhall refer the phænomena in general to the moiſture of the air, (or moiſt air) that quality being the moſt obvious to be obſerved in theſe phænomena; in the production of ſome of which it ſeems either the only, or the main cauſe, in others an aſſiſtant cauſe, and in all a not uſeleſs concomitant.

THE account, upon which a body is dry, being uſually but this, that the pores intercepted between its more ſtable parts are not filled with any viſible liquor, it is not to be expected, that a quality, ſo near of kin to a privation, ſhould furniſh much to our preſent hiſtorical notes: but yet drineſs may ſometimes have a not inconſiderable intereſt in the changes of a body, and that upon differing ſcores, whereof I take theſe two to be the chief. Firſt, as the body by exſiccation is deprived of thoſe liquid and exhalable parts, that were before harboured in its pores, and were perhaps the principle of divers operations aſcribed to it. And ſecondly, as theſe evaporable parts by their receſs may occaſion a change of texture in the body, eſpecially in regard of the pores, whoſe bigneſs, figure, and perhaps poſition being altered, the body by this change of texture acquires a diſpoſition to act, and be acted on in ſeveral caſes, otherwiſe than formerly.

A tranſcript of an obſervation made at *Lanton*.

SOMETIMES when the weather began to be overcaſt, the hygroſcope did not ſenſibly appear to grow heavier; and ſometimes it would preponderate, when I took notice of no vapours to make it do ſo: and though theſe things happened but ſeldom in reſpect of the ordinary changes of the hygroſcope according to thoſe of the weather; yet they made me ſuſpect, that ſometimes the clouds may conſiſt of other ſteams than aqueous, or that there may be ſome exhalations, that may have a peculiar congruity with the pores of the hygroſcope, and whoſe nature may be ſuch, as to the power of drying the hygroſcope, that upon theſe or ſome other yet unheeded accounts, the ſteams, that are ſometimes diffuſed in the air, may controul the uſual and regular

cauſes of increaſing or leſſening the gravity of the hygroſcope. And this ſuſpicion was the ſtronger, becauſe having made hygroſcopes with powder and ſalt, and alſo with the ſaw-duſt of wainſcot, hung at nice ſcales in very thin open glaſſes, purpoſely blown for lightneſs ſake at the flame of a lamp, though they uſually acquired and loſt weight, as the weather grew moiſter or drier, yet ſometimes they did not.

EXPERIMENT I.

At half an hour after nine o'clock at night, I looked upon the half hundred weight, that hung at the bottom of the rope, the weather being then fair; and a mark being put at that part of the erected board, where the bottom of the weight touched, I perceived the ſky a while after to grow cloudy and overcaſt, but without rain: wherefore going to viſit the weight again, I found it to be riſen $\frac{1}{4}$ of an inch or more; and looking on my watch, perceived there had paſſed an hour and a quarter ſince the mark was made.

This morning I came again to look upon the weight between eight and nine of the clock, and found it raiſed above the newly mentioned mark, made laſt night, about one inch (for it was about $\frac{2}{10}$ths of an inch.) This day, the weather being fair and windy, the weight was fallen by ten at night about ſix inches beneath its ſtation, at which I found it when I looked on it in the morning.

Being not well yeſter-night, the weight was obſerved at bed-time by two of my ſervants, and it then reſted at the 11th of the erected bound. This morning, about eight of the clock, I viſited it myſelf, and found it to be riſen about $\frac{1}{8}$ of an inch above the eighth inch, the morning being cloudy, though the morning very dry and duſty. The weather growing more overcaſt, within ſomewhat leſs than an hour after, I viſited the weight again, ſome ſcattered drops of rain then beginning to fall, and found it to be riſen about half an inch above the newly mentioned eighth mark.

I looked, when I was ready to go to bed, upon the ſuſpended weight of 56 pound, and marked how low it reached upon the divided board; and a great part of the night having been rainy, I looked again, when I was dreſſed in the morning, which was about half an hour after eight a clock, and I found the cord ſo ſhrunk, that the weight was raiſed above five inches higher than I left it the night before; but the day recovering dry and windy, and ſometimes warm, the rope was ſo ſtretched, that at night the weight ſunk a good way beneath all the marks. *N. B.* The rope near the weight was in diameter $\frac{3}{10}$ of an inch, and four decimal parts of a tenth.

EXPERIMENT II.

We took a rope of near three foot and an half in length from the point of appenſion, and ſomewhat leſs than $\frac{3}{10}$ (inch) in diameter: this we ſuffered to be ſtretched for ſome days by a weight of lead with an iron ring or anſula, weighing a quarter of an hundred, according to the great hundred, which is five ſcore and twelve: and then placing a flat board under it, ſo that the weight juſt reſted upon it, we had the rope well wetted over them with a ſponge dipped in water, and ſo often applied to it, that the liquor might be thoroughly ſoaked into the pores of the rope, which at firſt ſeemed thereby a little ſtretched, rather than ſhortened; but after an hour or two it began to ſhrink, ſo that we could make the weight ſwing like a pendulum over the piece of board it leaned upon before. But afterwards the ſame day the weight ſtretched out the rope again as much as formerly.

It is obſervable, that though *Morocco* be an inland-town, and the ſoil of thoſe parts be uſually dry, if not parched; yet doctor *D.* who was lately there, informed me, that

that about *Morocco*, notwithſtanding the violent heats he felt in the day-time, he obſerved the nocturnal air to be very damp, ſo as to make the clothes he put off at night exceeding moiſt, and unfit to be worn, without airing the next morning. He added, that though the air was very piercing, and manifeſted itſelf to be ſo by many other ſigns, yet it would not make his knife ruſt in his pocket, or his ſword in the ſcabbard, though it would quickly produce a ruſt in inſtruments of that metal expoſed naked to it.

Air too moiſt cannot be wholeſom. The air in our parts, *viz.* about *Oakly* in *Buckinghamſhire*, though a high country, is, as I ſaid before, between *Michaelmas* and *Allhallontide* very moiſt, eſpecially in rainy weather, and upon a thaw, inſomuch that wainſcots, ſtaircaſes and pictures will ſtand all of a water, and after run down in great drops; and at *Brill*, upon that high hill, it is in divers houſes worſe than in the valley, inſomuch that the ſtair-caſes, eſpecially if laid in oil, will run down with water: the north and north-eaſt ſide of our houſes are obſerved to be moiſter, inſomuch that the furniture will rot, if fires be not made ſometimes in the rooms, and the things aired: this is obſerved to be the moſt aguiſh ſeaſon of the year. Mr. *J. T.*

As in another experiment we tried, whether or no the removal of the air out of the receiver would much alter the temperature of the included medium or ſpace, as to heat and cold; ſo we endeavoured to diſcover, whether the alteration would be notable, as to drineſs and moiſture. To this purpoſe we did indeed wiſh for ſuch a hygroſcope (or inſtrument wherewith to meaſure the moiſture and drineſs of the air) as we uſed, many years ago, and ſince found well deſcribed by the induſtrious *Kircher*, in a place of his *Ars Magnetica*, to which I therefore refer your lordſhip. But in regard that to this inſtrument there is requiſite the beard of a wild oat ſeaſonably gathered, which we could not then procure; we recalled to mind another hygroſcope, which, though it diſcover not ſuch ſmall mutations as the former, we thought might be uſefully enough ſubſtituted inſtead of it.

Of this hygroſcope, having particularly deſcribed it in another paper, we ſhall now only ſay in a word, that it is made by faſtning to the upper end of a piece of gut-ſtring, or great luteſtring, a very light index, and ſtrongly faſtening the lower end of the ſame ſtring to the bottom of a box, or other convenient frame, the circumference of whoſe upper part may be at pleaſure divided into degrees or other partitions, upon which the index may move to and fro. For the inſtrument being thus made, when the air grows moiſter, the vapours inſinuating themſelves into the pores of the filaments, that compoſe the ſtring, do ſomewhat ſhorten it; and thereby thoſe filaments being altered in point of contortion, the index that is faſtened to them turns one way; and, upon the receſs of thoſe vapours, or of others of like nature, the ſtring comes to be wreathed, and conſequently the index to be moved another way. So that, in a ſtring of about three inches long, the point of the index will be oftentimes made to change its place very notably, by ſuch a mutation of the air, as to drineſs and moiſture, as was to be met with in the morning and at noon of the ſame day, though ſuch a change did not always need either rain, clouds or miſts, or the abſence of them, to make it notable.

EXPERIMENT III.

We took then one of theſe hygroſcopes, and conveyed it into a ſmall receiver, that the removal of the air being ſudden, the change of temperature (if any ſhould happen) in the exhauſted cavity, might be the more ſudden and conſpicuous. But we found

found not that the emptying of the receiver made the index ſenſibly change place. And though this experiment were carefully made, yet for the greater ſecurity we repeated it once more; and neither then perceiving the index to remove, we kept the receiver exhauſted for a pretty while, leſt there ſhould be ſome more time requiſite to the operation of the medium upon the inſtrument. But neither did this trial produce any ſenſible alteration of the index; but after the key was turned, and acceſs was thereby given to the excluded air, though the cover were ſtill kept on, we found, that then within ſome hours, the index was conſiderably removed. So that as far as theſe experiments informed us, the ether or ſubtile matter, that ſucceeds in the place deſerted by the air, if that place be not left void, and conſequently the thinner and more fluid part of the atmoſphere (in which the corpuſcles, that may be more properly called aerial, ſwim) ſeems in its own nature to be very ſenſibly, neither cold, or hot, or dry, or moiſt. I ſaid, as far as theſe experiments; I mean thoſe we made in this engine with the thermoſcope and hygroſcope, inform us; becauſe this conjecture (for I dare yet call it no more) may be examined divers other ways, whoſe events may either confirm, or oppoſe, or limit it. In the mean time I could wiſh, that if your lordſhip had one of *Kircher*'s hygroſcopes at hand, you would frequently and carefully try the laſt recited experiment with it; becauſe I have found, that if ſuch a hygroſcope be very well made, it is admirable, as well as pleaſant, to ſee how ſmall a mutation of the neighbouring air it will take notice of. But I thought fit to deſire to have it frequently tried, becauſe care muſt be taken, that ſuch motions of the index be not miſtaken for the effects of the altered temper of the medium in the receiver, which may in ſome caſes proceed from thoſe ſteams of the oil and water, which we elſewhere mention, that we now and then, though but ſeldom, obſerved to get out of the cylinder into the receiver, and play up and down there.

TITLE IX.

Of Clouds, Miſts and Fogs.

HEARING that an excellent aſtronomer of my acquaintance had often meaſured the height of clouds, I enquired of him what height he obſerved them to have? and was anſwered, that though he had meaſured eighteen or twenty even of white clouds in fair weather, yet he obſerved ſcarce any one to be higher than three quarters of a mile, and few of them he found to exceed half a mile.

A MIST coming, driving upon the ſea towards the ſhore, though without any ſenſible wind, will riſe a greater ſwell of a ſea, than a briſk wind will do. *N.*

I HAVE obſerved in a ground near my houſe, which is ſomewhat moiſt in winter, as alſo in other places, eſpecially after a warm day, and againſt fair weather in autumn, a moiſt bluiſh miſt to aſcend about twenty or thirty foot high, and then to ſubſide again in dew. Mr. *J. T.*

TITLE X.

Of terreſtrial Steams in the Air.

ENquiring of an ingenious acquaintance of mine, who, in an incloſed ſcope of ground, has ſeveral veins of differing metals and minerals, whether he did not ſee, and ſometimes ſmell ſteams aſcending out of this or that ſpot of his ground, in

circumſtances where their aſcenſion could not be imputed to the action of the ſun? he and his ſon, who was alſo a virtuoſo, told me, that they had divers times ſeen as it were pillars of fumes aſcending like ſmoke, whereof ſome would be inodorous, ſome ill-ſcented, and ſome, though but ſeldom, well-ſcented. And you may have obſerved, as well as I, that fogs, ſome of which I have known to be very laſting, and to have a large ſpread, did require no tender noſtrils to perceive them to ſtink.

I HAVE frequently obſerved the ſmoking ſteams, that aroſe out of the ſhafts of mines not wrought in: and it is certain, the charcoal made in *Cornwall* (eſpecially of that wood, that grows in the mineral part thereof) doth afford a manifeſt arſenical and ſulphureous ſmell beyond other charcoal. *N.*

Journal des Scavans III. 1685.

Tel eſt par exemple ce nuage horrible d'une fumée epaiſſe, qui s'eleva de la mer de Crete au commencement de l'eſte de l'an 721. *& qui s'etant repandu dans l'air le fit paroiſtre tout en feu. La mer n'en fut pas meſme exempte; car les groſſes maſſes de pierres enflammées qu'on en vit ſortir, & qui ſe joignirent a l'iſle qu'on nomme Hiera, échauferent ſi fort les eaux, qu'elles en bruloient les mains.*

TITLE XI.

Of Salts in the Air.

IT is ſufficiently known, that the peripatetick ſchools teach the air to be an element warm and moiſt; and if it be an element, it ought, according to their principles, and thoſe of the greateſt part of other naturaliſts, to be a ſimple and homogeneous body. But becauſe ſuch an elementary or uniform purity is much eaſier to be found in the writings of ſchoolmen, than amongſt the works of nature, many of the modern philoſophers have juſtly forſaken this doctrine of the elementary ſimplicity of the air in ſome meaſure; but perhaps very few of them, if any, have aſſerted the air to be ſo exceedingly compounded a body, as in my opinion it really is. For divers of them grant indeed, that the atmoſphere is not abſolutely pure, but yet think, that it differs but gradually from true and ſimple air, as water a little moved and troubled does from clear and ſettled water. But for my part, I confeſs I acquieſce not in either of thoſe notions of the air. For, as I have elſewhere more fully declared in a ſhort diſcourſe, purpoſely treating of the ſubſtance of the air, although I will not deny, that there is an ethereal matter more ſubtile than the common air, which ether I take to be diffuſed through all the interſtellar part of the univerſe known to us, reaching to and ſurrounding all its great globules; yet, ſpeaking of the air, which we men live and breath in, I take our atmoſphere to conſiſt not only of the purer ether, but in great part of a vaſt multitude of effluvia emitted by the terraqueous globe, and the various bodies it is made up of, and perhaps in ſome parts alſo of ſubſtantial emanations from the celeſtial bodies; and that that, whereby the atmoſphere differs from ſuch pure air, as the ſchools tell us of, is not a bare and indeterminate feculency, but a confuſed aggregate of ſeveral diſtinct and perhaps diſagreeing kinds of effluvia. And amongſt thoſe, one of the principal ſorts I take to be the ſaline ones, which rove up and down amongſt others in that vaſt ocean of effluxions, we call the atmoſphere: wherein yet I do not think there are to be met with, either all ſorts of them every where, or perhaps any ſort in like plenty, in all places, and at all ſeaſons.

TO ſhew, that the air is not unfurniſhed with parts of a ſaline nature, I might alledge ſome conſiderations, that ſeem to make it probable *à priori*, as they ſpeak, that there are always ſome ſuch corpuſcles emitted into the air. But, inſtead of inſiſting on

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ſuch particulars, becauſe they may ſeem too little of an hiſtorical nature, to be fit for this paper, I ſhall content myſelf to take notice in the general, that almoſt (if not more than almoſt) all the arguments I have employed, to prove the copious aſcenſion of ſubterraneal ſteams into the air, may be applied to our preſent purpoſe, ſince, amongſt the effluviating ſubſtances of the terraqueous globe, there are, as I have declared in another paper, huge quantities of common or marine ſalt, beſides nitrous, aluminous, vitriolate, and perhaps other kinds of ſalts. To which I ſhall add, that the emiſſion of ſubterraneal aporrheas or effluxes, is not the only means, whereby the air may be impregnated with ſaline particles; ſince the exhalations and vapours produced by the action of the ſun-beams upon the more ſuperficial parts of the earth and ſea may ſupply the air with ſwarms of corpuſcles, as well of ſaline, as of any other nature. Not to mention, that the number of theſe may, in divers places, be much increaſed by thoſe vulcanos, that have opened vents to diſcharge their fumes into the air; by thoſe numerous fires, which, burning in our chimnies, produce much ſaline ſmoak; and by other ways, which I ſhall here forbear to diſcourſe of, for the reaſon lately given for my declining arguments drawn *à priori*; though ſome things applicable to this purpoſe will in likelihood occur amongſt the inſtances I am about to add, to make it ſeem probable *à poſteriori*, or by ſome effects and phænomena, that the air is impregnated with ſaline corpuſcles, that are none of its leaſt active parts, and may have great intereſt in divers of its operations.

From what has been hitherto delivered, to make it probable, that there is a ſaline ſubſtance in the air, I thought fit to proceed to other inquiries. The firſt; whether the aerial ſalts be of differing kind? and if ſo, which they are? and the ſecond, how it comes by its ſaline ſubſtance? But about ſuch differing points I durſt promiſe myſelf but little ſatisfaction, and therefore ſhall not pretend to give you much.

And yet, to ſay ſomething to the firſt of the two enquiries, I am prone to think, that the ſaline particles of the atmoſphere are not all of one ſort, but that there may be three or four differing kinds of aerial ſalts.

I know, that divers learned men, ſome phyſicians, ſome chemiſts, and ſome alſo philoſophers, ſpeak much of a volatile nitre, that abounds in the air, as if that were the only ſalt wherewith it is impregnated. But though I agree with them, in thinking, that the air is in many places impregnated with corpuſcles of a nitrous nature; yet I confeſs I have not been hitherto convinced of all that is wont to be delivered about the plenty and quality of the nitre in the air: for I have not found, that thoſe, that build ſo much upon this volatile nitre, have made out by any competent experiment, that there is ſuch a volatile nitre abounding in the air. For having often dealt with ſalt-petre in the fire, I do not find it eaſy to be raiſed by a gentle heat; and when by a ſtronger fire we diſtil it in cloſe veſſels, it is plain, that what the chemiſts call ſpirit of nitre, has quite differing properties from crude nitre, and from thoſe that are aſcribed to the volatile nitre of the air; theſe ſpirits being ſo far from being refreſhing to the nature of animals, that they are exceeding corroſive: And even when I cauſed earth to be dug up in an old pigeon-houſe, becauſe that is accounted the moſt nitrous ſort of earth, and diſtilled it with moderate fires, I did not find the volatile ſaline parts, that came over, to be like that, which theſe learned men conceive the air to be ſtored with. Nor have I met with among them any poſitive proof, to evince the truth of their opinion; which yet, as I was ſaying, I am content to admit, as an ingenious ſuppoſition, until ſomething be offered, that ſhall prove it to be more; which I think not impoſſible to happen, at leaſt as to ſome times and places. But I am not yet ſure, that the exhalations, that aſcend from the ſubterraneal parts, and perhaps alſo the ſun-beams themſelves, may volatilize many of the

nitrous corpuſcles they chance to act upon, and elevate them into the air, without analyzing them, or deſtroying their texture, as our fires are wont to do. But however, I do not take the hitherto mentioned nitre to be the only ſalt, that impregnates the air: for when I conſider, how vaſt a portion of the terraqueous globe is covered with the ſalt ſea, and how vaſt quantities of foſſile ſalt, as well fine and clear, as coarſe, are dug up in *Poland*, eſpecially near *Cracovia*, in *Hungary*, *Tranſylvania*, and in divers other parts of the earth; when I conſider too, that we ſeldom find ſalt-petre in the earth, but that there is ſea-ſalt mixed with it, which puts the ſalt-petre-men to a great deal of trouble to ſeparate it; and that even from ſalt-petre, that paſſes for good, I had trouble enough, when I had the curioſity purpoſely to refine it, to free the purely nitrous from the other ſaline particles; I am prone to ſuſpect, that in very many places, eſpecially maritime ones, the effluvia of common ſalt do, at leaſt as plentifully as thoſe of ſalt-petre, abound in, or impregnate the air: which conjecture might be favoured by divers things, if I had leiſure to inſiſt on them.

That in ſome places, that abound with marchaſites, there is a kind of fretting vitriolate ſalt, copiouſly diſperſed through the air, I have been inclined to think, partly by other inducements, and partly by the anſwers made me by a very obſerving man, who lived in a place, that I remember I viſited; where being forced to reſide a good while, he found the hangings of his chamber, and the curtains of his bed, rotted by the vitriolate ſteams expired by the ſoil, whoſe effluvia had alſo very manifeſt and unwelcome effects on divers other things, that were kept near that place; though on the oppoſite ſide of the river, in a town, that is not half a mile diſtant from this place, neither I, at my being there, heard any ſuch thing complained of, nor the relator, who had often occaſion to repair thither, obſerved any ſuch miſchievous effects, the ſoil of this latter place being chalky; whereas the other above mentioned is vitriolate, inſomuch that he obſerved, that when the moiſt and blackiſh mould had been beaten upon by the ſun, that here and there the ſuperficial parts would be as it were beſprinkled with a ſomewhat whitiſh ſaline efflorescence.

Besides the hitherto-mentioned kinds of ſalts, it ſeems not improbable to me, that the air (eſpecially about great towns, and ſome other particular places) may be impregnated with volatile ſalts, that are of a nature contrary to acids. For that there may be places in the earth, even at a good depth under ground, that lodge ſuch ſalts, I have been induced to think by the experience of an acquaintance of mine; who, hoping to find in the ſalt of what he ſuppoſed to be virgin-earth, the true receptacle of an univerſal ſpirit, from which he promiſed himſelf great and profitable matters, cauſed to be dug up a great deal of a certain clay, in a place abounding with minerals, and obtaining thence, by mere diſtillation, no inconſiderable quantities of ſpirit and ſalt, which in divers qualities, as ſmell, *&c.* I judged to be near a kin to the ſpirit of urine or hartſhorn. And yet this earth was dug up at the depth of many feet, not to ſay yards, beneath the ſurface of the ground (as an ingenious potter, from whom the chemiſt had the clay, aſſured me upon the place itſelf) which I once viſited, to ſee ſome other choice minerals, that ennobled that ſoil; whence I would have got a quantity of the abovementioned clay, but that it being then the midſt of winter, the rain had (as the workmen ſpeak) drowned the pit.

In great cities, and alſo towns, where much wood is burnt, it is probable, that numerous particles of volatile ſalt may be diſperſed through the neighbouring air. For, as I have elſewhere ſhewn, the ſoot of burned wood, which is but that ſmall part of the ſmoke which chances in its paſſage upwards to ſtick to the chimney, does very much abound in a volatile ſaline ſpirit, which by many trials are found to have

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ſo much affinity to that of urine and of hartſhorn, as not to be eaſily, but by the ſmell diſtinguiſhed from it.

Besides in ſeveral places the putrefaction of ſubſtances, that once were parts of animal bodies, may furniſh the air with volatile ſalts, as I have elſewhere mentioned, that I found, that urine, without diſtillation, will by bare putrefaction afford ſaline and ſpirituous parts, that whilſt they yet ſwim in the copious phlegm, that makes up the body of the liquor, will manifeſtly diſcover themſelves to be volatile, not only by their ſmell, but by their hiſſing with acid ſpirits, and by their diſſolving ſome bodies, and precipitating others, according to the manner of volatile ſulphureous ſalts, as thoſe that abound in ſpirit of hartſhorn, blood, *&c.* And I am apt to think, that it is not only in the parts of animals, but alſo in thoſe of many vegetables, that putrefaction may either extricate or produce volatile ſalts. And I remember, I have obſerved in ſome ſucculent vegetables, that chancing to lie in a heap together, in a convenient ſeaſon of the year, to make them rot; I obſerved, I ſay, when the putrefaction was come to a certain point, that the ſtink did ſo reſemble that of carrion, that it was not eaſy for me to believe it came from cadaverous plants, not animals. And that it is not impoſſible for a vegetable to afford, without the help of an additament, a volatile ſalt, even *in forma ſicca*, may be gathered from what I elſewhere relate, of my having diſtilled ſuch a ſalt from a certain ſpiritous ſeed, though, I freely confeſs, I never obtained any (without previous incineration) from above two or three vegetables. But of this enough in this place.

I shall now add, that beſides the more ſimple ſalts hitherto enumerated, it is not unlikely, that in ſome places the air may ſometimes contain compounded ſalts. For I have elſewhere ſhewn, that ſome ſorts of ſaline ſpirits, meeting one another in the air, may there convene. And I elſewhere teach how to order a couple of liquors ſo, that one will never of itſelf afford any thing in a dry form; and yet the ſpirituous effluvia of this liquor, meeting with thoſe of the other, will exhibit a volatile and ſaline body in a dry form; though the liquors themſelves being mingled will not afford any ſuch ſubſtance. What I have elſewhere delivered concerning ſubterraneal ſteams, may make it probable, that at leaſt now and then, and in ſome places, there may be ſent up from under ground into the air, among other effluvia, ſtore of ſaline ones, which needs not be ſuppoſed all of them to be of an uncompounded nature. With which that agrees very well, that was related to me by a very intelligent acquaintance of mine, that lived long in parts of *America*, where there was a vulcano, which he and ſome others having the curioſity to viſit, told me, that before they came any thing near the fire, or were offended by the heat, not only the ſkin of his face was almoſt corroded by the ſharpneſs of the exhalations, but the colour of his hair was altered by it, which kept him from proſecuting his intended diſcovery. It is a known thing, and I have received information of it from more than one eye-witneſs, that about mount *Veſuvius*, the aſcending exhalations, that iſſue out at ſome of the holes, are of ſo ſaline and ſulphureous a nature, that part of them ſtick about the orifices of thoſe vents, in the form of flower of brimſtone, of which a learned acquaintance of mine brought away ſome quantity. And I have had brought me from ſome of thoſe vulcanos a ſtone, whoſe cavities abounded with a white ſalt, which, by fit trials purpoſely made, was found near a-kin to ſal-armoniac, and eaſily reſoluble into a ſalt, whereof one part was ſomewhat fixed, and the other very volatile; which made it highly probable, that the ſalt was compounded in the bowels of the vulcano: whence I have been credibly informed, that great quantities of it have been caſt up in the fiery eruptions, and therefore ſtore of it might in likelihood be diſperſed through the air, ſince I found the ſalt itſelf to be ſublimable.

But, beſides the ſaline ſubſtances hitherto mentioned, which may be referred to determinate ſpecies, I think it not impoſſible, that the air may, at leaſt in ſome times and places, be impregnated with corpuſcles of a ſaline nature, whether ſimple, or compounded, or of both kinds, not eaſily reducible to any of the ſorts we have been ſpeaking of, or are acquainted with. For which reaſon I ſhall not preſume to give them any other denomination, than that indefinite one of anonymous. And I have been inclined to think, there may be ſuch bodies in the air by theſe two inducements. The firſt, that the particular aerial ſalts, that have been hitherto recited, are but few, as it ſeems probable by what I have ſaid in other papers of ſubterraneal ſteams and menſtruums; and that therefore there may aſcend out of the earth into the air ſaline fumes, differing enough from thoſe, whoſe kinds we have hitherto deſcribed. But beſides this conſideration *à priori*, (as they ſpeak) experience has preſented us with ſome phænomena, that ſeem *à poſteriori* to confirm this conjecture. For there happen ſuch changes to ſome bodies, by being expoſed to the air, as though I am not ſure, and therefore ſhall not be confident, that they are mainly produced by ſome nameleſs ſubſtance of a ſaline nature, may yet make it allowable to ſuſpect them to proceed thence. And amongſt theſe I ſhall take leave to inſert ſome, which I deny not to be probably referrible, either to one or other of the formerly enumerated kinds of aerial ſaltneſs. For laying theſe inſtances before you together, they may, by appearing thus aſſociated, give the ſtronger probability to our opinion, that there are ſaline ſubſtances in the air. And thoſe inſtances, that are not ſo proper to perſuade you, that there are anonymous ſalts, may ſerve to confirm, that there are, at leaſt in divers places, differing ſorts of aerial ſalts. I remember I have more than once viſited old glaſs-windows, in high and ancient buildings, and found ſome of the panes of glaſs here and there corroded, as if they had been worm-eaten; which probably enough argued the ſharp and fretting corpuſcles to have been carried along with the winds, to which they were expoſed, as will not eaſily be reduced to any formerly named ſalts, whoſe being unable to corrode glaſs, eſpecially no finer than that was I ſpeak of, is ſufficiently known to chemiſts.

Besides the above-mentioned phænomena, others have occurred to me, which poſſibly it would not be thought impertinent to ſubjoin on this occaſion; but I chooſe rather to reſerve them for another diſcourſe; and now ſhould put an end to this, but that I dare not conceal from you, that I ſometimes had thoughts of trying, whether a diſcovery may not be made, what kind of ſaltneſs there is to be found in the air, and whether the aerial ſaltneſs does or does not abound there, at leaſt at this or that time. But this I freely confeſs to be ſo difficult an attempt, that all that I can offer pretends but to diſſuade you from rejecting it, as too deſperate and extravagant a thing to be fit to be tried.

And I ſpeak the leſs promiſingly of what I am to ſay in the remaining part of this paper, becauſe I have not by me any notes to aſſiſt my memory, (which I dare not truſt alone) concerning the iſſues of the not numerous trials, I had opportunity to attempt in purſuance of thoſe thoughts. This I well remember, that among other ways of making the intended aerial diſcoveries, I looked upon this as the leaſt unpromiſing, that ſuch ſubjects ſhould be carefully choſen out, as being diſpoſed to be differingly wrought upon, according to the differing ſorts of ſaltneſs, that may be found predominant in the air.

This more general way of inveſtigating the ſalts of the air may contain divers particular methods, of which I ſhall now touch upon the following three.

First, it may be worth while to expoſe to the air ſuch bodies, as we judge fitteſt to be wrought upon by the ſalt, that we think likelieſt to be met with in it. So where

we gueſs the air to be impregnated with nitre, we may expoſe lime to it, or ſome other body, that we think diſpoſed to imbibe or retain ſuch a ſaltneſs. We may alſo hang up in ſuch an air clothes or ſilks died with ſuch colours, that nitrous (for inſtance) or ſalinoſulphureous ſpirits (as ſome chemiſts call them) have been found peculiarly apt to make to fade, or to diſcolour them. In the places where we ſuſpect vitriolate ſteams to abound, ſome appropriated preparations of ſulphur, either common or metalline, may be expoſed, to try, whether they will acquire a blackneſs, as I have ſeveral times found ſome of thoſe ſulphurs, though otherwiſe of no dark colour, to do upon the leaſt contact of vitriolate corpuſcles. In ſome places alſo, which are judged likely to afford ſubterraneal ſteams, gueſſes may be made, whether this or that kind of ſalt aſcends into the air, by ſpreading upon the ground, in places free from dirt and duſts, large pieces of clean and white linen cloth, that has no reliſh of ſoap or lees; and obſerving, after they have lain a competent while, whether, and how they are diſcoloured, and what kind of ſaltneſs, if any, is to be found in the moiſture imbibed by them, from the aſcending ſteams and falling dew.

THE next of the above-mentioned ways of enquiring after the ſaltneſs of the air may be, to find, if it be poſſible, ſome one body, that is both capable to be wrought on by ſeveral aerial ſalts, and will be ſo differingly wrought on by them, as to diſcover which kind of ſalt it is, that has produced the change. That it is very difficult to find ſuch a body, I will readily grant; but that it may be poſſible, I will not be forward to deny. For having pitched upon copper to make this trial with, though the attempt did not ſucceed according to my wiſh, yet perhaps it was chiefly for want of time and accommodations that it miſcarried. For having taken plates of copper beaten thin, (without regarding their bigneſs, or figure, or ſmoothneſs, as things not neceſſary to my purpoſe) I cauſed the ſurfaces to be made very clean, that the colours might be the more eaſily produced, and the better diſcerned: then keeping theſe over glaſſes, wherein were placed divers ſpirits, as of common ſalt, and of nitre, partly ſincere, and partly diluted with water, I obſerved, as I expected, that though I put the glaſſes in no heat, yet there aſcended fretting particles out of the liquors, and that within leſs than a day, the ſteams of the two above-mentioned liquors had much darkened the ſurfaces of the copper plates they met with in their way, the keeping them a while in the air was not hard to know by the differing diſcolorations that appeared, which plate had been invaded by the ſaline corpuſcles, and which by the nitrous; which I did not at all wonder at, becauſe I have formerly found, as I have elſewhere noted, that whereas ſpirit of nitre will make of copper a greeniſh blue ſolution, ſpirit of ſalt will, if duly employed, diſſolve that metal into a graſs-green liquor, as the ſpirit of ſoot and that of urine will into a deep blue, almoſt like ultramarine. But, as I ſaid, the want of time, of which good ſtore may be requiſite for ſuch trials, kept me from proſecuting my attempt to an iſſue. Notwithſtanding which I look not upon the deſign as deſperate, not only becauſe of the encouragement I have already mentioned to reſume it; but becauſe I have obſerved pieces of malleable copper, brought me, to examine, out of an Engliſh mine, (which is yet concealed) to be overcaſt here and there with a fair verdegreaſe, which by circumſtances I judged to have been produced, not by groſs liquors, but by the air impregnated with ſteams fit to work on that metal. And poſſibly there may be other ſubterraneal bodies, and even metalline ones, that by their degree of colour, or peculiar kind of ruſt or ſtain, that they will acquire in the air, may help us to gueſs what ſubſtances, and among others what ſalts the air of that place is impregnated with. I have been in a great and ſtately houſe, which being oddly ſeated, had this peculiar inconvenience, upon the ſcore of the ſteams that infeſted the air, that thoſe that dwelt in it,

Experiment I.

as

as one of the chief of themſelves complained to me, could not keep their ſilver plate, of which they had great ſtore, from being blemiſhed by odd diſcolorations, or, as they ſeemed to think it, ruſt; though when it was not uſed, they carefully kept it in a place judged convenient for ſuch a purpoſe. And I have been informed by an obſerving man, who lived there ſome time, that there is nothing more generally known in *Amſterdam*, than that their ſilver plate there, expoſed a little while to the common air, tarniſhes immediately, contracting a dirty colour, partaking of yellow and black. Another inſtance or two, though not afforded by plate, I could mention to the ſame purpoſe; but I reſerve them for another place, my haſte obliging me to paſs on to the laſt of the three ways I propoſed of inveſtigating the differences of aerial ſalts.

THE third way may be looked upon, if you pleaſe, as a variation of the ſecond; but there is this difference betwixt them, that here we make uſe of metalline bodies, not crude, but already prepared by ſome chemical operations; ſo that being before hand reduced to very ſmall parts by the intervention of ſaline ſubſtances, the operation of the air upon them is wont to be much the ſooner performed. In this third way then we employ ſuch fictitious minerals or other bodies, as having for the moſt part an adventitious colour already, will change that colour by being expoſed to the air. For it ſeems not impoſſible, but that by diligently obſerving, what difference may be found in the diſcolorations produced in theſe ſubſtances by the differing kinds of ſalts, as nitrous, ſalinoſulphureous, *&c.* that we have ſhewn may be met with in the air, ſome gueſſes may be made in a ſhort time of this or that ſalt, which has the chief ſtroke in the production of the exhibited colour. And I ſhall on this occaſion mention two or three bodies, without determining, till I be better ſatisfied, whether their changes proceed only or chiefly from the ſalt of the air; but I am content not to pretermit them, becauſe if they do not prove what I propoſe, they will at leaſt clear the meaning of it, and may however help us to gueſs at the reſemblance or difference of airs in ſeveral places, by the likeneſs or unlikeneſs of the produced changes of colour, whether theſe changes proceed from ſaline, or from any other ſubſtance intermingled with the air.

Experiment II. IF we precipitate a ſtrong ſolution of good ſilver made in aqua fortis, with a competent quantity of ſpirit of ſea-ſalt, we ſhall have a powder, which at firſt will be very white; but if the liquor be not poured off, this being expoſed for a good while to the air, it would acquire on the ſurface a dark colour, which perhaps an attentive eye will diſcern ſomewhat various, as this or that kind of ſaltneſs happens to be predominant in the air.

Experiment III. WE took an equal weight of good filings of copper, and powdered ſal-armoniac, which being well mixed, were put into a covered crucible, and kept in a moderate fire over ignited coals, till the ſal-armoniac had either quite or almoſt done ſmoking: then as much of the remaining maſs as could be parted, was taken out, and looked of a dark colour; but this maſs being groſly beaten, and expoſed for ſome time to the air, looked like a kind of verdegreaſe, which is a ſubſtance, whoſe colour may be obſerved ſomewhat to vary, according to the nature of the particular ſalts, which by working on, and embodying with the copper, produce the pigment. But a parcel of the ſame maſs being, before the air had time to work much upon it, groſly powdered, and hermetically ſealed in a glaſs egg, to fence it from the air, and left in a ſouth window, did not appear diſcoloured, when the out-ſide of the other parcel ſhewed like verdegreaſe: which ſeems to argue the change of colour to have been made by the aerial ſalt, if we ſuppoſe the moiſture of the air to have had no intereſt in the change, or to have concurred to it, but as a kind of vehicle aſſiſtant to the ſalt.

I ALSO took ſpirit of the ſoot of wood, and having poured a little of it on the filings of copper, my expectations were anſwered by my finding, that the liquor diſſolved ſome parts of the metal into a deep and lovely azure like ultramarine; and that this ſolution being ſuffered to grow dry in an open glaſs, by the mere operation of the air, the ceruleous colour very ſoon degenerated, even before the matter was quite dry, into a cyanious colour, ſuch as may be ſeen in good turquoiſes. And to manifeſt, that this change proceeded not from any peculiarity in the ſpirit of ſoot, and that this ſpirit acted as abounding with a ſalino-ſulphureous ſalt; I ſhall add, that I had the ſucceſs in a trial made with an urinous ſpirit drawn from animal ſubſtances, and put upon crude filings of copper. And in thoſe trials I ſometimes obſerved the differences of colours, that did not diſcourage me from hoping, that the proſecution of them might not be inſignificant to my purpoſe. Experiment IV.

I HAVE not been ſolicitous to deſcribe the fore-mentioned changes of colours more particularly, becauſe it had been very difficult to do ſo, and therefore I judged it more expedient not to attempt it. For there is ſo great a variety of colours, that few but painters can exactly enumerate and diſtinguiſh them by proper names. And yet, beſides thoſe more noted ones, there are many others, for which, though our language, nor perhaps any other, is not copious enough to furniſh us with diſtinct appellations, yet our eyes, eſpecially when they have been attentively converſant with ſuch objects, are ſharp enough to diſcern them: and by the help of theſe nameleſs (as well as the ſtated) colours, I am apt to think a heedful obſerver may perceive divers variations in the colours of the bodies we have been ſpeaking of, that may aſſiſt him to gueſs, what ſubſtance it is in the air, whereto theſe diverſities may be aſcribed. And as nature is much more rich in things, than our dictionaries are in words, ſo has ſhe furniſhed men with ſenſories capable of diſtinctly perceiving a far greater variety of objects, than they are able verbally to expreſs. And this might be ſhewn by inſtances, in the organs and objects of ſenſes leſs acute than ſight, whoſe ſubtilty in diſtinguiſhing things I could exemplify, not only by what is related, but by what has been performed by ſome perſons not unknown to me, particularly our famous Doctor *Harvey*. But examples of this kind I have not leiſure to ſtay on; and therefore, without ſpending more words upon this third way of diſcovering aerial ſalts, I ſhall barely recommend the care of ſuch obſervations to their curioſity, who ſhall think it worth while to make them.

WITH how little confidence of ſucceſs, trials, that have the aims of thoſe I have been ſpeaking of, are to be attempted, not only conſideration, but experience, hath made me ſenſible. But yet I would not diſcourage human curioſity from adventuring, even upon ſlight probabilities, where the nobleneſs of the ſubjects and ſcope may make even ſmall attainments very deſirable. Thoſe adventurous navigators, that have made voyages for diſcovery in unknown ſeas, when they firſt diſcerned ſomething of obſcure near the horizon, at a great diſtance off, have often doubted, whether what they had ſo imperfect a ſight of, were a cloud, or an iſland, or a mountain: but though uſually it were more likely to be the former, (as that which more frequently occurred than the latter) yet they judged it adviſable to ſteer towards it, till they had attained a clearer proſpect of it: for if it were a deluding meteor, they would not however ſuſtain ſuch a loſs in that of no great labour, as, in caſe it were a country, they would in the loſs of what might prove a noble and rich diſcovery. And if they deſiſted too ſoon from their curioſity, they could not rationally ſatisfy themſelves, whether they ſlighted a cloud, or neglected a country.

I DO not perceive, that the air of our inland parts is conſiderably impregnated with cfurine ſalt; ſince I do not find the bars and caſements of our windows much im-

paired by ruſt after near eighty years ſtanding, or that they are more ruſty towards one quarter than another; though the air hereabout, (*viz. Oakly* in *Buckinghamſhire*) is very damp about the end of autumn, and beginning of winter. So that I conceive this ſalt either proceeds from the ſea-vapours near the ſea-coaſts, or elſe from the diſſolution of this eſurine ſalt in the air, upon the burning of ſea or other mineral coles. Mr. *J. T.*

Agricola de re metallica, lib. duodec.

Mox ollam ex igni removent; poſtea ex refrigerata eximunt halinitrum puriſſimum: quod candidi marmoris ſpeciem gerit; atque tunc etiam id, quod terrenum eſt, in fundo reſidet. At terra, ex qua dilutum fuit factum, & rami quernei vel conſimilis arboris alternis ſub dio ponantur, & aqua quæ combibit halinitrum conſpergantur: quò modo quinque vel ſex annis rurſus apta fit ad conficiendum dilutum. Halinitrum quodammodo purum, quod dum terra tot annos quievit interea, ortum fuit, & quod lapidei parietes in cellis vinariis & locis opacis exudant, cum primo diluto permiſtum decoquatur.

Si verò locus aliquis talium venarum copiam ſuppeditaverit, ipſæ ſtatim non conjiciantur in caſtella; ſed primo convehantur in areas, atque cumulentur: quanto enim diutius aeri & pluviis expoſitæ fuerint, tanto meliores fiunt. Nam in ejuſmodi cumulis, aliquot poſt menſibus, quam venæ in areas fuerunt congeſtæ, naſcuntur fibræ longe venis bonitate præſtantes: deinde vehantur in ſex, pluraeve caſtella, longa & lata ad novem pedes, ad quinque alta.

Si verò dum dilutum recoquitur, ſeparata non fuerint, mox ex minoribus vaſis infundatur in majora, eaque concludantur: in quibus item atramentum ſutorium ſeparatum ab alumine concreſcit: utrumque exciſum, & in hypocauſto ſiccatum divendatur dilutum, quod in vaſis & cupis non concrevit in cortinam refuſum recoquatur: ſed terra, quæ in fundo cujuſque cortinæ reſedit, ablata in caſtello unà cum venis, denuo aqua & urina diluatur. At terra, quæ in caſtellis diluto, poſtquam effluxit, ſuperfuit egeſta & coacervata quotidiè, rurſus magis ac magis fit aluminoſa, non aliter atque terra, ex quâ halinitrum fuit confectum, ſuo ſucco plenior fit: quare denuo in caſtella conjicitur, & aquæ affuſæ ea percolantur.

A LEARNED obſerver, who practiſed phyſic in one of the moſt ſouthern of the Engliſh colonies, being aſked by me about the effects of the air there upon iron, affirmed to me, that the great guns there are ſo ſubject to become ruſty, that, after they have lain a very few years in the air, one may with a hammer knock off whole ſcales, or rather cakes, of crocus martis: and he obſerved, that thoſe guns, that lay only expoſed to the air, did this much more than thoſe, that by accidents were drowned, and lay covered with the ſalt water.

AND ſince dew is made of ſteams of the terreſtrial globe, which whilſt they retain that form, and were not yet convened into drops, did ſwim to and fro in the air, and made part of it; the phænomena, that ſhew the power of dew in working on ſolid bodies, may help to manifeſt, how copiouſly the air may be impregnated with ſubtil ſaline parts. Wherefore I ſhall here add, that having met with a perſon, that was bred as well a ſcholar as a traveller, and had viſited not only ſome of the maritime places of *Braſil*, but ſome of the inward parts of that vaſt country, I enquired of him about the ſubtilty of Braſilian dew, and its power to ruſt metals: about which he told me, that it was certainly very great, and would not only ruſt knives and ſuch inſtruments, but likewiſe money, which he aſſured me he had particularly obſerved; adding, that in ſeveral places the Portugueſe kept their great guns caſed over, that the dew might not fall upon them, and by its corroſiveneſs ſo ruſt them, as to be apt, after a while, to break in the diſcharge. And when I demanded whether he taſted the dew, to obſerve the ſaltneſs of it? he replied, that he had not, but that he had in divers places obſerved, that it left the graſs, *&c.* that it had reſted on, covered over with a pure white ſalt, as if it had been a hoar froſt.

AN

An ingenious traveller, and ſtudent of phyſic, being diſcourſed with by me about ſome particularities of his country (which is *Swedeland)* relating to minerals, and their effects upon the air, aſſured me, that in a city, or notable town called *Fahlun*, which is built on the lower part of an hill, containing one of the beſt copper mines in *Sweden*, the exhalations, that are copiouſly emitted by the latent minerals, do ſo affect the air in and about the place, that their ſilver coins are oftentimes notably diſcoloured by them, not ſeldom made even black or blackiſh, though the money be kept well tied up in bags or purſes, and theſe perhaps placed one within another, and the whole aggregate be kept locked up in coffers or preſſes made of wood of perhaps an inch thick: he added, that theſe ſubterraneal ſteams have manifeſt effects upon braſs, (wherewith that country abounds) inſomuch that there being kept in the principal church ſeven crowns made of that metal upon a particular occaſion, the ſulphureous ſteams made thoſe, that looked to them, take the pains to cleanſe and brighten them at a month's end, till finding, that the labour was every month to begin again, they at length grew weary of it, and ſuffered theſe crowns to grow, as they yet continue, as black (to uſe his own phraſe) as the tunnel of a chimney: this he averred to be true, as having a good opportunity to be ſure of it, in regard of his being a native of this town. And he further aſſured me, that the corroſive exhalations did ſo penetrate the bars and veſſels of iron, that lye expoſed to the air, that, after a while, it is eaſy with a hammer to knock off ſcales of Mars, which are friable into a powder, like crocus, ſave that the colour is more dark.

TITLE XII.

Of Sulphur, and inflammable Particles in the Air; and of Lightening, and its Effect.

Yesterday a Neapolitan lord, a perſon of high quality, and very curious, being aſked by me ſome queſtions about ſome natural phænomena relating to *Veſuvius* and the adjacent country, aſſured me, that, having had occaſion to ſtay for divers months at a country houſe but little diſtant from *Naples*, he took much pleaſure, taking the air on horſeback upon a very ſulphureous ſoil, to take notice of divers obſervables to be met with there; and that he often found, that, when his horſe trod ſomething hard upon the ground, there would be produced a great (and as it were a crackling) noiſe, which would have frighted a ſtranger; and that oftentimes he could diſcern, that, where his horſe had trod, there would preſently ariſe a duſt, and fumes that were manifeſtly ſulphureous and ready to take fire: adding, that ſometimes he thought that they actually did ſo. He further told me, that he ſometimes, for curioſity ſake, cauſed ſome clods, or as it were turfs, to be cut out of that ſoil, and laid in a kind of heap; and that then in the night he could obſerve, that the ſteams, that plentifully iſſued thence, would ſometimes be kindled by ot in the air, as they aſcended in it.

The ſame nobleman told me, that, when ſome years ago there were eruptions of fire in mount *Veſuvius*, he and others obſerved, with amazement and horror, that the flame, which ſhot up into the air, from the *Volcano*, was of ſo prodigious a height, as invited them to meaſure it with a quadrant, by which they found it to be near two miles high: and when I aſked, if he compriſed in that height the altitude of the mountain itſelf? he anſwered, that he did not; for the flame, that appeared above the top of the mountain, appeared as high as the mountain itſelf; and is

was from the top of the hill, and not the bottom, that they computed the height of the flame. He added, that ſometimes the earth would tremble, and there would be diſcharges of ſuch vaſt ſtones, and other heavy things, that he ſaw ſome maſſes of ignited matter thrown up a great way into the air, that were bigger than the chamber he did me the honour to viſit me in, though that were a large room for a bed-chamber.

Voyage de Levant, p. 203.

Voila tout ce qu'on peut dire de cette iſle, qui ſemble un enfer, car on voit la mer du port, & de la coſte toute noire & brûlée d'un petit eſcueil, qui paroiſt depuis environ ſoixante ans, & d'ou on vit ſortir en ce temps là une grande flamme, qui y a laiſſé une ouverture ſi profonde, que ſi on y jette une pierre, on ne l'entend point tomber. Mais ce qui eſt arrive depuis en ce port, n'eſt pas moins eſtonnant: je le rapporteray icy comme je l'ay appris de diverſes perſonnes en pluſieurs endroits.

Accident extraordinaire à Santorini.

Il y a environ 18 ans, que durant la nuit d'un certain dimanche, commenca dans le port de Santorini un tres grand bruit, lequel s'entendit juſques à Chio, qui en eſt eloigné de plus de deux cent milles, mais de telle ſorte, qu'on crut à Chio, que c'eſtoit l'armée Venitienne, qui combattoit contre celle des Turcs, ce qui fit que dés le matin chacun monta aux lieux les plus élevez pour en eſtre ſpectateur, & me ſouviens que le reverend pere Bernard *ſuperieur des Capucins de Chio, homme venerable, & tres digne de foy, me conta, qu'il y avoit eſte trompé comme les autres, car il crut auſſi bien qu'eux entendre pluſieurs coups de canon; cependant ils ne virent rien, & en effet ce fut un feu, qui ſe prit dans la terre du fond du port de Santorini, & y fit un tel effet, que depuis le matin juſqu'au ſoir il ſortit du fond de la mer quantite de pierres de ponce, qui montoient en haut avec tant de roideur & tant de bruit, qu'on euſt dit, que ce fuſſet autant de coups de canon, & cela infecta tellement l'air, que dans la dite iſle de Santorini, il mourut quantité de perſonnes, & pluſieurs de la meſme iſle en perdirent la veue, qu'ils recouvrerent pourtant quelques jours apres. Cette infection s'eſtendit auſſi loin, que le bruit qui l'avoit precede, car non ſeulement dans cette iſle, mais meſme a Chio, & à Smyrne, tout l'argent devint rouge, ſoit qu'il fut dans les coffres, ou dans les poches; & nos religieux demeurans en ces lieux là me dirent que tous leurs calices en eſtoient devenus rouges. Au bout de quelques jours cette infection ſe diſſipa, & l'argent reprit ſa premiere couleur. Ces pierres de ponce, qui ſortirent de la, couvrirent tellement la mer de l'Archipel, que durant quelque temps, quand il regnoit de certains vents, il y avoit des ports qui en eſtoient bouchez, en façon qu'il n'en pouvoit ſortir aucune barque, pour petite qu'elle fut, que ceux qui eſtoient dedans ne ſe fiſſent le chemin au travers de ces pierres de ponce avec quelques pieux; & on en voit encor à preſent par toute la mer Mediterranée, mais en petite quantité, cela s'eſtant diſperſé ca & là. Seneque raconte en une de ſes epiſtres, que Santorini eſt baſtie ſur des mines de ſouphre, & ce ſont elles, qui fourniſſent aſſeurement la matiere pour allumer ce feu. On dit qu'Alexandre le Grand meſura la mer en cet endroit, & n'y trouva point de fond. Il y a pourtant une petite iſle appellée Fireſia, à la pointe de laquelle on peut donner fonds, & point en aucun autre endroit.*

It has been often obſerved, that upon the falling of thunder there has been produced in the air, near the places where it fell, a ſtrong odour of burnt brimſtone. And I remember, that being one night at a town built almoſt upon the great lake of *Geneva*, anciently called *Lacus Lemanus*, the thunder was ſo violent, as much frighted the inhabitants; though (by reaſon of the neighbourhood of the high mountains of *Savoy* and *Switzerland*) thunders be very frequent there: and the next day I had a great complaint made me, of the ſtrong ſtink of ſulphur, produced by the thunder, that fell hard by into the lake, and was ready to overcome, by its ſmell, even a ſoldier, that ſtood centinel near it.

On *July* 24, *An.* 1681, the ſhip Albemarl, whereof Mr. *Edward Lad* was then maſter, being an hundred leagues from cape *Cod* in latitude 48. about 3 P. M. met with

with a thunder ſtorm; the lightening burnt the main-top-ſail, ſplit the main cap in pieces, rent the maſt all along. There was in ſpecial one dreadful clap of thunder, in report bigger than of a great gun, at which all the ſhip's company were amazed: then did there fall ſomething from the clouds upon the ſtern of the boat, which it broke into many ſmall parts, ſplit one of the pumps, the other pump much hurt: it was a bituminous matter, ſmelling much like fired gunpowder: it continued burning in the ſtern of the boat. They did with ſticks diſſipate it, and poured much water on it, and yet they were not able, by all they could do, to extinguiſh it, until ſuch time as all the matter was conſumed. But the ſtrangeſt thing of all is yet to be mentioned.

When night came, obſerving the ſtars, they perceived, that their compaſſes were changed. As for the compaſs in the biddekel the north point was turned clear ſouth. There were two other compaſſes unhung in the locker in the cabin, in one of which the north point ſtood ſouth like that in the biddekel. As for the other the north point ſtood weſt, ſo that they ſailed by needle, whoſe polarity was quite changed. The ſeamen were at firſt puzzled to work their veſſel right, conſidering, that the ſouth point of their compaſſes was now become north; but after a little uſe it was eaſy to them: thus did they ſail a thouſand leagues. As for the compaſs, wherein the lightning had made the needle to point weſtward; ſince it was brought to *New-England* the glaſs being broken, it has, by means of the air coming to it, loſt its virtue. One of their compaſſes, which had quite changed the polarity from north to ſouth, is ſtill extant in that country, in the hands of Mr. *Increaſe Mather*; the north point of the needle doth remain fixed to this day, as it did immediately after the lightning cauſed the alteration.

An induſtrious gentleman, that was long an eminent planter of trees, wherewith he furniſhed many of his neighbours, preſented me with a piece of a branch, that ſeemed to have had a ſlit, for it reached thorough the bark almoſt to the very wood, from one end to the other, but had now the lips of the wound overgrown on each ſide with new bark: of this kind of gaſhes, he told me, he found in other branches of the ſame tree, which made him think, that ſome envious knave had done this in ſpite: but, conſidering the circumſtances more curiouſly, he found that conjecture much diſcountenanced by ſome of them, and ſuſpected, that theſe wounds muſt have been made by ſome deſignleſs agent. For by his own obſervations, and thoſe of his friends, it appeared, that theſe fiſſures are to be met with, not only in divers others of his own trees of differing kinds, and in differing plantations, but alſo in the trees of ſeveral others, which, though growing in the ſame country, were remote enough from his: ſo that it having been obſerved with ſome wonder, that, in the foregoing ſeaſon, lightnings had been very numerous and frequent, he and his friends concluded, for reaſons that need not be here repeated, that the above-mentioned gaſhes were ſome of the odd effects of thoſe lightnings, which kept me from wondering at his negative anſwer, to the curioſity I had to know, whether all theſe wounds of the trees looked the ſame way, as eaſt or weſt, north or ſouth. For I had formerly obſerved, that the ſame fulmen, or flaſh of lightning reaching to the earth in the form of fire, appeared by the recent effects, as well of its impetuous motion, as of its violent heat, to have moved in an irregularly winding-line; which made me compare its motion to that of a ſquib, and helped me to ſolve ſome odd phænomena of lightning, that this is not the fitteſt place to diſcourſe of: the foregoing mention of what happened to the trees, being deſigned, partly to preſerve the memory of an unuſual phænomenon, and partly to ſhew, that, whatever is wont to happen in animals, lightning is not always deſtructive or corruptive of vegetables, ſince the wounds

inflicted to trees were happily cicatriſed, and did not kill or poiſon the plants And whether this phænomenon were produced by ſome mineral exhalations kindled in the air, or by the violent and irregular motion of ſome ſuch ſubſtance, or by both together, the phænomenon will be pertinent to the ſubject or deſign of the preſent tract.

TITLE XIII.

Of celeſtial Influences or Effluviums in the Air.

To Mr. *HARTLIB.*

DEAR SIR,

I SHALL not, I hope, altogether forget the charge, which you have been pleaſed to lay upon me, in reference to the conſideration of all winy liquors, their affections, and the ſeveral diſtempers incident to them, with my thoughts about the preſerving of them, ſo as may beſt retard the quickneſs of their motion, and hinder their dyſcraſy and corruption.

To which end an exact ſcrutiny into the air, its quality, temperament and motion, and an enquiry of the efficacy and force, that this hath upon all ſuch bodies, will be in ſome meaſure neceſſary.

AND this puts me in mind to leave one requeſt with you, *viz.* to beg your aſſiſtance and countenance on all occaſions to Mr. *Streete*, when he ſhall at any time wait on you, who both as to his undertaking, and to the modeſty and ſimplicity of his ſpirit, doth very much emulate our ſo much joint eſteemed friend Mr. *Mercator*, who, though he may differ from the former, in reference to his method, or to ſome of the profounder parts of learning; yet I think it very poſſible to reconcile them in the main, and cannot but expect ſomething extraordinary in the aſſerting and perfecting of the theory of the planets, will be brought forth between them, which I ſhould the more gladly ſee, by how much moſt ſcholars complain of it, as of a thing hitherto wanting, by how much alſo I gueſs, that, having the examples of ſo many who have already attempted the ſame thing in vain, they will find themſelves the more conſtrained to lay down ſome new choice ſingular and undeniable hypotheſis, for the better invitation of the admittance of their opinion among learned men, although ſuch a work be no leſs neceſſary alſo for other reaſons.

FOR, if we aſſert not the theory of the planets rightly, and upon ſuch grounds as are indubitably demonſtrable, we ſhall never be free from errors and diſagreements in opinion about their motions, and the right calculation of them.

AND if we miſtake in either of theſe, we muſt miſtake of the true place in the heavens, in which each planet is, or conſtantly ought to be: and if we at all err in our judgment of their due places, it is impoſſible we ſhould aſſert their ſeveral aſpects, and the mutual influences and virtues they have (through this) one upon another: and ſo the phyſical uſe of their motions falls to the ground wholly, or at leaſt becomes ſubject to very much uncertainty.

AND truly, if there be no ſuch uſe at all of the motions of theſe bodies, as that which I may call phyſical, *viz.* for predicting, and for (in ſome meaſure) determining, the affections, diſpoſitions, and alterations, that are introduced into ſeveral things here, either immediately, or into the air immediately, by reaſon of the courſe of theſe ſuperior bodies, it would very much leſſen and depreciate with me that toil, coſt, pains, watchings, and continual exerciſes and endeavours, that have been uſed

for the gaining of exact obſervations in aſtronomy. Seeing, when we have done all, and obtained all beyond the mere bare knowledge of them, we can propound no end, benefit, uſe, or advantage, that may recompenſe the trouble and pains beſtowed upon them (at leaſt upon ſome of them), nor ſo much as any real or particular relation between us and them; and if ſo, we know them only to know them.

But we ſhall at preſent preſume the contrary, and therefore ſhall crave leave to ſay, that although ſeveral objections are commonly brought againſt any ſuch uſe or application of theſe bodies, or of their power, influence, or motions, which are occaſioned partly by the ſuperſtition and paganiſm incident to this kind of doctrine, partly by the impoſture, ignorance, and want of learning, generally obſerved in the perſons profeſſing this knowledge, partly by the manifeſt miſtakes and uncertainty, that there is in the predictions of this nature, and partly by the inexplicableneſs of the way or manner how they come to affect one another, which admits not, as many conceive, of an eaſy, viſible, or familiar demonſtration: yet all theſe objections, if thoroughly examined, do not, as we humbly conceive, really null or take away the poſſibility of the thing ſimply, but are raiſed rather againſt the enormities and imperfections, that are confeſſed to be in it; and it may, notwithſtanding all thoſe objections, ſtill be certain, that theſe celeſtial bodies, (according to the angles they make one upon another, but eſpecially with the ſun or with the earth in our meridian, or with ſuch and ſuch other points in the heavens) may have a power to cauſe ſuch and ſuch motions, changes, and alterations, (ſtronger or weaker, according to the nature of the angle) as the extremities of which ſhall at length be felt in every one of us: and this may be evidenced, 1ſt, by undeniable experiments, not only from things inanimate and vegetative, but from the undoubted obſervations of phyſicians, as well in ſeveral chronical as acute diſtempers, and more eminently in all lunatic, epileptic, paralytic, or lethargic perſons. 2dly, It may further admit of a demonſtration; for if the extreme motions of phyſic be generation and corruption, and the mean motions rarefaction and condenſation, allowing then theſe bodies to have a ſhare in promoting the mean motions, (*viz.*) of rarefaction and condenſation, we ſhall or may ſoon be convinced, that their effects then upon all other things here cannot but be exceeding conſiderable.

For the better underſtanding of which, I ſhall offer a little more largely to you my conceptions, *viz.*

That, to ſpeak properly and ſimply, I take generation and corruption to be the extremes of motion, rather than motions themſelves; for the ſcope, intentions, or effects, of all phyſical motions (ſtrictly ſo taken) are only to one of theſe ends, *viz.* either for generation or corruption; and theſe two are they alſo, which limit and bound all motion; for beyond theſe metes there is no phyſical progreſſion, and therefore theſe two muſt be the true *termini*, as well *à quo*, as *ad quem*, of all ſuch motion, ſeeing all things are corrupted to be generated, and all things generated are at length corrupted.

But if theſe be rather the *termini* and extremes of motion, than motion itſelf, we muſt acknowledge there are motions, which nature uſeth as means, between theſe two extremes: which mean motions muſt be as oppoſite alſo one to another, as the two extremes. Otherwiſe we ſhould never be at a certainty, which way nature intends by her motion: otherwiſe alſo we muſt ſay one and the ſame courſe, or one and the ſame thing in nature, may ſimply and of itſelf be the immediate cauſe of generation and corruption, of life and of death, of hardneſs and ſoftneſs, which is abſurd and impoſſible.

Now

Now as theſe two motions of rarefaction and condenſation are oppoſite one to the other, as is required, ſo do they ſquare to all other the inſtruments and phænomena in nature, (*viz.*) the one anſwering to heat, the other to cold; the one to hardneſs, compactneſs, and aridity, the other to gentleneſs, ſoftneſs, ſweetneſs, maturity, &c.

For which reaſons therefore, as well as for many other, which might be urged, (if inſiſted on) we do conclude, (ſubmitting it nevertheleſs to be examined) that generation and corruption, rarefaction and condenſation, is the ſimpleſt, plaineſt, and trueſt analyſis, that can be found in nature, for all phyſical motions, as unto ſome of which all motion, purely phyſical, may (as we humbly conceive) without ſtraining, be immediately referred, and as by and through which all may likewiſe with as little difficulty be reſolved.

And having laid this as a ſecond argument, we ſay thirdly, that it cannot be denied, but all the affections and diſpoſitions of moiſture, heat, cold, drought, the courſe of all winds, ſhowers, thundering, or whatſoever elſe is uſed by nature, to produce theſe two general and univerſal effects of rarefaction and condenſation, do in great meaſure, if not wholly, depend upon, and are altogether regulated by, the courſe, motion, poſition, ſituations or aſpects, of the ſuperior and celeſtial bodies or planets. And therefore, 4thly, we ſay, that every planet hath its own proper light: and as the light of the ſun is one thing, the light of the moon another, ſo every planet hath its diſtinct light, differing from all the other. Now we muſt either ſay, that this light is a bare quality, and that the utmoſt uſe and end of it is only to illuminate; and that there is no light but is accompanied further with ſome power, virtue, or tincture, that is proper to it; which if granted, it will inform us then, that every light hath its own property, its own tincture and colour, its own ſpecific virtue and power; and that, according to the ſeveral bodies of light, there are ſeveral properties, tinctures, and powers; and that as one ſtar differs from another in glory, (according to the apoſtle) ſo one ſtar and one planet differs from another in its virtue, in its colour, in its tincture, and in its property.

And conſequently, that thoſe eminent ſtars and planets, that are in the heavens, are not to be conſidered by us as ſluggiſh inergetical bodies, or as if they were ſet only to be as bare candles to us, but as bodies full of proper motion, of peculiar operation, and of life; the ſun not only ſhining upon the reſt of the planets, but, by his quickning warmth, awakening, ſtirring, and raiſing, the motions, properties, and powers, that are peculiar to them. According therefore to the angles they make with the ſun, and according as they are more or leſs enlightned by him; according alſo as they are at the ſame time more directly or more obliquely, more remotely or more nearly, ſituated and placed in reſpect to us; ſo muſt the effects of the powers, virtues, and tinctures, that are proper to them, be more or leſs felt by us. 5thly, For the manner of the planets tranſmitting theſe their properties and powers, and of their affecting other bodies at ſo remote diſtance, there is nothing begged or required in it, that is inſuperable to a man's apprehenſion or belief: ſeeing,

1. We affirm not any property, operation, virtue, or power, to be tranſmitted from any of the ſaid planets, but what doth deſcend with its light, and is the real property of its light.

2. No man judgeth, that the light of any planet, or of the ſun itſelf, is refracted, or by any other means weakned, hindred, or impaired by the æther, (or that ſubſtance which fills up the ſpace between one planet and another) through which it paſſeth; but that it doth deſcend whole directly and inrefracted unto (or upon) our atmoſphere.

3. But

3. But whatſoever is received by the atmoſphere is alſo received by the thin and ſubtile air, that is contiguous to the atmoſphere: and this air therefore cannot but be capable of being moved, ſtirred, altered, and impreſſed by theſe properties, virtues, and lights, as penetrating each part of it.

4. Not only the air, by reaſon of its thinneſs and ſubtilty, is capable of being thus penetrated, moved, and altered, by theſe planetary virtues and lights; but foraſmuch alſo as our ſpirits, and the ſpirits likewiſe of all mixed bodies, are really of an aerious, etherial, luminous production and compoſition; theſe ſpirits therefore of ours, and the ſpirits of all other bodies, muſt neceſſarily no leſs ſuffer an impreſſion from the ſame lights, and cannot be leſs ſubject to an alteration, motion, agitation, and infection through them and by them, than the other, *viz.* the air: but rather, as our ſpirits are more near and more analogous to the nature of light than the air, ſo they muſt be more prone and eaſy to be impreſſed than it. And if our ſpirits, and the ſpirits of all mixed bodies, may be altered, changed, moved, and impreſſed by theſe ſuperior bodies, and their properties; then theſe ſpirits being the only principles of energy, power, force and life, in all bodies wherein they are, and the immediate cauſes through which all alteration comes to the bodies themſelves; it is impoſſible therefore ſpirits ſhould be altered and changed, and yet no alteration made in the bodies themſelves: and therefore a leſs limit or extreme cannot be ſet to the power or operation, or force of the ſuperior bodies upon the inferior, than what muſt terminate at length into the very bodies themſelves.

5. As a further confirmation or proof of this, in reference at leaſt to ourſelves, I ſhall offer to your conſideration the accidents, that often happen to men, by the mere air, as convulſions, cramps, blaſtings, lameneſs, colds, many of which endure a man's life-time; and which (with many bitter infirmities, that ſometimes ſeize upon a man, while ſtanding, walking, or lying in the air) are rarely or never felt or diſcerned at the inſtant of their approach or inſults upon a man, nor yet accompanied with the ſenſe of any exceſs in the air for heat or cold at that time, and therefore not well referrible to any cauſe in the air, if not to the power of thoſe properties and operations of the celeſtial bodies that we ſpeak of; and this I ſubmit to the judgment of common experience.

6. Lastly, as the ſun ſhining on the reſt of the planets doth not, as we ſaid, only barely illuminate their bodies; but beſides this, through the power, virtue, and activity it hath, doth alſo raiſe, excite, awaken and ſtir up the ſeveral properties and diſpoſitions, that are in thoſe ſeveral and reſpective bodies, whereby they are more lively and effectually brought forth upon us; ſo we are to ſuppoſe it is in reference to this our planet, which is the earth, which is not only enlightned, warmed, cheriſhed and fructified, by the power, virtue, and influence of the ſun, but hath its proper magnetical planetary virtue alſo fermented, ſtirred, agitated and awakened in it, which it remits back with the reflected light of the ſun; and together with this magnetic planetary property of the earth, which is ſtirred and raiſed by the ſun, are awakened alſo the ſeminal diſpoſitions, odours, and ferments, that are lodged in, and proper unto, particular regions or places, which do likewiſe emit and diffuſe through the air, as their ſeveral and reſpective benign, grateful (ſo their ſeveral malignant, congelative, and fracedonous) natures and qualities.

And hence therefore, though the air, its temperament, diſpoſition and quality in general, is to be looked at according to the motions, influences, and aſpects, of the ſeveral ſuperior bodies; yet the particular healthfulneſs and unhealthfulneſs of the places, the evil diſpoſition of the air, evenings, nights, and early in the mornings, in ſome parts more than in others; the ſuperabundunt moiſture, exceſſive winds, droughts,

or other ſeaſons proper to one country, and not to be obſerved in another neighbouring to it; all theſe are rather to be allowed and referred to thoſe odours, vapours, and exhalations, that are, through the power of the ſun or other planets, drawn forth from their particular ſeats into the air, from the planets themſelves.

And thus I have hinted, as well as I may, at the ſolutions of all the phænomena pertaining to this matter, that I can think of.

And if this be ſo, then wholly to neglect this phyſical uſe (and conſideration) of the motion of theſe bodies, and either to reject it, becauſe of the ſuperſtition that hath been mixed with it, or to exclude it from all manner of care, and from all other further ſcrutiny, as a thing not worth our enquiry or ſearch at all after, is as great an extreme on the other hand, and a miſtake, that muſt not paſs untaxed among learned men.

You did not expect, I am ſure, I ſhould have adventured into ſo particular an apology for aſtrology; nor did I intend it, when I begun my letter; nor do I now aim to juſtify any thing farther, than what may properly, if not neceſſarily, fall into the conſideration of natural philoſophy, being indeed much induced to think, that (were the theory of the planets ſo exactly ſtated, ſo perfectly or ſo undeniably demonſtrated, that we might be ſure we rightly underſtood the place, courſe, and poſition, of each of their bodies in the heavens) this other doctrine of their phyſical uſe, with the weight, dignity, extent, conſiderableneſs or inconſiderableneſs of it, would ſoon confirm and demonſtrate itſelf by the evidence and proof of itſelf; eſpecially if any will pleaſe to take the pains to calculate theſe motions for his own private uſe, and according to the meridian he was in, and ſo compare them with his own obſervations of the change and alteration of the air from day to day. Which doubtleſs, as it is the way at firſt taken by the ancients, to find out their efficacy, (I mean the making ſuch a conſtant obſervation, and keeping ſuch a diary) ſo the doing of that again, and giving us firſt an hiſtory or diary of the obſervations of the weather, and its changes in all reſpects, and then an account of the ſeveral places, motions, or aſpects, each day, of the ſeveral bodies of the heavens, with the agreements, doubts, or diſagreements, that theſe bear one to another, and that muſt neceſſarily riſe thereupon, would be that, that could not but prove both ſatisfactory and delightſome to us in this great point, about their phyſical power and uſe.

And the commodity of this in our œconomical or civil concerns, in huſbandry, in gardening, in phyſic, and to the producing many other very ſtupendous effects, cannot poſſibly be ſo well credited or diſcerned as it would, if ſome ſuch plain foundation and demonſtration of the power of theſe bodies in general were laid. Which methinks we ſhould be much the more encouraged to undertake, having an advantage given us in this age, beyond what moſt ages ever had, by the uſe of thoſe rare inſtruments, that they call the thermometers, or weather-glaſſes.

And truly when I conſider, that things of the greateſt conſequence do oft-times depend upon the moſt common obſervations; and that matters of the higheſt improvement do receive their beginning from mean, ſmall, ordinary experiments; I would have no man, who hath leiſure, opportunity, and time, to think it a ſlight thing to buſy himſelf in collecting obſervations of this nature. It being much more commendable for a man to preſerve the hiſtory of his own time, though but in the obſervation of the motions of this kind, than to ſay, upon every occaſion that offers itſelf, this is the hotteſt, or this is the coldeſt, or this is the rainieſt, or this is the moſt ſeaſonable or unſeaſonable weather, that ever he felt; whereas it may perhaps be nothing ſo.

And if there were no other uſe, yet obſervations of this nature would much conduce to compleat the natural hiſtory of any place; as we may obſerve by that learned author, who writ *Hiſtoriam Naturalem Braſiliæ*; and who, to prove not only the habitableneſs, but healthfulneſs, of that climate and country, exhibits the account of every day's weather, obſerved by him for many years together, and ſo the agreement of it to that temper, which we account healthful.

But the inſtituting and perfecting of accurate obſervations of this nature, by the help of ſeveral large and exact thermometers, placed in ſeveral rooms, or expoſed after ſome convenient manner to the air itſelf, would be a more noble and uſeful undertaking than ordinary. I ſay, the doing this accurately, by large and exact glaſſes, by placing ſeveral of them, either together, or at ſome fit diſtance one from another; it being much to be lamented, and that which I cannot but complain to myſelf of, that no improvement conſiderable hath, as I can learn, been made by any man, of theſe glaſſes, either in our own country, or any where elſe, ſince their firſt invention, (but only to hang them in a room for ornament ſake) there being many things yet wanting, that were much to be deſired for the perfecting of them. For,

1. None hath hitherto given us the beſt proportions between the diameter of the head, and the diameter of the bodies or cylinder, although this be indeed the very firſt conſideration, and that which is moſt neceſſary in the uſe of theſe inſtruments; for as by how much the bigger the cylinder is, and by how much the leſſer the head, by ſo much the more ſlow and imperceptible the air's alteration and motion will be; ſo by how much the bigger the head, and ſmaller the cylinder is, by ſo much the more quick, ſubtile, and diſcernible, will every ſmall difference of the air appear; which therefore, being on both ſides capable of an extreme, ought to be regulated neceſſarily according to ſome mean.

2. Admitting a mean or convenient proportion between theſe two diameters, to be as one to 16, or one to 24; we in the next place do no leſs want the fitteſt proportion for the length of the cylinder, which muſt doubtleſs alſo be varied anſwerably, as we vary the proportion of its diameter; the ſmaller cylinder in proportion to its head requiring the greater length, the bigger cylinder on the contrary the ſhorter length.

3. I have not hitherto ſeen any cylinder, that hath been well graduated, 12 or 16 degrees being the moſt, that are ſet upon the common weather-glaſs; whereas, to the making of accurate obſervations, it would require a cylinder to be divided into at leaſt 360 parts; though I think it neither unreaſonable nor unpracticable, to have one divided into 1000 parts, allowing but 10 degrees to each inch, which is no unuſual diviſion, ſeeing ſuch an one will much better diſcover, not only the ſmall (but the more ſudden and remarkable) changes of the weather (which are of chiefeſt uſe) than any others, that are common and ordinary.

4. Although no liquor ought to be uſed in theſe glaſſes, that is ſubject to froſt, yet we have little or no account what thoſe liquors are, that might be beſt or fitteſt for the accurate making of thoſe experiments, whether thoſe, whoſe property it is ſomewhat to attract the air, and ſo to preſerve themſelves in at leaſt their firſt quantity, as *oleum ſulphuris per campanam*, *ol. vitrioli*, *liquor ſalis tartari*, &c. or 2dly, whether thoſe, whoſe parts are fineſt, ſubtileſt, and neareſt of kin to the air, ſuch as is ſpirit of wine, ſpirit of terebinth well rectified, and, according as there is occaſion, ſtill freſh ſupplied. Or 3dly, whether thoſe, that are of a middle nature, as ſtrong ſpirit of vinegar. Or 4thly, whether inſtead of theſe, and beyond theſe, it may not be beſt to uſe only well-refined quickſilver.

All which ſeveral particulars, as they are neceſſary, and ought to be firſt aſcertained, yet they are but preliminary to the experiments themſelves.

In the making of theſe experiments themſelves, therefore, it would be convenient, 1ſt, That ſeveral thermometers of one proportion, length, and graduation in the cylinders in all reſpects, as near as may be, were ſet in one frame together, either with one and the ſame, or with variety of liquors. 2dly, That ſeveral of theſe frames were ſet in ſeveral rooms; and that ſome were expoſed immediately to the air itſelf; yet ſo as it may be conveniently ſheltered from the actual rays of the ſun, and from the injury of ſtorms, rain, and winds.

In the hiſtory itſelf there cannot be too much care and exactneſs; provided the air of the chimney, cranny of a wall or door, breath of people, or other ſuch accidents, do not interpoſe to deceive a man's obſervation, which muſt be circumſpectly foreſeen and conſidered.

The proportion between the warmth of the day and night in conſtant weather; the agreement or diſagreement of the motion of the air, with the motions of the ſuperior bodies, in all uncertain, changeable, and inconſtant weather; the efficacy or inefficacy through theſe in foretelling of winds and rain; the air its particular diſpoſition under thunder, under times of mildews or blaſtings, eminent eclipſes, conjunctions, with many other the like particulars, which will of themſelves be incident to an ingenious, diligent, apprehenſive perſon, may be the ſubject of this hiſtory.

I shall not digreſs ſo far, as to tell you, what other things may be done by the help of this excellent inſtrument, this being not pertinent to our preſent purpoſe.

Yet it is certain, that *Drebble*, that great, ſingular, learned mechanic, did, by the help of this inſtrument, make a dial continually to move of itſelf, regularly ſhewing both the time of the day, and other motions of the heavens; did alſo make an automatous inſtrument of muſic, and found out a furnace, which he could govern to any degree of heat: but whether theſe have died with him, or how far the meditations of others have wrought upon them, I ſhall humbly refer to a more leiſurable enquiry. And if you can inform me among any of your acquaintance or correſpondents, I ſhould be glad to hear and to learn any thing of this nature, or relating to the further uſe, experiment, or improvement of this rare little inſtrument, or to the further clearing, ventilating, or diſcuſſing the theory or doctrine of the planets, or the phyſical uſe and power of theſe bodies, that we have thus briefly made an eſſay of. Thus far that letter.

They have a received tradition in *Java*, and probably in divers other iſlands of the *South Sea*, that the beams of the moon are wont to cauſe contractures in the body of thoſe men, that ſtay too long expoſed to them: the truth of which tradition was lately confirmed to me by an ingenious doctor, that with applauſe practiſed phyſic in thoſe parts; who aſſured me, that he had obſerved, that upon the account beforementioned ſome were made lame, or elſe had ſome of their limbs contracted for divers weeks, and ſome for many months, or even a longer time. And when I aſked him, whether he had at any time been ſubject to that miſchief himſelf? he anſwered, that, whilſt he was a novice in thoſe parts, after a very hot day, he laid himſelf down, very ſlenderly covered, to ſleep (according to the cuſtom of the place) near the door of the houſe he lodged in; but, being unacquainted with the tradition, he unſkilfully choſe a place, upon which the moon could fully beat for a good part of the night, which being paſt before he waked, when he went to riſe, he found his neck ſo ſtiff, that he was ſcarce able at all to ſtir it; and his mouth was ſo drawn awry, that it was hideous to behold, and continued ſo unſightly, that ſhame forced him to keep within for ſome days, during which he made uſe of briſk aromatic medicines, by whoſe

whoſe help he got off a contracture, that uſed to ſtay very much longer with others. And when I aſked him, if theſe diſtempers were not occaſioned rather by the coldneſs of the night and ſubtility of the air, than the operation of the moon's beams? he anſwered me, that it was generally obſerved, that the other cauſes, without the direct beams of the moon, were not wont to produce ſuch bad effects; and that his landlord, when he ſaw his mouth awry, told him, that if he had made him acquainted with his deſign to paſs the night in the open air, he would have prevented this miſchief, by lodging him in a place unexpoſed to the moon's light.

TITLE XIV.

Of the Height of the Atmoſphere.

TITLE XV.

Of the Motion of the Air, and of Winds.

Extract of a Letter from Fort St. George, *dated* January 23, 1668.

ALTHOUGH the bar of *Porta Nova* proved more ſhallow and dangerous than we were informed, yet ſhe (our ſhip) got ſafe in thither; and it was well ſhe did ſo. Had we kept her here, there had been no poſſibility of her eſcape from periſhing in a dreadful ſtorm, or rather hurricane, which happened here the 22d of *November*; the like hath not been known here in any man's memory. The tempeſt of wind and rain was ſo exceeding violent, that nothing could ſtand before it; men and beaſts carried into the ſea by the violence of the winds and floods; the generality of the houſes in this and the neighbour towns were ruined; ſcarce any trees left ſtanding in gardens or elſewhere; the wall in this town laid flat in ſeveral places; your godowns and other houſes in and about the fort uncovered, and exceedingly ſhattered; no place in the fort, where we could keep our perſons, books or papers free from the wind or rain; nor ſcarcely any doors could ſtand againſt the violence of it; and we hourly feared the falling of the fort down upon us, it was ſo exceedingly rocked; and yet abroad we could have no ſhelter, nor were able to ſtand againſt it. The repairing of the damage will neceſſarily require a great charge, which at firſt we thought would have amounted to 3000 pagothes; but hope it will come ſhort thereof.

CAPTAIN *Brookehaven* told me, that about the iſland *Mauricius*, hurricanes were the moſt frequent of any place he knows; and that near that iſland he met with one which laſted four days in all: in one of which days the ſtorm had ſeven paroxyſms or exacerbations, which the ſeamen call frights of weather, each of which he obſerved to differ two points of the compaſs from the preceding, by which means the ſurface of the ſea, by the colliſion of the waves, became to be all white, as if the ſhip had been among rocks. He added, that the ſtorm made the day exceeding dark; and that the noiſe was rather like that of thunder, than of wind, inſomuch that thoſe on the ſhrouds could not hear thoſe on the deck.

A LEARNED phyſician, that travelled into *America*, affirmed to me, that thoſe countries

countries only have conſtant winds from the land in the night, which are furniſhed with hills; and therefore the *Barbadoes* wants ſuch winds, becauſe it has no hills.

One of the Eaſt-Indian committee, (who had lived years in the iſland of *Teneriff*) anſwered me, that he uſually obſerved there the breezes to come in from the ſea about nine of the clock in the morning, and that about two hours after ſun-ſet, there blew a ſharp land-wind, every way from the iſland to the ſea-ward, which continued all night till the next morning.

A LEARNED traveller anſwered me, that though the air were generally calm and clear at the top of the mountains, yet ſometimes he had met there with winds conſiderably ſtrong.

In Lettere di Venetia.

MARTEDI ſui li 29 Agoſto 1679, alle hore 19, incirca ſi leuolevò nelle paludi della villa di Fauis del dominio Ceſareo tre miglia lontana da Palma Nova dominio Veneto un vento chiamato Biſſa Boua, che allargandoſi per circa cinquanta paſſi ſcorſe con tanto empito, è furore, che portò per aria diverſi huomini, che tagliavano il fieno in quei prati, è anco alcuni carri carichi di fieno con ì buoui precipitandoli aſſai lontano con la rouina delli animali, de carri, è degli huomini, è paſſando per ì campi ſbarbicando ogni ſorte di piante le portò per aria gettandole molti paſſi lontano, rendendo la terra per oue ſcorſe coſi arſa, che parc non vi ſii mai ſtata piantata coſa alcuna. Arrivò nella villa detta Bagnaria del dominio Veneto doue gettò à terra molte caſe ſino à fondamenti, et altre diſcoperſe, è rouinò portando per ari atavole, travi, et ogni altra coſa che era dentro eſſe caſe reſtando mal trattate molte perſone ſenza però la morte di alcuno.. Fuori di dettata villa vi è una chieſa chiamata S. Tomaſo, la quale reſto ſcoperta, è rouinata una parte del muro portando via il campanile, è campane che nel giorno ſeguente non ſi erano per anco trovate;—di là ſi portò verſo Senigliano dominio Veneto, è rouinò tutta la campagna ſenza danno però della villa, mentre li paſsò poco lontano, è girando poco lungi dalla villa ſteſſa ſpiantò da fondamenti un palazzo del d. co. Horatio Straſoldo, nel quale gli amazzò ogni ſorte di animali che vi erano, portando per aria li mobili è ſino le botti, eſterminando parre della poſſeſſione. Non reſtorono però offeſe perſone, perche erano alla campagna à lavorare, è nel camino getto pure à terra due altre caſe che ſono nel taglio per andare à ſtraſoldo ſpiantandole affatto con la morte di una donna, d'un fanciullo, è diverſi animali.

Di là voltò verſo Palma, et arrivando ſino alle mura della fortezza giò verſo la villa di Privano mezo miglio diſtante quale rouinò la meta, ſpiantando da fondamenti beliſſimi palazzi, portando per aeria travi, tavole, et ogni altra coſa con la morte di molti, quantità di feriti, è diverſi ſtrapazzati con far alla campagna di molto male. Di poi ſcorſe nella villa di Viſco dominio Imperiale, è tra li altri danni fatti rouinò tutto il palazzo novo del D. Marco Foſcolini gentilhuomo di Cinidal, nel quale eſſendoni una gran remiſſa da Carozze, la di cui porta havena tre Cadenazzi, & entrando il turbine per li balconi gettò la carozza con tanto empito nella porta ſteſſa che la ruppe, è portò fuori la carozza tutta fracaſſata gettandola ſopra un muro della corte aſſa alto, portando il cielo della ſteſſa mezzo miglio lontano, è vertò nel medemo palazzo ferito, è mel trattato un ſervitore di eſſo foſcolini, di cui rouino pure una braida, & un brolo eſſendo in detta villa reſtati due morti, è diverſi feriti;—s' inoltrò poi nella villa di S. Vido di Crauglio ſtato Imperiale, la quale rouino tutta affatto ſenza reſtarvi nemeno una caſa, portando per aria coppi, travi, legne, ſaſſi, è mobili con la morte di moltiſſime perſone, è moltiſſimi feriti è rouinati, et in detta villa non ſi può andare, ne con carri, ne con cavalli per la grande moltitudine di rouinazzo, arbori et altro che hanno attraver-ſato le ſtrade, eſſendo rimaſſi morti gran numero di animali—.

Da queſto luoco ſi portò verſo villes villa Imperiale buona parte della quale gettò à terra

per

per andar al territorio di Monſalcone con la morte di molte perſone, et quantità di animali con laſciar le campagne per dove è paſſata ſenza piante, è come ſtrada battuta——.

Hà danneggiato anco altre ville, ma leggiermenre, ne per anco ſi sà quello haverà fatto piu avanti nel detto territorio.

Queſto ſucceſſo hà laſciato un ſpavento grande in queſte parti, eſſendoſi vedute coſe incredibili mentre pioveuano ſaſſi, tavole, arbori, travi, coppi, huomini, donne, fanciulli, botti, ſorghi, uva, galline, animali, et in concluſione ciò che incontrava portava per aria con un rumore, è fracaſſo così gradne, che faceva terrore, eſſendo per dette ville un concorſo grande di popolo vicino per vedere coſe che, ſi rendono incredibili.

Doctor *B.* anſwered me, that though the eaſtern winds blew near $\frac{1}{4}$ of a year at *Tangier*, yet they ſeem not to reach far into the inland country, where he obſerved them to be very unfrequent.

An ingenious gentleman, who is owner of a mine or two near the ſea, being aſked by me, whether he could by any peculiar change appearing in the deeper parts of the mines, foretel any alterations of weather? he anſwered me, that the only preſage he had conſtantly obſerved, was of the change of the wind. For many hours before the wind was to ſhift from ſome other corner, and get into the ſouth, the water at the bottom of the mine would appear manifeſtly more troubled, or leſs limpid than before: and when the wind was to blow from the eaſt, he was uſually forewarned of it by an unuſual degree of clearneſs in the waters, which would appear more diaphanous than ordinary, though the ſouth wind had not immediately before operated on the waters. The depth of the mine was between fifteen and twenty fathom.

He told me, that the hurricanes about *Goa* are obſerved to come uſually but at two ſeaſons, about the beginning of *March*, and the 4th of *October*.

TITLE XVI.

Of the Air as the Medium of Sounds, and of Sounds and Noiſes in the Air, and particularly Thunder; and of the Air's Operation on the Sounds of Bodies.

THIS variety of the air is the cauſe of moſt dreadful thunders; which when *Gregory* deſcribed, he aſtoniſhed his hearers. For upon the riſing of ſeveral tempeſts, all together, the ſky is of a ſudden covered over with black and thick, as it were, globes of ſmoky clouds: by and by the thunder breaks forth on every ſide, rattling continually with lightning, as inceſſantly flaſhing, enough to amaze the moſt reſolute and moſt accuſtomed to the noiſe. *Ludolph*'s *Hiſt. of Ethiop.* L. I. c. 5.

The ſtring of a viol has been by Mr. *F.* obſerved to give a ſharper ſound againſt or in rainy weather, by almoſt half a note.

Mr. *F.* alſo aſſures me, that more than once or twice it has happened to him, that having put up falſe ſtrings in his pocket, to make frets of, as judging them uſeleſs for any other purpoſe, the want of ſtrings having driven him to make uſe of thoſe, he has found them not falſe any more, but good ſtrings. And alſo that he obſerves ſome ſtrings apter to receive a tenſion from the moiſt air, than others are.

TITLE

TITLE XVII.

Of the Weight of the Air.

A ſhort Account of the ſtatical Baroſcope, imparted by Mr. Boyle *March* 24, 1665. *In a Letter to Mr.* H. Oldenburg.

AS for the new kind of Baroſcopes, which not long ago * I intimated to you, that my haſte would not permit to give you an account of, ſince your letters acquaint me, that you ſtill deſign a communicating to the curious as much information as may be, in reference to baroſcopes, I ſhall venture to ſend you ſome account of what I did not name (in my former letter) to you.

THOUGH by a paſſage you may meet with in the 19th and 20th pages of my *Thermometrical Experiments and Thoughts*, you may find, that I did ſome years ago think upon this new kind of baroſcope; yet the changes of the atmoſphere's weights not happening to be then ſuch as I wiſhed, and being unwilling to deprive myſelf of all other uſe of the exacteſt balance †, that I (or perhaps any man) ever had, I confeſs to you, that ſucceſſive avocations put this attempt for two or three years out of my thoughts; till afterwards returning to a place, where I chanced to find two or three pair of ſcales I had left there, the ſight of them brought it into my mind; and though I were then unable to procure exacter, yet my deſire to make the experiment ſome amends for ſo long a neglect, put me upon conſidering, that if I provided a glaſs bubble, more than ordinary large and light, even ſuch balances as thoſe might in ſome meaſure perform what I had tried with the ſtrangely nice ones above-mentioned.

I CAUSED then to be blown at the flame of a lamp ſome glaſs bubbles as large, thin, and light, as I could then procure; and chooſing among them one, that ſeemed the leaſt unfit for my turn, I counterpoiſed it in a pair of ſcales, that would loſe their æquilibrium with about the 30th part of a grain, and were ſuſpended at a frame. I placed both the balance and the frame by a good baroſcope, from whence I might learn the preſent weight of the atmoſphere. Then leaving theſe inſtruments together, though the ſcales being no nicer than I have expreſſed, were not able to ſhew me all the variations of the air's weight, that appeared in the mercurial baroſcope; yet they did what I expected, by ſhewing me variations no greater than altered the height of quickſilver half a quarter of an inch, and perhaps much ſmaller than thoſe: nor did I doubt, that if I had had either tender ſcales, or the means of ſupplying the experiment with convenient accommodations, I ſhould have diſcerned far ſmaller alterations of the weight of the air, ſince I had the pleaſure to ſee the bubble ſometimes in an æquilibrium with the counterpoiſe; ſometimes, when the atmoſphere was high, preponderate ſo manifeſtly, that the ſcales being gently ſtirred, the cock would play altogether on that ſide at which the bubble was hung; and at other times (when the air was heavier) that which was at the firſt but the counterpoiſe, would preponderate, and upon the motion of the balance, make the cock vibrate altogether on its ſide. And this would continue ſometimes many days together, if the air ſo long retained the ſame meaſure of gravity; and then (upon other changes) the bubble would regain an æquilibrium, or a preponderance; ſo that I had oftentimes the ſatisfaction, by look-

* See number 11. p. 185. of the Philoſophical Tranſactions.

† The ſcales here meant were before competent eye-witneſſes made to turn manifeſtly with the thouſandth part of a grain.

ing

ing firſt upon the ſtatical baroſcope (as for diſtinction's ſake it may be called) to foretel, whether in the mercurial baroſcope the liquor were high or low. Which obſervations, though they hold as well in winter, and ſeveral times in ſummer, (for I was often abſent during that ſeaſon) as the ſpring, yet the frequency of their viciſſitudes (which perhaps was but accidental) made them more pleaſant in the latter of theſe ſeaſons.

So that the matter of fact having been made out by variety of repeated obſervations, and by ſometimes comparing ſeveral of thoſe new baroſcopes together, I ſhall add ſome of theſe notes about this inſtrument, which readily occur to my memory, reſerving the reſt till another opportunity.

And firſt, if the ground, on which I went in framing this baroſcope, be demanded, the anſwer in ſhort may be, 1. That though the glaſs bubble, and the glaſs counterpoiſe, at the time of their firſt being weighed, be in the air, wherein they both are weighed, exactly of the ſame weight, yet they are nothing near of the ſame bulk; the bubble, by reaſon of its capacious cavity (which contains nothing but air, or ſomething that weighs leſs than air) being perhaps a hundred or two hundred times (for I have not conveniency to meaſure them) bigger than the metalline counterpoiſe. 2. That according to a hydroſtatical law (which you know I have lately had occaſion to make out) if two bodies of equal gravity, but unequal bulk, come to be weighed in another medium, they will be no longer equiponderant; but if the new medium, be heavier, the greater body, as being lighter in ſpecie, will loſe more of its weight, then the leſſer and more compact; but if the new medium be lighter than the firſt, then the bigger body will outweigh the leſſer: and this diſparity ariſing from the change of mediums, will be ſo much the greater, by how much the greater inequality of bulk there is between the bodies formerly equiponderant. 3. That laying theſe two together, I conſidered, that it would be all one as to the effect to be produced, whether the bodies were weighed in mediums of differing gravity, or in the ſame medium, in caſe its (ſpecifick) gravity were conſiderably altered: and conſequently, that ſince it appeared by the baroſcope, that the weight of the air was ſometimes heavier, and ſometimes lighter, the alterations of it, in point of gravity, from the weight it was of at firſt counterpoiſing of the bubble of it, would unequally affect ſo large and hollow a body as the bubble, and ſo ſmall and denſe a one as a metalline weight: and when the air by an increaſe of gravity ſhould become a heavier medium than before, it would buoy up the glaſs more than the counterpoiſe; and if it grew lighter than it was at firſt, would ſuffer the former to preponderate: (the illuſtrations and proof can ſcarce be added in few words; but, if it be deſired, I may, God permitting, ſend you them at my next leiſure.) And though our Engliſh air be about a thouſand times lighter than water, the difference in weight of ſo little air, as is but equal in bulk to a bubble, ſeemed to give ſmall hopes, that it would be ſenſible upon a balance; yet by making the bubble very large and light, I ſuppoſed and found the event I have already related.

Secondly, the hermetically ſealed glaſs bubble I employed, was of the bigneſs of a ſomewhat large orange, and weighed about 1 drachm and 10 grains. But I thought it very poſſible, if I had been better furniſhed with conveniencies (wherein I afterwards found I was not miſtaken) to make among many, that might be expected to miſcarry, ſome that might be preferable to this, either for capacity or lightneſs, or both, eſpecially if care be taken, that they be not ſealed up whilſt they are too hot. For though one would think, that it were advantageous to rarify and drive out the air as much as is poſſible, becauſe in ſuch ſealed bubbles the air itſelf (as I have elſewhere ſhewn) has a weight; yet this advantage countervails not the inconvenience of

being obliged to increaſe the weight of the glaſs, which when it includes highly rarified air, if it be not ſomewhat ſtrong, will be broken by the preſſure of the external air, as I have ſufficiently tried.

THIRDLY, I would have tried, whether the dryneſs and moiſture of the air would in any meaſure have altered the weight of the bubble, as well as the variation of gravity produced in the atmoſphere by other cauſes; but the extraordinary conſtant abſence of fogs, kept me from making obſervations of this kind, ſave that one morning early, being told of a miſt, I ſent to ſee (being myſelf in bed) whether it made the air ſo heavy as to buoy up the bubble, but did not learn, that that miſt had any ſenſible operation on it.

FOURTHLY, by reaſon of the difficulties and caſualties, that may happen about the procuring and preſerving ſuch large and light bubbles, as I have been lately mentioning, it may in ſome caſes prove a convenience to be informed, that I have ſometimes, inſtead of one ſufficiently large bubble, made uſe of two, that were ſmaller. And though a ſingle bubble of competent bigneſs be much preferable, by reaſon, that a far leſs quantity and weight of glaſs is requiſite to compriſe an equal capacity, when the glaſs is blown into a ſingle bubble, than when it is divided into two; yet I found, that the employing of two inſtead of one did not ſo ill anſwer my expectations, but that they may for a need ſerve the turn inſtead of the other, than which they are more eaſier to be procured: and if the balance be ſtrong enough to bear ſo much glaſs, without being injured, by employing two or a greater number of large bubbles, the effect may be more conſpicuous, than if only a ſingle bubble (though a very good one) were employed.

THIS inſtrument may be improved by divers accommodations. As

FIRST, there may be fitted to the anſa (or checks of the balance) an arch (of a circle) divided into 15 or 20 deg. (more or leſs, according to the goodneſs of the balance) the cock reſting over-againſt theſe diviſions, may readily, and without calculation, ſhew the quantity of an angle, by which, when the ſcales propend either way, the cock declines from the perpendicular, and the beam from its horizontal paralleliſm.

SECONDLY, thoſe that will be ſo curious, may inſtead of the ordinary counterpoiſe (of braſs employ one of gold, or at leaſt of lead, whereof the latter being of equal weight with braſs, is much leſs in bulk, and the former amounts not to half its bigneſs.

THIRDLY, thoſe parts of the balance, that may be made of copper or braſs, without any prejudice to the exactneſs, will, by being made of one of thoſe metals, be leſs ſubject than ſteel, (which yet, if well hardned and poliſhed, may laſt a great while) to ruſt with long ſtanding.

FOURTHLY, inſtead of the ſcales, the bubble may be hung at one end of the beam, and only a counterpoiſe to it at the other, that the beam may not be burthened with unneceſſary weight.

FIFTHLY, the whole inſtrument, if placed in a ſmall frame, like a ſquare lanthorn with glaſs windows, and a hole at the top for the commerce of the internal and external air, will be more free from duſt, and irregular agitations; to the latter of which it will otherwiſe be ſometimes incident.

SIXTHLY, this inſtrument being accommodated with a light wheel and an index, (ſuch as have been applied by the excellent Dr. *Chr. Wren* to open weather glaſſes, and by the ingenious Mr. *Hook* to baroſcopes) may be made to ſhew much more minute variations than otherwiſe.

SEVENTHLY, and the length of the beam, and exquiſiteneſs of the balance, may eaſily,

eaſily, without any of the foregoing helps, (and much more with them) make the inſtrument far exacter than any of thoſe I was reduced to employ. And to theſe accommodations divers others may be ſuggeſted, by a farther conſideration of the nature of the thing, and a longer practice.

THOUGH in ſome reſpects this ſtatical baroſcope be inferior to the mercurial, yet in others it has its own advantageous conveniencies above it.

AND firſt, it confirms *ad oculum* our former doctrine, that the falling and riſing of the mercury depends upon the varying weight of the atmoſphere; ſince in this baroſcope it cannot be pretended, that a fuga vacui, or a funiculus, is the caſe of the changes we obſerve. 2. It ſhews, that not only the air has weight, but a more conſiderable one, than ſome learned men, who will allow me to have proved it has ſome weight, will admit; ſince even the variation of weight in ſo ſmall a quantity of air, as is but equal in bulk to an orange, is manifeſtly diſcoverable upon ſuch balances as are none of the niceſt. 3. This ſtatical baroſcope will oftentimes be more parable than the other; for many will find it more eaſy to procure a good pair of gold-ſcales, and a bubble or two, than a long cane ſealed, a quantity of quickſilver, and all the other requiſites of the mercurial baroſcopes; eſpecially if we compriſe the trouble and ſkill, that is requiſite to free the deſerted part of the tube from air. 4. And whereas the difficulty of removing the mercurial inſtrument has kept men from ſo much as attempting to do it, even to neighbouring places, the eſſential parts of the ſcale baroſcope (for the frame is none of them) may very eaſily in a little room be carried whither one will, without the hazard of being ſpoiled or injured. 5. There is not in ſtatical baroſcopes, as in the other, a danger of uncertainty as to the goodneſs of the inſtruments, by reaſon, that in theſe the air is, in ſome more, and in ſome leſs perfectly excluded; whereas in thoſe, that conſideration has no place. (And by the way, I have ſometimes upon this account been able to diſcover by our new baroſcope, that an eſteemed mercurial one, to which I compared it, was not well freed from air.) 6. It being, as I formerly intimated, very poſſible to diſcover hydroſtatically, both the bigneſs of the bubble, and the contents of the cavity, and the weight and dimenſions of the glaſſy ſubſtance, (which together with the included air make up the bubble) much may be diſcovered by this inſtrument as to the weight of the air, abſolute or reſpective. For when the quickſilver in the mercurial baroſcope is either very high, or very low, or at a middle ſtation between its greateſt and leaſt height, bringing the ſcale barometer to an exact æquilibrium; (with very minute diviſions of a grain) you may, by watchfully obſerving, when the mercury is riſen or fallen juſt an inch, or a fourth, or half an inch, *&c.* and putting in the like minute diviſions of a grain to the lighter ſcale, till you have again brought the balance to an exquiſite æquilibrium; you may, I ſay, determine, what known weight in the ſtatical baroſcope anſwers ſuch determinate altitudes of the aſcending and deſcending quickſilver in the mercurial. And if the balance be accommodated with a divided arch, or a wheel and index, theſe obſervations will aſſiſt you for the future to determine readily, by ſeeing the inclination of the cock, or the degree marked by the index, what pollency the bubble hath by the change of the atmoſphere's weight, acquired or loſt. Some obſervations of this nature I watchfully made, ſometimes putting in a 64th, ſometimes a 32d, ſometimes a 16th, and ſometimes heavier parts of a grain, to the lighter ſcale. But one, that knew not for what uſes thoſe little papers were, coming to a window, where my baroſcopes ſtood, ſo unluckily ſhook them out of the ſcales, and confounded them, that he robbed me of the opportunity of making the nice obſervations I intended, though I had the ſatisfaction of ſeeing, that they were to be made.

7. By this ſtatical inſtrument we may be aſſiſted to compare the mercurial baroſcopes of ſeveral places (though never ſo diſtant) and to make ſome eſtimates of the gravities of the air therein. As if, for inſtance, I have found by obſervation, that the bubble I employ, (and one may have divers bubbles of ſeveral ſizes, that the one may repair any miſchance, that may happen to another) weighed juſt a drachm, when the mercurial cylinder was at the height of $29\frac{1}{4}$ inches, (which in ſome places I have found a moderate altitude;) and that the addition of the 16th part of a gr. is requiſite to keep the bubble in an æquilibrium, when the mercury is riſen an 8th, or any determinate part of an inch above the former ſtation: when I come to another place, where there is a mercurial barometer, as well freed from air as mine (for that muſt be ſuppoſed) if taking out my ſcale inſtrument, it appear to weigh preciſely a drachm, and the mercury in the baroſcope there ſtand at juſt $29\frac{1}{4}$ inches, we may conclude the gravity of the atmoſphere not to be ſenſibly unequal in both thoſe places, though very diſtant. And though there be no baroſcope there, yet if there be an additional weight, as for inſtance, the 16th part of a grain, requiſite to be added to the bubble, to bring the ſcales to an æquilibrium, it will appear, that the air at the ſecond place is at that time ſo much heavier, than the air of the former place was, when the mercury ſtood at $29\frac{1}{4}$ inches.

But in making ſuch compariſons, we muſt not forget to conſider the ſituation of the ſeveral places, if we mean to make eſtimates, not only of the weight of the atmoſphere, but of the weight and denſity of the air. For though the ſcales will ſhew (as has been ſaid) whether there be a difference of weight in the atmoſphere at the two places; yet, if one of them be in a vale or bottom, and the other on the top or ſome elevated part of a hill, it is not to be expected, that the atmoſphere in this latter place ſhould gravitate as much as the atmoſphere in the former, on which a longer pillar of air does lean or weigh.

And the mention I have made of the differing ſituation of places, puts me in mind of ſomething, that may prove another uſe of our ſtatical baroſcope, and which I had thoughts of making trial of, but was accidentally hindered from the opportunity of doing it. Namely, that by exactly poiſing the bubble at the foot of a high ſteeple or hill, and carrying it in its cloſe frame to the top, one may, by the weight requiſite to be added to counterpoiſe there, to bring the beam to its horizontal poſition, obſerve the difference of the weight of the air at the bottom and at the top; and in caſe the hill be high enough, at ſome intermediate ſtations. But how this may aſſiſt men to eſtimate the abſolute or comparative height of mountains, and other elevated places; and of what other uſes the inſtrument may be put to when it is duly improved; and the cautions, that may be requiſite in the ſeveral caſes, that ſhall be propoſed, I muſt leave to more leiſure, and farther conſideration.

Weight of a cubick inch of water.

I caused to be made with great care, by a ſkilful mathematical inſtrument-maker, a hollow cube of braſs, whoſe every ſide was as exactly as could be procured an Engliſh inch. This we carefully counterpoiſed in a very good pair of ſcales, and found it to weigh 11 drachms, 1 grain and $\frac{1}{2}$ (Troy-weight:) then placing it in one of the ſcales as horizontally as we were able, we warily filled it with clear common water, (of the beſt ſort of that called pump-water) till the ſurface of the water ſeemed to lye as level as we could make it, to the brims of the veſſel: then weighing it carefully, we found the water alone (for the cube had been counterpoiſed before) to weigh to $254\frac{7}{10}$ grains: ſo that in regard it is ſcarce poſſible to know, that ſuch a veſſel is ſo filled, as to come nearer exactneſs, than within a drop or two, I preſume we may, without any ſenſible error, ſuppoſe an inch of water to weigh 256 grains, which latter number I rather chuſe, becauſe its aliquot parts make it more convenient, and it agrees

agrees well enough with ſome trials, that I made with ſolid cubes, to meaſure the true weight of a cubick inch of water.

THIS done, the veſſel was well dried within, and the ſame ſcales being well counterpoiſed, the inſtrument was ſo too; and being placed on one of the ſcales as horizontally as we could, mercury (diſtilled to have it more pure) was warily put into it, till by degrees it had filled the veſſel as to ſight; but we neither expected, nor found, that it would be brought to an exact level, and exquiſitely fill all the corners of the veſſel. But when it ſeemed to be ſo well filled, that even a critical eye could not readily find fault with it, though the mercury appeared capable of ſome acceſſion without overflowing, we weighed the quickſilver itſelf (for the veſſel had been counterpoiſed before) and found it to weigh 7 ounces, 2 drachms (Troy) which falling ſomewhat ſhort, (though not very much) of what the above-mentioned weight of the water required, we tried to add a little more quickſilver, without making it run over, and found the encreaſe of 82 grains; ſo that now the quickſilver weighed 7 ounces, 3 drachms, 22 grains; but it ſeemed when the eye was placed in a level with the brims of the veſſel, that it was rather a little of the higheſt, than any way depreſſed, and yet was not ſo full, but that we could add 112 grains to the former weight, without making it run over; and perhaps we might have added yet more, but I declined doing it, becauſe the laſt mentioned acceſſion ſeemed manifeſtly to make it ſo much ſwell above the brims of the veſſel. By all which it is evident, that it is ſcarce poſſible to determine preciſely, by ſuch hollow inſtruments, the true weight of a cubick inch of quickſilver. And therefore, ſince by other ways of trial, I have found the proportion of the weight of mercury to water of the ſame bulk, to be ſomewhat leſs than that of 14 to 1, I think we may, without any conſiderable inconvenience, ſuppoſe the weight of a cubick inch of quickſilver to be 3580 grains, which is near 14 times the above-mentioned weight of a cubick inch of water, and comes near enough to the ſecond or middlemoſt of the three eſtimates lately ſet down; and by the leaſt eſtimate of all it appears, that a cubick inch of quickſilver weighs $7\frac{1}{4}$ ounces troy weight, that is, 8 ounces averdupois weight: and conſequently when the quickſilver of the baroſcope, kept up by the counterpoiſe of the air 30 inches, (as I have obſerved it ſeveral times to be within a month laſt paſt) the weight of the air, that is incumbent on an inch ſquare here below, amounts to $18l.\frac{1}{4}$ troy weight; that is in averdupois weight $15l.\frac{1}{17}$.

The weight of a cubick inch of quickſilver.

The weight of a piliar of the atmoſphere.

As 11 to 14, or rather as 355 to 452, ſo is the area of a ſquare inſcribed in a circle to the area of the circumſcribed circle.

HENCE 355 : 452 : : 1 : 1,2732394.

HENCE if the ſide of an inſcribed ſquare be an inch, that multiplied by an inch renders a cubick inch for the ſolid content.

IN like manner if the height of a cylinder erected on the circumſcribing circle be an inch, the ſolid content of that cylinder is 1,2732394.

WHEREFORE 1, and 1,2732394 multiplied by the weight of the cubick inch of any kind of metal, give the weight of a cubick inch, and of a cylindrick inch, that circumſcribes the ſame, whence an inch table for both is eaſily made by continual addition, or for any height propounded, multiplying both by the ſame.

Mr.

Mr. *Townly*'s Regiſter, if I miſremember not.

November	23	2			28. 98
	24	8			29. 54
		9	p		28. 90
	25	3½			80
	27	9			99
	29	9			28. 97
		9	p		29. 09
October	6	9	p		28. 97
	7	9			60
	8	9			29. 05
	11	9			28. 93
		3	p		29. 01
	13	8½			28. 90
		9	p		95
	25	9	p		29. 04
	26	9	p		28. 32
	28	10	p		29. 13
January	1	9	p		28. 99
	2	9			82
	3	9			29. 08
		9	p		06
	5	10			28. 70
	6	10			29. 09
		9½	p		28. 62
	7	8			28. 99
	12	10			28. 88
		4	p		98
	16	1			29. 13
		9	p		28. 65
	17	10			14
	21	9½			29. 05
	22	4			28. 99
		9	p		94
	23	9			99
	24	11	p		29. 06
	25	9			28. 50
		9	p		29. 10

	29	9			28. 90
		9	p		71
	30	8			80
February	31	9	p	30. 12	
	1	12		22	
	2	8½		29. 97	
	15	9	p		28. 99
	16	9	p		95
	17	8			29. 10
March	2	9	p		28. 98
	4	8½			78
		9			86
	12	9			28. 80
		9	p		66
	13	8½			29. 03
1671 *April*	1	6	p		28. 29
	2	6	p		78
	3	8½			29. 03
June	8	1			29. 18
		8	p		28. 86
	9	7			99
August	12	6			28. 90
September	6	8½			29. 15
	7	10½			28. 65
	8	7½			29. 05
	12	9½			28. 98
	29	8			28. 96
		3	p		29. 08
October	30	9	p		29. 19
	1	10			28. 63
	3	8			29. 10

In all thoſe papers the mercury was ſtill about 12 of one inch higher than is ſet down, for the numbers ſignify only bottom of the cap.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather at *Oxford.*
1666. *June*	24	9	70	29		N E 2	Fair.
		22	76	29 1			Fair.
	25	4	73	29 1		N E 1	Fair.
		10	74	29 1		E 1	Fair.
		15	77	29 1		S E 2	Fair.
	26	9	73	28 8		N 1	Fair.
		12	75	28 7		N E 1	Thunder.
		13	75	28 7		S W 4	Thunder, Rain, Hail.
		14	74	28 8		N 4	Thunder, Rain.
		18	73	28 8		N 1	Clouds, dry.
		22	72	28 8			Fair.
	27	7	70	28 8		N W 1	Rain.
		9	70	28 2		N W 1	Rain.
		16	68	28 8		W 1	Fair.
	28	9	63	29 1		W 0	Clouds.
		17	67	29 1		N 1	Clouds.
	29	9	63	29 2		N 1	Clouds.
		19	69	29 1		N 1	Clouds.
	30	9	64	29 2		N 0	Clouds
		20	64	29 2		N 1	Fair.
July	1	9	57	29 4		W 2	Fair.
	2	11	63	29 3		W 1	Clouds.
		21	67	29 2		.	Rain.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *July*	3	9	66.	29 1		W 1	Clouds.
		22	66.	29 1			Clouds.
	4	11	64.	28 8		W 0	Clouds.
		17	68.	28 7		S E 2	Clouds.
	5	9	65.	28 7		S W 2	Clouds.
		23	65.	28 7		S W 2	Rain.
	6	9	63.	29 1		W 1	Fair.
		16	67.	29 1		S W 1	Clouds.
	7	9	67.	29 1		S 2	Fair.
		23	72.	28 7			Lightning.
	8	9	70.	28 8		S W 2	Clouds.
	9	9	66.	29 2		S W 2	Fair.
	10	9	66.	29 1		S 2	Clouds.
	11	10	67.	29 1		S 2	Clouds.
	12	10	66.	29 2		S 2	Fair.
	13	10	66.	29 3		W 1	Fair.
	14	3	75.	28 8		S W 2	Clouds.
	15	9	67.	29 1		S W 1	Fair.
	16	11	70.	29 1		S W 2	Fair.
	17	5	71.	28 8		E 0	Clouds after Rain.
		19	71.	28 8		W 1	Rain.
	18	7	62.	29 2		S W 2	Fair.
		9	64.	29 2		S W 2	Fair.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *July*	19	9	65.	29 3.		S W 2	Cloudy.
	20	12	67.	29 4.		W 1	Fair.
	21	8	64.	29 4.		W 1	Fair.
	22	9	67.	29 3.		S W 1	Fair.
	23	9	67.	29 2.		E 1	Thunder. Rain.
		15	71.	29 1.		N E 1	Fair.
		17	71.	29 1.		E 1	Rain.
		21	69.	29 2.		1	Clouds, Lightning.
	24	9	67.	29 2.		N 1	Clouds.
	25	9	67.	29 2.		N 1	Clouds.
	26	6	64.	29 3.		N 1	Cloſe.
	30	23	69.	29 3.	15		Fair.
	31	7	67.	29 3.	15	N W 0	Fair.
Auguſt	15	10	60	29 2.	20		Clouds.
	16	9	59.	29 2.	19	N 1	Fair.
	29	21	64	29 2.	19		
	30	9	59	29 3.	19	N 0	Fair.
	31	7	61.	29 3.	20	N E 0	Fair.
		9	61.	29 3.	20	N E 1	Fair.
September	1	6	55	29 3.	17	N E 1	Fair.
		9	55	29 3.	17	E 2	Clouds.
	2	9	52.	29 3.	16	E 3	Clouds.
	3	9	49.	29 4.	16	E 2	Fair.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *September*	4	9	47.	29 3.	15	E 1	Fair.
		13	50.	29 3.	15	E 2	Dim reddiſh Sun-ſhine *.
		20	51.	29 2.	14		

* This unuſual colour of the air, which, without a cloud appearing, made the ſun-beams of a ſtrange red dim light, was very remarkable. We had then heard nothing of the fire of *London:* but it appeared afterwards to be the ſmoke of *London* then burning, which, driven this way by an eaſterly wind, cauſed this odd phænomenon.

d	h	Th.	Bar.	Hy.	Wind.	Weather.
5	22	49.	29 1.			
6	9	44.	29 2.	15	N E 1	Fair.
8	9	44.	29 4.	15	N E 1	Fair.
9	9	46.	29 4.		S W 1	Thick, Sun.
	17	52.	29 2.	18	S 2	Rain.
	22	53.	29 --.	20	2	Rain.
10	9	52.	28 8.	20	S W 3	Fair.
	16	56.	28 8.	20	W 2	Rain.
11	11	53	28 8.	22	S W 2	Cloudy.
12	9	52	29 --.	23	S 3	Cloſe.
13	9	50.	29 2.	23	W 2	Fair.
14	9	53.	29 1.	23	S E 2	Fair.
15	10	57.	29 1.	27	N E 1	Cloſe.
	11	57.	29 1.	28	N E 1	Rain.
	23	61.	29 1.	35		Fair.
16	9	59.	28 8.	34	E —	Miſt.
	21	61.	28 7.	37		Rain.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *September*	17	9	54	28 8	35	NW 1	Cloſe.
		22	49	28 1	30		Rain.
	18	9	42	28 8	37	N E 4	Cloſe after Rain.
		11	43	29 1	36	E N 3	Cloſe.
		18	44	29 2	35	E N 3	Cloſe.
		17	45	29 3	35	E 2	Fair.
		23	45	29 4	35	0	Fair.
	19	9	41	29 5	35	N 1	Fair.
	20	9	46	29 4	37	N 1	Cloſe.
	21	8	47	29 3	36	0	Thick Miſt.
		22	52	29 4	38	0	Fog.
	22	10	84	29 4	37	S W 1	Cloſe.
	23	9	46	29 5	37	W 0	Clouds.
	24	8	49	29 4	38	S W 1	Fair.
		21	55	29 2	39	2	Fair, h. 19 few drops.
	25	6	53	29 1	38	S 1	Clouds.
		10	54	28 8	39	S 3	Rain.
		21	50	29 1	38	0	Fair.
	26	8	49	28 7	39	W 3	Cloſe.
	27	9	48	29 2	37	W 3	Fair.
		23	48	29 4	36	2	Fair.
	28	7	45	29 5	36	W 2	Fair.
		19	47	29 4	37	2	Rain.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *September*	29	7	51	29 4	40	W N 1	Rain.
		12	53	29 5	38	W N 2	Fair.
		18	53	29 5	35	N W 0	Fair.
	30	9	48	29 6	37	W S 0	Clouds.
		21	57	29 5	46	2	Fair.
October	1	8	54	29 5	45	S 1	Clouds.
		19	61	29 5	43	0	Fair.
	2	9	56	29 5	44	S W 2	Cloſe.
	3	7	54	29 5		S W 0	Cloſe.
November	25	10	32	29 1			
	26	9	31	29 2		0	Thick Fog.
		18	31	29 1		0	Fog.
	27	11	33	29 1		W 0	Fair.
		18	34	29 2		0	Clouds.
		22	34	29 2		2	Clouds.
	28	10	39	28 7	63	S W 2	Rain.
		21	36	28 7	62	2	Fair.
	30	9	31	28 7	60	W S 2	Fair.
		22	31	29 1	61		Fair.
December	1	9	29	29 3	61	W 0	Fair.
		22	29	29 4	61	0	Fair.
	2	9	27	29 2	60	S E 2	Clouds, Thaw.
	3	9	27	28 7	60	E 1	Clouds.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *December*		17	27	29 7	61	o	Rain.
	4	9	26	28 8	60	S E o	Thick Fog.
		12	26	28 8	61	S 1	Snow.
	5	9	30	28 6	63	S 1	Hard Rain.
		21	34	28 6	63	2	Fair.
	6	9	34	29 1	64	W S 1	Fair.
		18	36	29 1	64	o	Small Rain.
	7	9	32	29 3	63	W o	Fair.
	8	9	32	29 3	65	W S 3	Small Rain.
		23	35	29 3	64	o	Rain hard.
	9	9	31	29 1	63	N 2	Hard Snow.
		17	29	29 1	63	o	Fair.
	10	21	26	29 5	63		Fair.
	11	9	24	29 5	63	W N 1	Hard Froſt, Fair.
		21	21	29 5	60	2	Fair.
	12	9	20	29 6	59	N 1	Fair, hard Froſt.
	13	10	21	29 6	61	N 1	Fair, hard Froſt.
	14	9	22	29 6	63	N W 1	Little Miſt, and ſlow Thaw.
		11	24	29 5	63	N W 2	Clouds, Thaw.
	15	9	25	29 6	64	N 1	Fair, little Thaw.
	16	9	24	29 6	63	N E o	Fog, hoar Froſt.
		17	24	29 6	63	N E o	Thaw, Clouds.
	17	9	22	29 6	63	N o	Clouds, hard Froſt.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *December*		22	23	29 5	64		Thaw, Clouds.
	18	10	24	29 5	65	N 2	Small miſty Rain.
		21	24	29 5	64		Small Rain.
	19	9	23	29 5	64	N W	Small Snow, Thaw.
	20	9	23	29 5	64	N 2	Miſt, Thaw.
		22	22	29 5	64	0	Fair, freeze.
	21	10	20	29 3	63	S W 2	Hard Froſt. Clouds.
		21	22	29 2	63	1	Snow.
	22	9	22	29 2	63	N W	Clouds, no Thaw.
		22	21	29 2	63		Froſt, fair.
	23	8	21	29 1	64	N 0	Little Snow laſt Night, Froſt, cloſe.
		21	20	29 3	63	0	Fair, hard froſt.
	24	10	17	29 4	62	N W 2	Fair, hard Froſt.
		17	18	29 3	63	W 1	Snow.
	25	9	18	29 4	62	N W 1	Hard Froſt, Fair.
		22	19	29 4	61		Fair, hard Froſt.
	26	9	18	29 3	62	W 1	Fair, hard Froſt.
		19	22	29 2	63	0	Clouds, Thaw.
	27	8	22	29 2	64	N W 1	Fog.
		16	22	29 2	63	N W 1	Cloſe, Thaw.
		21	22	29 2	63	N W 0	Cloſe, freeze.
	28	9	20	29 3	63	N W 0	Cloſe, Froſt.
		22	18	29 3	63	N W 0	Cloſe, Froſt.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1666. *December*	29	10	16	29 4	63	N W o	Fog, hard Froſt.
		22	15	29 5	62	o	Thick Fog, hard Froſt.
	30	9	15	29 4	62	N W o	Very thick Fog, and hard Froſt.
		22	15	29 4	62	N W o	Clear, hard Froſt.
	31	8	14	29 4	62	N W o	Fair, hard Froſt.
		15	15	29 5	63	N W o	Fair, hard Froſt.
1667. *January*	1	8	12	29 4	62	N W o	Fog, hard Froſt.
	2	10	13	29 6	63	S E o	Fair, hard Froſt.
	3	9	10	29 5	63	S E o	Fair, hard Froſt.
		22	11	29 3	63	o	Cloſe, hard Froſt.
	4	10	13	29 3	63	E S 1	Cloſe, hard Froſt.
	5	11	12	29 2	62	E o	Snow, Froſt.
	6	9	13	28 8	3	E S o	Snow, Froſt.
		15	14	28 7	63	E o	Cloſe, Froſt.
	7	9	16	28 6	64	E o	Cloſe, hard Froſt.
		17	18	28 6	64	E o	Little dewy rain, and tendency to a thaw.
	8	8	20	28 6	65	E N o	Cloſe, Thaw, little Rain.
		21	21	28 8	64	o	Cloſe, Thaw.
	9	8	21	29 2	65	E N o	Little Snow, and little Thaw.
		21	22	29 3	65	o	Cloſe.
	10	9	21	29 3	65	N E o	Cloſe, Froſt.
		22	21	29 2	65	2	Cloſe.
	11	8	20	29 2	65	N E 1	Cloſe, Froſt.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1667. *January*		12	21.	29 2.	65	N E o	Cloſe, gentle Thaw.
	12	9	21.	29 2.	64	N E o	Cloſe, Froſt.
	13	11	22.	28 7.	65	N E o	Thick Fog, Thaw.
		22	23.	28 8.	65	o	Cloſe, great Thaw.
	14	8	24.	28 7.	65	E 1	Fog, perfect Thaw.
		21	24.	28 6.	65	2	Cloſe.
	15	10	22.	28 6.	64	E N 2	Cloſe, Froſt.
		22	23.	28 6.	65	o	Small Rain.
	16	8	23.	28 7.	65	E S 1	Cloſe.
	17	8	25.	28 7.	65	E N o	Fog.
	18	7	25.	28 6.	65	N E 2	Snow, Thaw.
		21	23	28 8.	64	2	Little Snow.
	19	8	21.	29 2.	64	N E o	Froſt, little Snow.
		22	20.	29 4.	64		Hard Froſt.
	20	9	18.	29 5.	63	N o	Fair, hard Froſt.
		22	20.	29 6.	63	o	Fair, Froſt.
	21	8	18.	29 6.	63	N W o	Fair, hard Froſt.
		17	21.	29 6.	63	W 1	Fair, Froſt.
	22	9	25.	29 5.	66	S W 2	Rain.
		23	28.	29 3.	66	3	Rain.
	23	9	29	29 3.	67	W S 1	Clouds.
		17	32.	29 4.	67	W 1	Fair.
	24	9	29	29 5.	66	W S 1	Fair.

A Register kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1667. *January*		21	32	29 3	66	4	Close.
		23	33	29 2	66	4	Close.
	25	8	36	28 8	67	S W 3	Little misty Rain.
		19	42	28 6	73	3	Little misty Rain.
	26	8	38	28 8	72	W S 2	Close.
		12	37	28 8	73	W S 1	Rain.
	27	10	33	29 2	70	W S 2	Fair.
	28	22	30	29 2	69	1	Rain.
	29	6	30	29 2	70	1	Mist.
		16	31	29 3	70	N W 0	Clouds.
	31	13	26	29 4	69	E 2	Close.
February	1	9	26	29 5	69	E 2	Close.
	2	9	28	29 5	70	E 1	Close.
	3	9	31	29 5	72	S E 0	Thick Fog.
	4	9	33	29 4	72	E 0	Fog.
		22	34	29 6	73	0	Close.
	5	8	32	29 7	72	E 1	Close.
		22	31	29 7	71	2	Close.
	6	18	26	29 7	68	N E 1	Clouds.
	7	9	24	29 5	69	N E 1	Clouds, Snow in the Night.
		23	23	29 5	67	1	Close.
	8	10	22	29 5	67	E N 2	Frost, close.
	9	8	21	29 4	67	E S 1	Close, Frost.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1667. *February*		22	22.	29 4.	68		Snow.
	10	9	23.	29 3.	29	S E 1	Rain.
		16	28.	29 3.	71	S W 2	Miſty.
		23	32.	29 2.	73	2	Cloſe.
	11	9	34.	29 2.	73	S W 2	Miſty.
		22	36.	29 1.	74		Cloſe.
	12	8	35.	28 7.	74	S E 2	Cloſe.
		22	37.	28 4.	73	2	Fair.
	13	8	34.	28 4.	72	S W 3	Fair.
		22	36.	28 2.	70	2	Cloſe.
	14	8	34.	28 4.	69	W S 3	Fair.
		22	33.	28 6.	68		Fair.
	15	8	32.	28 5.	69	S 2	Rain.
		23	32.	28 5.	69	S 2	Fair.
	16	23	31.	28 7.	69	N 1	Cloſe.
	17	9	30.	28 8.	69	W 1	Fog.
	18	11	32.	29 4.	66	N W 2	Fair.
	19	9	28.	29 7.	64	N W	Hoar Froſt, fair.
		15	33.	29 6.	56	S 2	Fair.
	20	9	28.	29 6.	63		Fair.
	21	9	28.	29 5.	63	E S 1	Fair.
	22	8	29.	29 5.	62	N E 1	Cloſe.
		15	29.	29 5.	60	N E 1	Rain.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1667. *February*	23	8	27	29 5	63	N E 2	Cloſe.
	24	9	26	29 6	62	N E 2	Cloſe.
	25	10	25	29 5	62	N E 1	Snow.
	26	7	23	29 4	61	N E 1	Froſt, little Snow.
	27	8	23	29 2	61	N E 1	Cloſe, Froſt.
	28	9	21	29 1	60	N E 1	Fair, Froſt.
March	1	11	22	29 2	59	E 1	Fair, hard Froſt.
	2	10	23	29 3	60	N E 1	Clouds, Froſt.
		17	26	29 3	59	N E 1	Hail.
	3	9	24	29 4	60	N E 2	Cloſe.
		21	25	29 4	62	2	Miſty, Rain.
	4	9	25	29 4	60	N E 2	Cloſe.
	5	9	24	29 2	60	N W 2	Cloſe, about 6 ſmall Snow.
	6	23	17	29 4	56	2	Fair, hard Froſt.
	7	9	15	29 4	55	N E 2	Fair, very hard Froſt.
		13	16	29 4	54	N E 2	Snow.
	8	8	14	29 2	54	N E 2	Very hard Froſt, *Thames* frozen, Carts went over.
	9	8	18	28 8	58	N E 2	Snow hard, already deep, hard Froſt.
	10	9	18	29 2	58	N E 2	Cloſe, hard Froſt.
	11	8	19	29 3	57	N E 1	Hard Froſt, little Snow.
	12	8	21	29 5	57	E N 1	Froſt.
	13	9	21	29 5	56	N E 1	Cloſe, Froſt.
	14	8	21	29 4	56	S E 2	Cloſe, Froſt.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1667. *March*	14	16	23.	29 3.	55	S E	Cloſe, Thaw.
	15	8	23.	29 2.	57	E 1	Miſt, Thaw.
	16	8	27.	29 1.	59	S E 2	Rain.
		21	30.	29 0	60	0	Fair.
	17	11	31.	29 2.	60	N E 1	Cloſe.
	18	8	28.	29 6.	61	N E 1	Fair.
		18	35.	29 6.	62	S 1	Fair.
	19	8	33.	29 6.	61	S W 1	Cloſe.
	20	6	37.	29 6.	61	W 1	Fair.
	21	10	35.	29 4.	55	S W 2	Small Rain.
		12	36.	29 4.	56	S W 2	Small Rain.
		23	38.	29 1.	59	3	Cloſe.
	22	9	37.	29 1.	58	W 2	Fair.
	23	9	35.	29 1.	58	S E 1	Clouds.
		11	36.	29 1.	58	S E 1	Rain.
	24	9	35.	29 2.	58	N W 1	Clouds.
	26	7	30	29 5.	50	N W 1	Fair.
	27	7	29.	29 6.	49	N E 1	Fair.
	28	9	28.	29 5.	48	N E 1	Fair.

I began to keep a regiſter of heat and cold at *London*; by a thermometer of the Royal Society's ſtandard: this thermometer I marked 2.

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
1669. *December*	26	9	0- 3				Extreme hard Froſt.
1670. *January*	13	10	.. 4				

A Regiſter kept by Mr. *Locke* in *London.*

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
1670. *January*	13	23	4				Cloſe.
	14	10	4				Cloſe.
		22	4				Mixt, *i. e.* part Clouds, part clear.
	15	23	3				
	16	10	2				Fair.
	17	10	2				Fair.
	18	9	2				Miſt.
	19	10	1				Miſt.
	20	1	0				Clouds.
		9	0				Cloſe, Froſt.
	21	9	1				Cloſe.
	22	23	1				Fair.
	23	9	1				Fair.
	24	9	1				Fair.
	25	9	1				Cloſe.
	26	8	0				Snow.
	27	10	0				Snow.
	28	10	0				Snow.
	29	23	0				Hard Froſt.
	30	11	0				Hard Froſt.
	31	11	0				Thaw.
February	2	11	0				Froſt.
	3	10	0				Froſt.

A Regiſter kept by Mr. *Locke* in *London.*

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
1670. *February*	6	23	0				
	7	9	0				Snow.
	8	9	0				Fair.
	9	10	0				Fair.
	10	9	1				Cloſe.
	11	10	0				Fair.
	12	10	1				Thaw.
	13	9	1				Rain.
	14	9	0				Fair, Froſt.
	17	23	3				Miſt.
	20	11	2				Fair.
April	1	10	1				Cloſe.

I here divide the degrees of the *Greſham College* thermometer, each into 4, ſo that 24 is now the ſame that 6 was before.

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
May	27	9	24				Fair.
	29	11	31				Fair.
		23	24				Fair.
	30	7	22				Fair.
		23	29				Fair.
June 1671.	1	9	28				Cloudy.
May	29	8	20				Rain.
June 1672.	5	8	31				Cloudy.
January.	31	9	4			N E	Fair.

A Register kept by Mr. *Locke* in *London.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1672.							
February	1	8	0-5				Fair.
June	15	16	36-				Cloudy.
	16	9	33				Cloudy.
		17	37			S W 2	Fair.
	20	9	29				Cloudy.
August	15	6	24				
	17	8	25				Close.
October	13	9	20				
December	23	22	20				
	27	17	18				
1673.							
January	1	22	18				
	4	18	14				
April	3	17	5				Snow.
May	10	21	16			E	
June	9	22	22			E	Rain.
	10	9	21				Cloudy.
	12	9	23				Fair.
	13	22	22				Rain.
	14	9	24				Close.
	17	9	26				
	18	9	26				Close.
	20	9	22				Fair.
	21	9	24				Fair.

A Register kept by Mr. *Locke* in *London*.

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
1673. *June*	22	6	23				Fair.
	27	10	26				
	28	9	25				Rain.

Memorand. That from the beginning of *May*, till the end of *July*, there was scarce one dry day, but so great rains, that produced greater floods than were known in the memory of man.

	d	h	T. 2.	Bar.	Hy.	Wind	Weather.
July	2	9	25				
	8	10	26				
	10	8	25				Fair.
	14	17	31				Fair.
	25	22	35				
	28	12	33				Close.
	30	9	24				Fair.
1674. *March*	9	8	1			N E	Frost and Snow.
	19	6	5				Snow.
	20	10	5			E N	Snow all day.
December	25	15	11				Fair.
	27	16	11			W	Fair.
	28	15	14			W	Close.
1675. *January*	3	16	14			W	Fair.
April	25	9	12			N E	Fair.
	26	10	12			N	Fair.
	27	12	12			E	Fair.
	28	9	12			E	Close.

A Regiſter kept by Mr. *Locke* in *London.*

	d	h	T. 2.	Bar.	Hy.	Wind.	Weather.
1675.							
May	2	9	16				Cloſe.
	23	15	27				Cloudy.
June	8	22	21				Cloudy.
	9	13	21				Cloſe.
	10	14	22				Cloſe.
	13	10	22			E	Cloſe.
	14	9	17				Rain.

The thermometer marked 3 is one which I began now to uſe at my return to *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1681.							
March	14	14	46	29 4		W 2	A little Miſt.
	15	8	36	29 6		N W	Fair.
	16	12	45	29 5		N W 2	Little Rain.
	17	7	37	29 7		E	Fog.
	18	8	33	29 7		E	Fair.
	23	11	34	28 8		N W	Cloſe.
	24	12	32	29 2		N	Cloudy.
	25	18	33	28 7		N W	Cloudy.
	26	15	32	8		N	Cloudy.
	27	13	28	29 2		N	Fair, Snow this Morning.
		14		29 2		N	Snow hard.
	28	11	29	5		N	Cloudy.
	30	7	34	5		W	Cloſe. All the foregoing Week it rained in Showers every Day.
April	6	18	49	4		S	Very fair.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1681. *April*	7	9	45	29.5		S	Very fair.
		17	55	.4		S W	Very fair.
	9	8	50	.3		S W	Cloſe.
		14	50	.2		S W	Rain.
	10	11	44	.3		W 2	Clouds, and a little ſhower this morning.
	11	17	46	.5		S W 2	Fair ever ſince yeſterday.
	12	15	51	.2		S 3	Fair ſince.
	13	14	49	.3		W 2	Fair ſince.
	14	13	45	.3		S W 3	Fair ſince.
	15	17	54	.3		E N	Cloſe all day.
	16	8	45	.3		E N 1	Miſt.
		17	52	.2		E N 1	A little ſhower between 4 and 5.
	17	6	49	.2		N E 1	Thick Fog, Showers between 6 and 7 laſt night.
	18	7	46	.2		S W 2	Fair, and Clouds ſince.
May	3	14	50	29.4		N E 2	Cloſe, no rain ſince *April* 18, but very hot and fair weather till yeſterday, the wind for the moſt part between N. and E.
	4	10	44	.4		N E 1	Cloſe ſince.
	5	8	37	.4		N E 1	Clouds.
	6	8	37	.2		E N 1	Fair, clouds yeſterday.
		19	46	29		W 1	Cloudy.
	7	7	41	28.8		W N 2	Clouds.
		11	43	.8		W 1	Rain.
		16	47	.7		W 1	Cloſe.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1681. *May*	8	9	41	29		N E 1	Cloudy ſince.
	9	9	42	2		E N 1	Fair.
	10	4	47	3		N 1	Fair ſince.
	11	9	48	3		S E 1	Fair ſince.
		15	61	2		S W 1	Fair ſince.
	16	11	54	6		S W 1	Fair, a little ſhower or two ſince.
		18	65	5		W 1	Fair ſince.
	17	8	55	6		N W 1	Fair ſince.
	19	17	70	2		N E 1	Fair ſince.
	20	6	6	64	3	N E 2	Cloudy, no rain from hence till *June* 20, the drieſt ſpring that hath been known, there having been no rain from the end of *March* to the end of *June*.
Auguſt	2	6	65	3	7	N W 1	Fair.
	3	11	60	3	8	N 1	Fair.
	4	9	62	3	9	W 1	Fair.
	5	9	62	3	8	E 1	Fair.
	6	15	71	1		S 1	Fair.
	7	9	68	2	9	S 1	Fair.
		15	72	28 8	8	S W 2	Cloudy.
	8	8	68	7	9	S 2	Cloſe.
		11	69	7	9	S 2	Rain a little.
	9	9	64	8	10	S W 1	Cloſe.
		17	66	7	10	S 1	Rain a hard ſhower.
	10	6	62	7	11	S W 2	Cloſe.

A Regiſter kept by Mr. *Locke* in *Oxford*:

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1681. *Auguſt*	11	9	62	29 1	11	S W 1	Cloſe.
	12	8	66	2	17	S W 1	Miſt.
	13	9	69	28 8	18	S 1	Rain.
		14	72	7	17	S W 1	Fair, Clouds.
	14	8	67	8	17	S 1	Fair.
		16	72	6	16	S E 1	Thunder Shower.
	16	9	69	29 2	17	S W 1	Rain for ⅛ hour, and then fair.
	17	6	69	2	16		
	18	4	67	3	16		
1682. *February*	10	12	25	29 5		E N 1	Cloſe, Froſt.
	11	10	24	29 6		N E 1	Fair, Ice.
	12	15	27	29 7		N E	Very fair.
	13	11	24	29 7	61	N E 1	Thick Fog.
	14	8	23	29 6	63	N E 1	Fair.
	15	8	29	29 5	65	E N 1	Cloſe.
	17	8	31	29 0	72	S 2	Cloudy, and ſome Rain.
	20	17	42	28 7	75	S E 2	Rain.
	21	8	44	28 6	75	S 2	Rainy.
	22	9	42	28 7	77	S 2	Cloſe.
	24	10	41	29 2	74	S E 1	Cloſe.
	25	15	39	28 7	75	N E 1	Rain ever ſince yeſterday in the afternoon.
	26	10	38	29 1	74	N 1	Cloſe.
	27	7	37	29 3	75	N W 1	Cloſe.

A Regiſter kept by Mr. *Locke* in *Oxford*:

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1682. *February*	28	10	39	29 4	73	W 1	Cloſe.
March	1	9	42	29 3	74		Fog.
	5	16	30	29 1	67	S 1	Very fair, hard froſt in the morning.
	6	10	28	29 2	67	N E 1	Fair.
	7	11	25	29 2	65	N 2	Very fair.
	22	13	29	29 2	57	N 3	Cloudy, and a little Snow.
	23	8	25	29 4	56	N 2	Cloſe, Froſt.
	24	7	29	29 4	57	W 1	Cloſe.
	25	9	36	29 2	59	N 2	Clouds.
	26	8	31	29 4	56	N 1	Cloſe.
	27	8	34	29 4	57	W 2	Fair.
		13	39	29 3	59	W N 1	A Shower.
	28	7	35	29 4	56	N W 1	Fair.
	29	7	30	29 5	50	N	Clouds.
	30	8	30	29 5	48	N E 2	Fair.
		11	31	29 5	47	N E 3	Snow.
	31	8	30	29 6	48	N E 2	Fair.
April	1	8	30	29 6	49	N E 2	Cloſe.
	2	9	33	29 6	50	N E 1	Cloſe.
		19	36	29 6	51	N E 1	Small Miſt.
	3	7	34	29 6	51	N E 1	Small Miſt.
	4	9	34	29 6	50	N E 1	Cloſe.
	5	7	34	29 5	50	N E 1	Fog, and Sun-ſhine.

A Regiſter kept by Mr. *Locke* in *Oxford*:

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1681. *Auguſt*	11	9	62	29 1	11	S W 1	Cloſe.
	12	8	66	2	17	S W 1	Miſt.
	13	9	69	28 8	18	S 1	Rain.
		14	72	7	17	S W 1	Fair, Clouds.
	14	8	67	8	17	S 1	Fair.
		16	72	6	16	S E 1	Thunder Shower.
	16	9	69	29 2	17	S W 1	Rain for $\frac{1}{8}$ hour, and then fair.
	17	6	69	2	16		
	18	4	67	3	16		
1682. *February*	10	12	25	29 5		E N 1	Cloſe, Froſt.
	11	10	24	29 6		N E 1	Fair, Ice.
	12	15	27	29 7		N E	Very fair.
	13	11	24	29 7	61	N E 1	Thick Fog.
	14	8	23	29 6	63	N E 1	Fair.
	15	8	29	29 5	65	E N 1	Cloſe.
	17	8	31	29 0	72	S 2	Cloudy, and ſome Rain.
	20	17	42	28 7	75	S E 2	Rain.
	21	8	44	28 6	75	S 2	Rainy.
	22	9	42	28 7	77	S 2	Cloſe.
	24	10	41	29 2	74	S E 1	Cloſe.
	25	15	39	28 7	75	N E 1	Rain ever ſince yeſterday in the afternoon.
	26	10	38	29 1	74	N 1	Cloſe.
	27	7	37	29 3	75	N W 1	Cloſe.

A Regiſter kept by Mr. *Locke* in *Oxford*.

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1682.							
February	28	10	39	29 4	73	W 1	Cloſe.
March	1	9	42	29 3	74		Fog.
	5	16	30	29 1	67	S 1	Very fair, hard froſt in the morning.
	6	10	28	29 2	67	N E 1	Fair.
	7	11	25	29 2	65	N 2	Very fair.
	22	13	29	29 2	57	N 3	Cloudy, and a little Snow.
	23	8	25	29 4	56	N 2	Cloſe, Froſt.
	24	7	29	29 4	57	W 1	Cloſe.
	25	9	36	29 2	59	N 2	Clouds.
	26	8	31	29 4	56	N 1	Cloſe.
	27	8	34	29 4	57	W 2	Fair.
		13	39	29 3	59	WN 1	A Shower.
	28	7	35	29 4	56	N W 1	Fair.
	29	7	30	29 5	50	N	Clouds.
	30	8	30	29 5	48	N E 2	Fair.
		11	31	29 5	47	N E 3	Snow.
	31	8	30	29 6	48	N E 2	Fair.
April	1	8	30	29 6	49	N E 2	Cloſe.
	2	9	33	29 6	50	N E 1	Cloſe.
		19	36	29 6	51	N E 1	Small Miſt.
	3	7	34	29 6	51	N E 1	Small Miſt.
	4	9	34	29 6	50	N E 1	Cloſe.
	5	7	34	29 5	50	N E 1	Fog, and Sun-ſhine.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1682. *April*	6	9	39	29 4	49	N 1	Fair.
	7	9	39	29 5	48	N 1	Fair.
	8	8	39	29 5	44	S E 2	Fog and ſun-ſhine.
		11	43	29 5	44	S E 2	Fair.
	9	7	40	29 3	40	S E 2	Thick Fog.
		14	41	29 1	41	S 2	Rain.
		20	43	28 7	44	S 2	Rain till paſt 6, now fair.
	10	7	43	28 6	47	S W 2	Cloſe, rain in ſhowers moſt part of the day
	11	8	43	28 6	49	S W 2	Cloſe, rain in ſhowers moſt part of the day
	12	7	41	28 5	48	S W 1	Cloſe, ſhower about noon.
		16	44	28 6	47	W N 1	Fair.
	13	6	37	28 8	47	S E 1	Fair.
		17	44	28 5	47	2	Rain.
	14	7	42	28 2	48	S E 2	Rain all the morning till paſt 12.
		14	45	28 5	50	W 3	Rain, more or leſs, almoſt all the afternoon
	15	6	40	29 1	50	S W 2	Fair.
	16	7	43	29 1	48		Fair, hard ſhower about 18.
	17	7	47	28 8	49	S E 1	Cloſe, ſhowers ſeveral times in the day.
	18	7	43	28 7	50	S E 1	Rain the greateſt part of the day.
	19	6	44	28 7	52	S 2	Cloſe, rain a great part of the day.
	20	6	44	28 6	51	S E 1	Rain, and ſo in ſhowers ſeveral times of the day.
	21	4	45	28 6	51	S 1	Cloudy, rain moſt part of the morning.
	22	8	47	28 7	51	S 1	Rain.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1682. *April*		17	51	28 8	52	N 1	Rain, moſt part of the afternoon.
	23	7	46	29 2	52	N 1	Cloſe.
		13	49	29 3	52	S 1	Cloſe, rain almoſt all the afternoon.
		22	49	29 3	52	N about 18	Hard rain.
	24	6	46	29 4	52	E 1	Cloſe, hard rain at night.
	25	7	47	29 1	52	E S 1	Cloſe, ſome rain.
		14	42	28 8	53	S E 1	Dropping.
		22	54	28 7	54	3	Hard rain from 18.
	26	7	52	28 6	54	S 2	Cloudy, rain often in the day.
	27	5	52	28 8	55	S W 1	Cloſe, a good deal of rain before night.
	28	18	51	28	55	S W 1	Cloſe, rain a good part of the morning, and ſome in the afternoon.
	29	8	47	29 1	55	S W 1	Cloudy, a little rain in the afternoon.
	30	5	47	28 8	55	S W 1	Fair.
		18	46	28 6	55	N E 1	Hard rain, which began about 11, and laſted till 21 or 22.
May	1	4	42	28 8	55	N W 2	Cloudy.
		21	47	29 2	54	N W 1	Fair.
	2	8	43	29 2	54	S W 1	Cloudy, hard rain from 19 or 20 all night.
	3	6	49	28 7	54	S W 2	Clouds, wind W. all the afternoon, but fair, bating a little rain in the evening.
	4	5	52	28 7	54	S E 1	Rain hard till 13.
		13	54	28 7	53	N 1	Rain hard till night.

Memorand. That new fitting my barometer, here the mercury was raiſed by addition of more in the receiver about $\frac{2}{10}$ inch, which is almoſt 2 of my degrees, which are eighths; though I ſuſpect it is ſtill, by reaſon of included air, a degree or two too low.

A Regiſter kept by Mr. *Locke* in *Oxford.*

1682. *May*	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
	4	22	53	29 2	54		Small rain.
	5	8	48	29 3	54	E 1	Rain.
		20	51	29 3	55	E 1	Cloſe rain moſt part of the morn. and 2 or 3 ſhowers in aftern.
	6	7	48	29 3	55	N E 1	Miſt.
	7	8	46	29 4	55	E 2	Rain a great part of the day.
	8	4	53	29 2	56	S W 2	Hard rain till 7 or 8.
	9	10	54	29 1	55	E 1	Cloſe.
		14	55	29 1	55	S W 1	Rain.
	10	9	50	29 2	54	S 1	Cloudy, a little rain about 17, and again about 22.
	11	6	49	28 2	54	S W 1	Cloſe.
		9	50	29 2	55	S W 1	Short ſhower, ſeveral ſhort ſhowers in the aftern.
	12	6	49	29 3	54	S W 1	Cloſe, a ſhower in the morning.
	13	4	51	29 2	53	E 1	Cloſe, ſeveral ſhowers in the day.
	14	9	53	29 4	54	S W 2	Clouds.
	15	7	51	29 4	51	S 1	Fair.
	16	8	61	29 2	48	S E 1	Fair, hard ſhower about 18.
	17	5	60	29 3	48	S W 2	Cloſe.
	18	7	57	29 5	47	W 1	Fair.
	19	8	58	29 5	45	W S 1	Fair.
	20	5	63	29 3	43	S E 1	Fair.
		16	69	29 3	43	W S 1	Very fair.
	21	8	59	29 3	44	S 1	Fair.
	22	9	69	29 1	42	S E 1	Fair.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1682. *May*		17	47	29 1	38	S W 2	Fair.
	23	7	64	29 2	38	W 1	Fair, gentle rain from 8 to 11.
		10	63	29 2	38	W 1	Rain.
	24	7	62	29 2	39	N 1	Cloſe.
	25	6	59	29 3	42	N W 1	Fair.
	27	9	53	29 5	42	W 1	Fair.
	28	14	67	29 3	33	S 1	Fair.
October.	14	9	45	29 6	49	W 1	Cloſe, rain laſt night.
	16	13	48	29 4	51	S W 2	Rain till bed-time.
	17	9	47	29 2	51	W 1	Fair, little rain.
	18	10	41	29 1	51	S W 2	Cloudy, hard rain from 5 to bed-time.
	19	9	39	28 7	51	W 1	Fair, ſhower in the afternoon.
	20	9	34	28 7	51	0	Rain.
	27	22	38	29 7	60		Cloſe.
	28	10	37	29 7	60	E N 2	Fair.
November	8	18		29 8			Fair, hard froſt.
	9	9	22	29 8	57	N 1	Fog, gone before noon; hard froſt.
	10	10	26	29 8	58	E N 1	Fair, hard froſt.
	11	9	25	29 7	56	N E 1	Cloſe, hard froſt.
	12						Fair, hard froſt.
	13	10	26	29 5	57	N E 1	Cloſe, hard froſt.
	14	13	23	29 7	57		Thick fog, fair in the afternoon.
	15	10	36	29 4	56	S W 1	Cloſe, rain this morning, hard rain 22.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	Th.	Bar.	Hy.	Wind.	Weather.
1682. *November*	16	5	41	29 1	66		Hard rain, rain moſt part of the day.
		17	41	29 1	65	S W 1	Rain.
	17	11	39	29 1	64	W S 2	Fair.
	18	9	37	28 7	64	0	Fog, rain moſt part of the day.
	19	9	33	29 1	62	W 1	Fair, rain in the night.
	20	10	40	29 1	64	W N 1	Fair, rain in the afternoon.
		22	42	29 2	63	2	Fair.
	21	6	42	29 1	64		Hard rain till 10.
		16	43	29 2	64	W 2	Fair.
	22	11	33	29 5	63	W 1	Small fog, froſt this morning.
	23	9	28	29 5	62	N W	Fog, thick fog all day.
	24	9	25	29 5	62	N W	Thick fog, little rain in the evening.
	25	8	35	29 3	67	S W 1	Cloſe, rain in the evening.
	26	9	35	29 4	65	W N 1	Fair.
	27	10	31	29 7	64	W N 1	Fair.
	28	4	32	29 8	65		Fair.
	29	8	33	29 7	65	W S	Small fog.
	30	9	35	29 7	65	S W 1	Fair.
December	1	8	35	29 6	66	S 1	Miſt.
	2	9	34	29 6	66	S 1	Cloſe.
	3	9	34	29 6	66	S W 1	Foggy.
1683. *June*	21	9	62	29 3	46	W 1	Cloſe.
	22	8	65	29 2	48	W S 2	Cloſe, ſome ſhowers.

A Regiſter kept by Mr. *Locke* in *Oxford.*

	d	h	T. 3.	Bar.	Hy.	Wind.	Weather.
1683. *June*	23	7	59	29 4	46	W 1	Cloudy.
	25	19	67	29 4	44	W N 1	Fair, miſt in the morning.
	26	10	64	29 5	43	S 1	Very fair.
		17	72	29 3	43	S W 2	Fair.
	30	13	62	29 3	37	W N 3	Fair.

An Explication of the foregoing Regiſter.

THE firſt column with *d.* at the top, contains the day of the month.

The ſecond column, with *h.* at the top, contains the hour of the day, which beginning from midnight, I count to 24, which is midnight again; ſo that 13 ſtands for one afternoon, and ſo on.

The third column, with *Th.* at the top, marks the degrees of my thermoſcope, which having been blown up at a lamp, though the ſpaces of the degrees were equally divided, yet becauſe of the unequal bigneſs of the ſmall tube, towards the extremities, where it grew bigger, it did not always in every degree mark equally proportionable degrees of heat and cold. The points to be obſerved in that and the next column, which is that for the baroſcope, ſhew the juſt place, where the top of the tinged ſpirit of wine in the one, and the mercury in the other, ſtood between the line of the degree marked, and the following, when the obſervation was made. The thermoſcope I made uſe of till *December*, 1669, was a ſealed one, with all the degrees increaſing with the heat in one continued ſeries. The thermoſcope, which I uſed from *December* 1669, to *June* 1675, and is marked 2, was one of Mr. *Cotgrave*'s adjuſting, which beginning the reckoning from the temper of freezing, hath the numbers increaſing both upwards and downwards; the points ſhew it to be in the degrees, above 0, if ſet over, and under 0, if ſet under : and ˙ ˙ ˙ or ˙ ˙ ˙ ſhew it higher or lower in each degree. The thermoſcope uſed from *March* 1681, to the end, is marked 3, and is of the kind of that uſed firſt.

The column having *Hy.* at the top, contains the degrees of moiſture, as marked by an hygroſcope made of the beard of a wild oat.

In the column of the wind, I not having the convenience to obſerve the points exactly, have marked but 8, but yet with this variety, that where I ſet two letters, the wind was moſt from that point whoſe letter ſtands firſt, *v. g.* W. N. ſignifies more weſt than north. When I ſet only one letter, it was in or very near that cardinal point.

The ſtrength is marked by 0, 1, 2, 3, 4. 0 ſignifies not ſo much wind, that moved any leaf that I could ſee in a garden I looked into out of my window, but the letter joined to it ſignifies which way the weather-cock then ſtood, whether the former wind left it ſo, or the preſent breeze blew that way. 1 ſignifies a gentle gale,

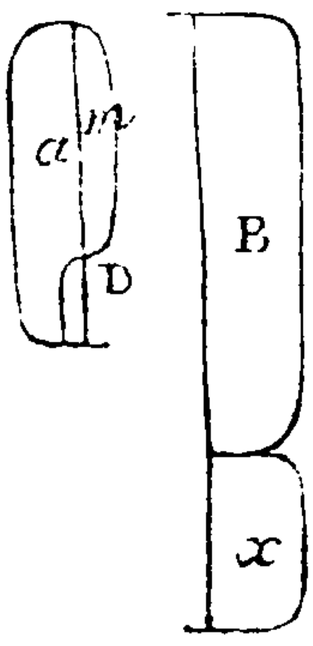
juſt perceivable by the moving of the leaves or plants. 4 ſignifies a very violent ſtorm: 2 and 3 the ſeveral degrees between 1 and 4, as well as I could judge. Theſe degrees, though not ſo exactly meaſured as I could have wiſhed, I yet thought better than nothing.



LE tuyau recourbé eſtoit fermé au bout æ et ouvert à l'autre extremité B. *la recourbure depuis.* G. *juſq' à* C. *eſtoit pleine de mercure, & tout le reſte eſtoit plein d'air. La longueur* Æ. C. *eſtoit* 4 *pouces ou* $^{2}_{8}{}^{3}$. *J'echauffay cet air, et il fait baiſſer le mercure juſques en* f. *qui eſtoit* $\frac{3}{8}$ *plus bas, & en meſme temps il monta juſq' en* H. *qui eſtoit* $\frac{5}{8}$ *plus haut que* G. *ou* C.

Pour ſçavoir quélle hauteur de mercure auroit eſte neceſſaire pour empeſcher la dilatation de l'air, & retenir le mercure en C. *je n'ay que trouver ce qui ſeroit neceſſaire pour repouſſer le mercure en* C. *et ainſy contenir l'air dans l'eſpace* Æ C. *non obſtant la chaleur. Je poſe pour principe ce que l'experience fait voir, c'eſt que quand une quantité d'air occupe un certain eſpace que j'appelle.* Æ. *et que la preſſion qui le retient dans cet eſpace ſoit* B. *ſi on vient à augmenter cette preſſion de telle quantité que l'on voudra comme* X. *on diminuera l'eſpace* Æ. *d'une certain quantité.* D. *laquelle quantité eſt au reſtant.* M. *comme* X. *eſt à* B.

D : M : : X : B.
donc
M : D : : B : X.



Il eſt aiſé d'appliquer cette reigle à l'experience cydeſſus; car Æ. f. *ou* $\frac{3}{8}{}^{5}$ *de pouce ſont l'eſpace* Æ. *La preſſion ordinaire de l'air, qui eſt de* 30 *pouces jointe æ un pouce de haut que ſe trouve entre* f. *et* H. *eſt* B X. 31 *pouces de mercure: et ſi nous y en adjouſtons aſſez pour reduire l'air à l'eſpace.* Æ C. *le dit.* Æ C. *ſera* M. X. $\frac{3}{8}{}^{2}$ *et.* f C. *ſera* D X. $\frac{3}{8}$.

Poſant donc. M. D. . B.
32. 3. 31.

La quatrieſme proportionelle ſera X, X. 2 $\frac{2}{3}\frac{9}{2}$ *pouces, qui eſtants joints à* B X. 31 *pouces ſeront* 33 $\frac{2}{3}\frac{9}{2}$ *pouces, dont l'air ſera preſſé en* C Æ. *qui ſont pres de* 4 *pouces au deſſus de la preſſion ordinaire.*

Experiment made at the Spire of the cathedral Church in Sarum, *by colonel* John Windham, *aſſiſted by Mr.* Thomas Naſh, *clerk of the Works, and* John Warner, *in* November, 1684.

HAVING gotten together all the ſurveying chains the city afforded, and carefully examined their truth, and having prepared a proper frame for the baroſcope, we went into the church, filled the tube, and with all the nicety we could uſe purged it of the airy particles; and then immerſing it as in the Torricellian experiment, the mercury was there ſuſpended 30 inches, and 50 cents of an inch, meaſuring it from the ſurface of the ſtagnum: then drawing it up to the firſt floor above the vaulting, which is 1033 inches and $\frac{1}{2}$ high from the pavement, the mercury ſubſided 9 cents of an inch: from thence drawing it up to the middle floor, which is 935 inches higher, the mercury ſubſided 8 cents lower than before: and from thence drawing it up to the weather-door, which is 2313 inches higher than the laſt, the mercury ſubſided 23 cents below its ſtation. So the whole height it was drawn up is 4281 inches and a half; and the whole difference of the mercury's ſtanding is 40

cents of an inch. And letting it down the ſame way, the mercury reaſcended to its firſt ſtations.

At another time with an inverted baroſcope, like the figure in the margin, having made a mark, where the liquor ſtood, when it was below in the church, and drawing it up to the firſt floor over the

Vaulting	Which is above	1033 and $\frac{1}{2}$	The liquor aſcended	1 25
To the middle floor	the pavement of	1968.		2 39
To the 8 doors floor	the church	2467.		3 22
To the weather-door		4281.		5 64
To the top		4800, or 400 feet.		6 40



If your honour deſires to have any other experiments made at the ſpire, Mr. *Naſh*, whom I have mentioned above, is a perſon well ſkilled in the practical parts of mathematicks, and a great lover of learning, but more eſpecially natural and experimental philoſophy, having all of your honour's philoſophical works. This perſon I know would moſt gladly and heartily embrace any opportunity of ſerving your honour, whenſoever you will be pleaſed to let me impart any thing to him in a letter.

This is humbly advertiſed by, Sir,

Your honour's moſt obliged,

and moſt obedient ſervant,

4 *Decembris* 17. *Anno* 1685.

JOHN WARNER.

At a place in the great continent in *Europe*, but not far from the ocean, a learned acquaintance of mine keeping a baroſcope ſome years, and being diſcourſed with by me about the difference of the phænomena, that may be expected in places ſituate upon the continent, from what we find in this country, as it is an iſland: he related to me, that a few years ſince, caſting his eyes upon the baroſcope in ordinary weather, and that was calm enough, he was ſurpriſed to ſee the mercury ſo ſtrangely raiſed, as to exceed above two inches its wonted ſtation, which great alteration he found within few hours to have been the forerunner of ſo hideous a ſtorm, as was generally wondred at, and did a great deal of miſchief both in the towns and country of thoſe parts, where it left ſad inſtances of its fury. This wind came all along the continent; but my relator divers times obſerved, that when very boiſterous winds blew from the ſea, and the ſtorms came thence, (which lying to the ſouthward) the mercury in the baroſcope would conſiderably ſubſide, as has likewiſe been obſerved here in *England* by an ingenious gentleman, living within leſs than two leagues of the ſea, to whom I preſented a baroſcope to make obſervations with.

An induſtrious young man, that, whilſt he was my domeſtic, I bred up to chemiſtry, (of which he now teaches courſes) relating to me the other day, that toward the latter end of the laſt month (which was *June*) being at *Oxford*, where his houſe is, he had occaſion to caſt his eyes upon his baroſcope, and was not a little ſurpriſed to find, that the quickſilver was in an extraordinary meaſure altered from the height it ſtood at but a while before: whereupon, though the weather were very hot and fair, as is uſual in *June*, and had continued ſo for ſome days, yet he took upon him

to

to foretel from this great and quick ſubſidence of the mercury, that there would be before long ſome notable change of weather. And accordingly it happened within about four or five hours, that the ſky was all overcaſt; and there fell a hideous ſtorm of rain, lightning, thunder, and accompanied with ſuch a whirlwind, as ſcarce any remember to have ſeen in that city.

A Letter to the Author.

HONOURED SIR,

I HAVE been able to do ſo little in the attempts I have made to ſerve you, that I am aſhamed to have been ſo well furniſhed to ſo ſmall purpoſe. The barometer I had from you was conveyed ſafe into the country, and as ſoon as it came to my hands, I rode to *Minedeep*, with an intention to make uſe of it there in one of the deepeſt gruffs (for ſo they call their pits) I could find: the deepeſt I could hear of was about 30 fathom, but the deſcent ſo far either from eaſy, ſafe, or perpendicular, that I was diſcouraged from venturing on it. They do not, as in wells, ſink their pits ſtrait down, but as the cranies of the rocks give them the eaſieſt paſſage; neither are they let down by a rope, but taking the rope under their arm, by ſetting their hands and legs againſt the ſides of the narrow paſſage, clamber up and down, which is not very eaſy for one not uſed to it, and almoſt impoſſible to carry down the barometer, both the hands being employed. This information I ſhould have ſuſpected to have come from their fear, had not an intelligent gentleman, neighbour to the hill, aſſured me it was their uſual way of getting up and down. For the ſight of the engine, and my deſire of going down into ſome of their gruffs, gave them terrible apprehenſions; and I could not perſuade them but that I had ſome deſign: ſo that I and a gentleman, that bore me company, had a pleaſant ſcene, whilſt their fear to be undermined by us made them diſbelieve all we told them; and do what we could, they would think us craftier fellows than we were. But, Sir, I will not trouble you with the particulars of this adventure: but certain it is the women too were alarmed, and think us ſtill either projectors or conjurers. Since I could not get down into their gruffs, I made it my buſineſs to enquire what I could concerning them: the workmen could give me very little account of any thing, but what profit made them ſeek after; they could apprehend no other minerals but lead ore, and believed the earth held nothing elſe worth ſeeking for: beſides, they were not forward to be too communicative to one they thought they had reaſon to be afraid of. But at my return, calling at a gentleman's houſe, who lives under *Minedeep* hills, and who had ſent out his ſon to invite me in; amongſt other things he told me this, that ſometimes the damps catch them, and then, if they cannot get out ſoon enough, they fall into a ſwoon, and die in it, if they are not ſpeedily got out; and as ſoon as they have them above ground, they dig a hole in the earth, and there put in their faces, and cover them cloſe up with turfs; and this is the ſureſt remedy they have yet found to recover them. In deep pits they convey down air by the ſide of the gruff, in a little paſſage from the top; and that the air may circulate the better, they ſet up ſome turfs on the lee ſide of the hole, to catch, and ſo force down the freſh air: but if theſe turfs be removed to the windy ſide, or laid cloſe over the mouth of the hole, thoſe below find it immediately by want of breath, indiſpoſition, and fainting: and if they chance to have any ſweet flowers with them, they do not only loſe their pleaſant ſmell immediately, but ſtink as bad as carrion. Notwithſtanding this ill ſucceſs, I had attempted ſome trials once more, had not the ſpreading of the contagion made it leſs ſafe to venture abroad, and

haſtened me out of the country ſooner than I intended. But I have ſome hopes, the next journey I make into thoſe parts, to give you a better account than this that follows. Near the houſe, where I ſometimes abode, was a pretty ſteep and high hill. *April* 3. *hora inter* 8 & 9. *matutin.* the wind weſt, and pretty high, the day warm, the mercury was at 29 inches and $\frac{1}{8}$, being carried up to the top of the hill, it fell to 28 inches $\frac{3}{4}$, (or thereabouts, for I think it was a little above 28 inches $\frac{3}{4}$:) both going up and coming down, I obſerved, that proportionably as I was higher or lower on the hill, the mercury fell or roſe. At my return to the bottom of the hill, the mercury wanted of aſcending to its former height $\frac{1}{32}$ of inch, which I impute to the ſun's rarifying ſome particles of air, that remained in the upper part of the tube, rather than to any other change in the air; for I find it harder to clear the tube of the air perfectly, than at firſt I thought, or of water, if that have been put in with the mercury, and I fear liable to the ſame inconvenience with air incloſed. I know this is far ſhort of what you might have expected, and has, I fear, but little anſwered your deſires, ſince I gueſs it was the perpendicular height of the place I made the experiment in, that you would have had, and perhaps other conſiderations of air, incloſed, and liable to mineral ſteams, would have made a trial in one of the gruffs more acceptable to you. I do not think any thing in this letter worthy of you, or fit for the public. But ſince I find by the two laſt Philoſophical Tranſactions, that obſervations on the Torricellian experiment are much looked after, and deſired to be compared; if for want of better, this ſhould be thought fit to fill an empty ſpace in the philoſophical news-book, I ſhall deſire to have my name concealed. But I fear, that this very caution of being in print, where there is no danger of it, has too much of vanity in it. I am ſure it is boldneſs enough, though allayed with obedience, to venture ſuch ſlight things to your ſight. I viſited the incruſted ſpring I formerly mentioned to you, and could not find any thing incruſted within at leaſt 20 yards of the riſe of it. The place, where it works moſt, is about 40 or 50 yards from the ſpring head, and is at a fall higher than my head: there it ſheaths every thing with ſtony caſes, and makes the ſides of the bank hard rock, and from thence all along its ſtream it covers ſticks, *&c.* with a cruſt; and ſome ſo candied I found above this fall, but not ſo frequent; whether the mixing of air with the water in the fall contributes any thing to the effect, I cannot gueſs; but that the fall does, I ſuppoſe: for beſides, that at the above-mentioned fall it ſeems to operate moſt ſtrongly, I obſerved, that though I could not find any thing incruſted within a good diſtance of the ſpring, yet that the moſs above the ſpring was a little incruſted, (but not ſo firmly as at the other place) for the water in the winter, when the ſprings are full, runs out alſo at a hole two or three yards above the place, where now only it riſes, and from thence falls perpendicularly into this lower ſpring, from whence it runs by an eaſy deſcent to the next fall. A gentleman, in whoſe field it riſes, and by whoſe houſe it runs, told me upon enquiry, that he uſes it both in his kitchen and brewhouſe, without any ſenſible ill effects, he being a pretty ancient, but healthy man, and long inhabitant of that place. It will bear ſoap, freezes quickly, and waters his grounds upon occaſion, with advantage. All the ill effects of it, that he can gueſs, are, that his horſes are uſually ſhort-breathed, which he imputes to the drinking of that water. I brought with me from *Minedeep* ſome ore, and ſome ſtones; but I think them ſo inconſiderable, that I ſhall not judge them worth ſending, unleſs you pleaſe to command them. I am, Sir,

Your moſt humble, and

moſt obedient ſervant

Ch. Ch. 5° *May*, 1666.

JOHN LOCKE.

POSTSCRIPT.

I HAD forgot to mention to you, that in their gruffs, after burning, (when they meet with hard rocks in their way, they make a fire upon them, that they may dig through the eaſier) they find it very dangerous to go down into them, as long as there remains any fire or heat in any chinks of the rocks.

SOME days ago the king doing me the honour to diſcourſe with me about the uſe of baroſcopes, was pleaſed to ſay, among other remarkable things, that at a time his majeſty then named, he went from *Whitehall* about ſix in the morning, towards the mouth of the river, attended by divers of the nobility, and particularly by one lord then preſent, whom his majeſty put in mind of the adventure; and then he added, that though the weather were exceeding fair, and likely to continue ſo, inſomuch that ſome of the courtiers congratulated to his majeſty ſo promiſing a morning; yet when they were once gone too far to return, he told them he thought they would be much miſtaken, and that they were to prepare for a ſtorm; which conjecture his majeſty grounded upon his having, unknown to the company, conſulted a good baroſcope before he went out, and found the mercury in it to have ſuddenly, and very notably ſubſided. And accordingly within a very few hours the event verified his majeſty's prediction, a ſudden ſtorm driving on the yatch he was in for divers leagues, at a very unuſual rate.

Nous apprenons de ces experiences, que puiſque le poids de l'air et le poids de l'eau, qui eſt dans les pompes, ſe tiennent mutuellement en equilibre, ils peſent preciſement autant l'un que l'autre; & qu'ainſi en connoiſſant la hauteur, ou l'eau s'éleve en tous les lieux du monde, nous connoiſſons en meſme temps, combien chacun de ces lieux eſt preſſé par le poids de l'air, qui eſt au deſſus d'eux; et partant.

Que les lieux, qui ſont au bord de la mer, ſont preſſez par le poids de l'air, qui eſt au deſſus d'eux juſques au haut de ſa ſphere, autant preciſement, que ſi au lieu de cét air on ſubſtituoit une colomne d'eau de la hauteur de 31 *pieds deux poulces.*

Ceux, qui ſont plus élevez de dix toiſes, autant que s'ils portoient de l'eau de la hauteur de 31 *pieds un poulce.*

Ceux, qui ſont élevez au deſſus de la mer de 500 *toiſes, autant que s'ils portoient de l'eau à la hauteur de* 26 *pieds onze poulces: & ainſi du reſte.*

Nous apprenons par ces experiences, que l'air, qui eſt ſur le niveau de la mer, peſe autant que l'eau, à la hauteur de 31 *pieds deux poulces; mais parce que l'air peſe moins ſur les lieux plus élevez que ſur le niveau de la mer; et qu'ainſi il ne peſe pas ſur tous les points de la terre egalement, & meſme qu'il peſe differemment par tout, on ne peut pas prendre un pied fixe, qui marque combien tous les lieux du monde ſont chargez par l'air, le fort portant le foible; mais on peut en prendre un par conjecture bien approchant du juſte; comme par exemple, on peut faire eſtat, que tous les lieux de la terre en general, conſiderez comme s'ils eſtoient également chargez d'air, le fort portant le foible, en ſont autant preſſez, que s'ils partoient de l'eau à la hauteur de* 31 *pieds; et il eſt certain, qu'il n'y à pas un demy pied d'eau d'erreur en cette ſuppoſition.*

Or nous avons veu, que l'air, qui eſt au deſſus des montagnes hautes de 500 *toiſes ſur le niveau de la mer, peſe autant que l'eau à la hauteur de* 26 *pieds* 11 *poulces.*

Et par conſequent tout l'air, qui s'étend de puis le niveau de la mer juſqu' au haut des montagnes, hautes de 500 *toiſes, peſe autant que l'eau à la hauteur de* 4 *pieds un poulce, qui eſtant à peu prés la ſeptiéme partie de la hauteur entiere; il eſt viſible, que l'air com-*

pris

compris depuis la mer juſques à ces montagnes eſt à peu pres la ſeptiéme partie de la maſſe entiere de l'air.

Nous apprenons de ces meſmes experiences, que les vapeurs, qui ſont épaiſſes dans l'air, lors qu'il en eſt le plus chargé, peſent autant que l'eau à la hauteur d'un pied huit poulces; puiſque pour les contrepeſer elles font houſſer l'eau dans les pompes à cette hauteur, par deſſus celle, ou l'eau contrepeſoit déja la peſanteur de l'air: de ſorte que ſi toutes les vapeurs, qui ſont ſur une contrée, eſtoient reduites en eau, comme il arrive, quand elles ſe changent en pluye, elles ne pourroient produire que cette hauteur d'un pied huit poulces d'eau ſur cette contrée. Et s'il arrive par fois des orages, ou l'eau de la pluye qui tombe vienne à une plus grande hauteur; c'eſt parce que le vent y porte les vapeurs des contrées voiſines.

Nous voyons auſſi de là, que ſi toute la ſphere de l'air eſtoit preſſée & comprimée contre la terre par une force, qui la pouſſant par le haut, la reduiſiſt en bas à la moindre place qu'elle puiſſe occuper, & qu'elle la reduiſiſt comme en l'eau, elle auroit alors la hauteur de 31 *pieds ſeulement.*

Et par conſequent, qu'il faut conſiderer toute la maſſe de l'air en l'eſtat libre ou elle eſt, de la meſme ſorte, que ſi elle euſt eſte autrefois comme une maſſe d'eau de 31 *pieds de haut à l'entour de toute la terre, qui euſt eſté rarefiée et dilatée extremement, et convertie en cet eſtat, ou nous l'appellons air, auquel elle occupe à la verite plus de place, mais auquel elle conſerve preciſement le meſme poids, que l'eau à* 31 *pieds de haut.*

Et comme il n'y auroit rien de plus aiſé, que de ſupputer, combien l'eau, qui environneroit toute la terre à 31 *pieds de haut peſeroit de livres; et qu'un enfant, qui ſcait l'addition et la ſouſtraction le pourroit faire; on trouveroit par le meſme moyen, combien tout l'air de la nature peſe de livres, puiſqne c'eſt la meſme choſe; et ſi on en fait l'épreuve, on trouvera, qu'il peſe à peu prés huit millions de millions de millions de livres.*

J'ay voulu avoir ce plaiſir, et j'en ay fait le compte en cette ſorte.

J'ay ſuppoſé, que le diametre d'un cercle eſt à ſa circonference, comme 7 *à* 22.

J'ay ſuppoſé, que le diametre d'une ſphere eſtant multiplié par la circonference de ſon grand cercle, le produit eſt le contenu de la ſuperficie ſpherique.

Nous ſçavons, qu'on à diviſé le tour de la terre en 360 *degrez: cette diviſion à eſté voluntaire, car on l'euſt diviſée en plus ou moins, ſi on euſt voulu, auſſi bien que les cercles celeſtes.*

On à trouvé, que chacun de ces degrez contient 50,000 *toiſes.*

Les lieues autour de Paris ſont de 2500 *toiſes; et par conſequent il y à* 20 *lieues au degré: d'autres en comptent* 25; *mais auſſi ils ne mettent que* 2000 *toiſes à la lieue; ce qui revient à la meſme choſe.*

Chaque toiſe à 6 *pieds.*

Un pied cube d'eau peſe 72 *libres.*

Cela poſé, il eſt bien aiſe de faire la ſupputation, qu'on cherche.

Car puiſque la terre à pour ſon grand cercle, ou pour ſa circonference . . . . . 360 *degrez.*

Elle à par conſequent tour de . . . . . 7200 *lieues.*

Et par la proportion de la circonference au diametre aura . . . . . 2291 *lieues.*

Donc en multipliant le diametre de la terre par la circonference de ſon grand cercle; on trouvera, qu'elle à en toute ſa ſuperficie ſpherique . . . . . 1649200 *lieues quarrées.*

C'eſt à dire . . . . . 103, 095, 000, 000, 000, *toiſes quarr.*

C'eſt à dire . . . . . 3711, 420, 000, 000, 000, *pieds quarr.*

Et parce qu'un pied cube d'eau peſe 72 *livres:*

Il s'enſuit, qu'un priſme d'eau d'un pied quarre de baſe, et de 31 *pieds de haut, peſe* 2232 *livres.*

Donc ſi la terre eſtoit couverte d'eau juſques à la hauteur de 31 *pieds, il y auroit autant de priſmes d'eau de* 31 *pieds de haut, qu'elle à de pieds quarrez en toute ſa ſurface.* (*Je ſcay bien, que ce ne ſeroient pas des priſmes, mais des ſecteurs de ſphere; et je neglige exprés cette preciſion.*)

Et partant elle porteroit autant de 2232 *livres d'eau, qu'elle à de pieds quarrez en toute ſa ſurface.*

Donc cette maſſe d'eau entiere peſeroit,

8283, 889, 440, 000, 000, 000, *livres.*

Donc toute la maſſe entiere de la ſphere de l'air, qui eſt au monde, peſe meſme poids de

8283, 889, 440, 000, 000, 000, *livres.*

C'eſt à dire, huit millions de millions de millions, deux cent quatre vingt trois mille huit cent quatre vingt neuf millions de millions, quatre cent quarante mille millions de livres.

Mr. *Paſcal*, in his ſmall Tract, either *De la Peſanteur de l'air*; or in that *De l'Equilibre des liqueurs.*

De cætero, feci haud ita pridem experimentum ponderandi aeris, quod pulcbrè ſucceſſit; nam ſumptâ vitreâ lagenâ, valde levi et ad lampadem ſufflatâ, ejus figuræ, qualem hic excuſam vides, magnitudine parvæ pilæ, quales habentur in ſphæriſteriis, non habente niſi minimam quandam aperturam, per quam immittatur pilus in extremitate orificii ſui B. ponderavi eam in bilance valde exacta, & frigida pondus habuit 78 *granorum cum dimidio: poſtea calefeci eam carbonibus impoſitam, & repoſui in bilancem eo ſitu, quo hic deſcriptum vides, nimirum orificio in imum verſo, & deprehendi eam vix habere pondus* 78 *granorum, tum immergendo orificium in aquam, refrigeſcere feci, & dum aer ſe condenſat pro modo, quo refrigeſcit lagena, intravit tantundem aquæ, quantum aeris calor antea expulerat; denique ponderans eam cum omni illa aqua deprehendi eam habere pondus* 72 *granorum & dimidii plus quam antea: unde concludo aerem, qui per ignem expulſus erat, ſe habere ad aquam, quæ in locum ſuum regreſſa erat uti* $\frac{1}{2}$ *ſe habet ad* $72\frac{1}{2}$, *aut uti ſe habet* 1. *ad* 145. *ſed potui in eo erraſſe; difficile quippe eſt in ea re omnino exactum eſſe; id ſaltem certò ſcio, quòd pondus aeris hoc modo ſit ſenſibile, & prolixe hic deduxi proceſſum meum, ut ſi te eadem curioſitas inceſſat, poſſis id eodem modo perficere experimentum. Vale.*

A

B

TITLE XVIII.

Of the Conſiſtency of the Air, its Rarity, Denſity, Fluidity, Subtilty.

A THIN but large bladder, wherein there was about the third part of the air it was capable of containing, being ſtrongly tied at the neck, and at the oppoſite part ſuſpended and clogged at the bottom, with a weight of 14 pound, ſo that it reſted on the floor, which ſuſtained it; the ſtrings, that tied the bladder, were well ſtretched before, and could not ſhrink a quarter of an inch without drawing up the weight. Then two fire-ſhovels, with ſmall coals and aſhes were applied at a convenient diſtance, and kept moving to warm and rarify the included air, without cracking the bladder; by which means, after ſome of the wrinkles of the bladder had been diſplayed, not without noiſe, the air being expanded, and conſequently the bladder a little ſwelled, and the whole ſtring ſhortened, the weight was raiſed and made to ſwing

ſwing like a pendulum. The ſame experiment being tried two or three times with a quarter of an hundred, ſucceeded not, though with large bladders, the heat ſtill either breaking the bladder with noiſe, or occaſioning ſome little leak, which hindered the deſired ſucceſs; though once we came ſo very near it, that it is ſcarce to be doubted, that if we had had good accommodations, it would have ſucceeded well, and that perhaps if the weight had been greater.

To try whether the corpuſcles of the air would dive into a liquor, that was expoſed but to the ordinary preſſure of the free air or atmoſphere; we covered the bottom of a cylindrical vial with filings of copper, and then poured on it an urinous ſpirit, to the height of about three fingers breadth; and on this liquor we poured oil of almonds to the thickneſs of a crown piece of ſilver, or that of about the fifth part of an inch; then we ſtopped the vial well, and left it in a quiet place for ſeveral days. The event was ſuch as we expected, namely, that the urinous liquor did then firſt acquire, and then loſe a blue tincture, both were done but ſlowly. And when the colour was pretty well loſt, (for the liquor was not clear, but ſomewhat troubled) we took out the cork, and kept the vial unſtopped for one minute of an hour, and then ſtopped it again, that in that ſhort time the upper part of the urinous ſpirit began to be tinged with blue, and within an hour, though the veſſel were all the while kept ſtopped, the ſky-colour reached to the lower part of the liquor, which at this time is wholly and deeply of that colour, the oil that ſwims above it being clear.

TITLE XIX.

Of the Heat and Coldneſs of the Air.

THOUGH the peripatetick doctrine about the limits and temperaments of the three regions, into which they divide the air, hath been ſo plauſibly propoſed, that it has been readily entertained, not only by the Ariſtotelian ſchools, but by the generality of philoſophers, as well modern as ancient: yet ſince I think it becomes a naturaliſt to conſider, not ſo much how eaſy a doctrine is, by reaſon of its concinnity, to be remembred or ſuppoſed, as how ſtrongly it is to be proved, I muſt not diſſemble, that as to this vulgar theory, I thing it fitter we ſhould wiſh it to be true, than that we ſhould believe it is ſo: for I confeſs, that upon the beſt informations I have been able to procure from travellers by land and ſea, or from writers, that relate rather what they have obſerved, than what they have been taught, I have been much tempted to queſtion the received doctrine of the ſchools about the regions of the air. And that you may judge, whether or no my thoughts be rational, the enſuing diſcourſe ſhall acquaint you with ſeveral of the particulars on which they are grounded.

WHAT I have in other papers written concerning cold, does not only make it leſs proper for me to treat of it indefinitely in this place, but would make it difficult for me to ſay much on this ſubject without repetition. And it were perhaps fitteſt for me to ſay nothing on an occaſion, wherein I have left myſelf little to ſay, that is new and pertinent; but yet ſince this title promiſes not any thing about cold in general, but only ſome leſs heeded particulars relating to the coldneſs of the air; that I may not leave it wholly unfurniſhed, I will refer to it a few inſtances that enſue.

THE phyſician elſewhere mentioned, that was lately at *Morocco*, anſwered me, that notwithſtanding the exceſſive heat reigned there in the day time, he felt the night very cold, and ſo he did the mountainous air in thoſe parts.

AN intelligent gentleman, that ſtayed a year in *Guinea*, and ſpent part of that

time in the land, anſwered me, that notwithſtanding the exceſſive heat of the climate, he was divers times, about four of the clock in the morning, reduced to be ready to tremble for cold, as he lay in his hammock, for about an hour together.

A LEARNED man, that lived at *Jamaica*, aſſured me, that when he laid in his hammock, about three or four foot from the ground, though he had much clothes under him, and little or none over him, he felt it cold beneath, and hot above.

IT is obvious to every man's ſenſe or obſervation, that the greater heat, that is uſually found in our air, during the ſummer, than in other ſeaſons of the year, has manifeſt effects upon ſuch eaſily agitable bodies as liquors, and upon the juices and fleſh of animals, and the ſofter parts of vegetables. But that even in places ſheltered from the ſun-beams, the warmth of a temperate ſummer ſhould be able ſenſibly to rarify and expand ſo cold and compact a body, as glaſs itſelf, would not be eaſily ſuſpected or believed. And yet, that this is one of the effects of the temperature of the air in ſummer, ſeems very probable by this experiment, that having two large fictitious cryſtal vials, I cauſed ſome ſtopples of the ſame matter to be exquiſitely ground, and fitted, this or that veſſel exactly cloſed, when the ſtopple was in it, was very eaſy to be opened in winter, and in the colder parts of the neighbouring ſeaſons; but in ſummer it was oftentimes ſo difficult to unſtop the ſame veſſel, that a man's force, though aſſiſted with a ſtring, was not able to pull out the ſtopple: ſo that I was often reduced to cauſe the necks of the vials to be held under a pump, or to be ſtirred to and fro in a veſſel full of water, that the coldneſs of that liquor might take off the expanſion, that the heat of the ſeaſon had given the glaſs, which being by this means made to ſhrink into its former dimenſions, the vial and ſtopple would be eaſily enough disjoined. This was tried in ſeveral veſſels, and in more than one more year. But to make this experiment ſucceſsfull, the two parts muſt at firſt have been exquiſitely adjuſted to one another, which in thoſe glaſſes, with ſtopples of the ſame matter, that are commonly ſold, they are not uſually found to be.

We are wont to attribute the effects we feel of the ſummer's heat, to the bare warmth of the air, and to the agitations, that ſuch warmth produces in the parts of our bodies, eſpecially in the blood, juices, and ſpirits; whereas it may very well happen, that we may find odd changes in ourſelves, upon very hot weather, which proceed not from the heat of the air as ſuch, but rather from this cauſe, that by ſuch a degree of heat, divers bodies, that we think not of, may be ſollicited to ſend forth effluvia, that have emitted none before, or at leaſt no ſuch quantity as could make them ſenſibly operative. And theſe effluvia may be the true and immediate cauſes of divers effects, that are unwarily aſcribed to the mere heat of the air, and that, which it produces in our bodies. To illuſtrate and confirm this conjecture, I ſhall propoſe the following experiment.

BEING in the heat of ſummer in the country, I took a ſomewhat large piece of fine amber, that I uſually employed about electrical experiments; and when the ſun had reached a conſiderable height above the horizon, I placed it in a ſhaded part of a window, on which he ſhined freely: though I left the amber here for a competent time, yet I could not find, that it would draw a piece of ſtraw, feather, or other light body, that at a convenient diſtance was held to it. But when I removed it a very little farther into a part of the window, into which the ſun-beams fell freely, they quickly put its parts into ſuch an agitation, as made it emit electrical effluvia, and readily attract thoſe light bodies, that would not ſtir before, and which it would ſoon, though not immediately, loſe the power of drawing, as before, if it were removed back into the neighbouring ſhaded part of the window.

MAY 26. Mr. *Nickſon*, who was four years governor of the Engliſh colony in *Hudſon's*

Hudſon's bay, anſwered me, that when they ſailed within a certain diſtance of floating iſlands of ice, if the wind blew from thence toward the ſhip, or, as the ſeamen ſpeak, if they were to the leeward of the ice, they could by the new and ſenſible cold they felt, know, that ſuch ice lay to windward of them, ſometimes even before they were able to diſcover it by ſight. And when I farther aſked, at what diſtance that might be, he anſwered, that it was ſometimes twelve or fifteen miles, if not twenty. He added, that uſually, when the wind blew from thoſe great maſſes of congealed water, it brought along with it a foggy air, which he ſuppoſed to come (as well as the cold) from the ice.

THE ſame gentleman anſwered me, that in that part of *Hudſon*'s bay, wherein he wintered, the rivers began to freeze about the latter end of *October*, or beginning of *November*, and uſually were not free from ice till about the middle or latter end of *May*, though he divers times took the latitude of *Charleton* iſland, the place moſt frequented by the Engliſh, and ſeated at the bottom of the bay, and found it to be near the ſame with that of *London*, and at moſt but about 52 degrees.

WHEN I enquired about the depth of the ice in the rivers, he anſwered, that they had often occaſion to obſerve it; for in the winter they made their wells there, (not in the ground) and were obliged to dig about ſix foot deep in the ice, before they could come at unfrozen water.

HE anſwered me, that when they ſent their men up into the country, their bottles of brandy would oftentimes ſo freeze, that about a fourth part of it would be turned into ice. And when I aſked, whether the unfrozen part of the liquor was not exceeding ſtrong, he anſwered me, that it was, and ſometimes ſo much ſo, as to be too fiery and unpleaſant to the taſte.

HE anſwered me, that he always found the ice freſh, that floated upon the ſea-water; and that when they wanted freſh water, or had a mind to ſpare what they had aboard, they often ſupplied themſelves out of the cavities of great floating maſſes of ice; in which hollow places the ſun-beams thawing ſome parts of the ice, they frequently found ſtore of liquor, that was produced by the action of the ſun-beams upon the ſuperior parts of the ice, whence the water ran into theſe cavities. He added, that when the ſeamen were in haſte, they uſed to relieve themſelves by cutting or breaking off pieces of the floating ice, and preſently melting it in their pots.

A LEARNED traveller, that made ſome conſiderable ſtay among the high Pyrenean mountains, anſwered me, amongſt other notable things, about which I made enquiry, that he had ſeveral times obſerved at the top of one or other of thoſe tall hills, that the air would be very hot, and that yet the ſame day, and perhaps within very few hours, the place would be covered with ſnow, though it were then ſummer time.

DOCTOR *N.* anſwered me, that the winds he felt at *Morocco* were ſo very hot, that they were ready to ſtifle him, ſeeming to him like the ſteams and ſmoke coming out of the mouth of an oven.

THE Ruſſian emperor's phyſician confirmed to me, that at *Archangel* (where he was more than once) they averred to him, that in winter time a northerly wind (which comes from the ſea) produces a kind of thaw, ſo as to make the eves drop, though a north-eaſt wind rather confirms the froſt; but on the contrary, a ſoutherly wind which, blows over a thouſand or a hundred miles of frozen land, does rather increaſe the froſt, than bring the thaw.

A VERY inquiſitive perſon, that viſited the lofty Pyrenean mountains, anſwered me, that he and his company had more than once obſerved, from the top or higher part

part of one of thoſe hills, that though it were fair weather there, yet a great way beneath them, the hill was ſurrounded with thick clouds, which produced ſtorms of rain on the lower grounds: and that (which was the chief point I enquired after) they could manifeſtly ſee, that out of thoſe clouds, when it thundered, lightnings flaſhed upward as well as they are generally obſerved to do it downward.

OCTOBER 19. Doctor *Stubbs* aſſured me, that having at *Jamaica* taken a bolt-head about two foot and a half in length, he uſually found, that betwixt 7 and 8 in the morning, which they there call the faint time (of the day) becauſe for want of the daily breezes, the exceſſive heat makes them to faint away; the water was wont to riſe in the neck but a quarter of an inch and a half, though at that time, by reaſon of the winds, men found the heat very ſupportable: and after noon was paſt, the water would ſubſide by degrees till towards the above mentioned time the next morning. This happened in a ſouth window, where the freſh winds came fully and freely in to beat upon the bolt-head, without any glaſs to ſkreen the veſſel from the wind.

HE added, that though the bolt-head were not ſtopped, yet the water did not even in that hot country decreaſe ſenſibly in eight or ten months.

A HEEDFUL perſon, that frequented the coaſt of *Sumatra* in the *South-Sea*, anſwered me, that he never obſerved ice or froſt, or ſnow, in that great iſland, but that he had known hail fall even in that torrid climate.

THOUGH the famous iſland of *Ceylon* lyes almoſt in the midſt of the torrid zone, namely, between the 6th and 10th degrees of northern latitude, yet an obſerving man, that lived many years upon it, told me, that in hills not ſo high, but that we might eaſily aſcend to the top in half an hour, the inequality of the air's temperature, as to heat and cold, was very great: for he had divers times obſerved in himſelf and others, that though at the bottom of the hill the heat was ſo great, as to oblige them to go almoſt ſtark naked, yet when they aſcended the hill, they found the air quite altered; and as they went up higher and higher, the cold increaſed upon them; ſo that notwithſtanding the heat, ſo uneaſy a motion as climbing had given them, the coldneſs of the air obliged them to put on unuſually warm clothes, and at the top of the hill they would for all that be ready to quake for cold.

CAPTAIN *Knox* anſwered me, that in 18 years, that he ſpent in the iſland of *Ceylon*, he never obſerved any ice or ſnow, nor any more than a little kind of meteor, that was between dew and hoar froſt, which ſometimes in winter mornings appeared very oddly, but quickly vaniſhed. And when I aſked, if he had not ſeen hail itſelf, he anſwered, that he never ſaw it but once, but the inhabitants looked upon it as a wonderful thing, unſeen by them before; that the hail was as large as a black cherry, but not very round, and ſeemed to have the corners melted, which made him think it had been formed high in the air; that for fear of miſtaking, he not only gathered ſome of it, but champed it between his teeth, and found it cold and hard, like our European hail; and that he was fain to be nimble in making his trials, becauſe when the hail came to touch the ground, it would melt away much more ſuddenly than one would have expected,

GREGORY being aſked, upon a very ſultry day, whether it were not very hot in *Germany*, made anſwer, to day has been ſomething hot; ſuch is the winter in *Suaquena*. *Ludolf.* hiſt. of *Ethiop.* L. I. c. 5.

Ludolp. hiſt. of *Ethiop.* L. I. c. 5.

THE heat of the iſland *Suaquena*, *Gregory* uſed to call infernal: for, ſays he, it excoriates the ſkin, melts hard Indian wax in a cabinet, and ſears your ſhoes like a red hot iron.

THE

THE higher you aſcend the mountains of *Ethiopia* from the coaſt of the *Red Sea*, the more temperate you ſhall feel the air, inſomuch that, as *Tellezius* witneſſes, in many regions of *Ethiopia* the ſummer heats are more mild than in *Portugal*, ſo many degrees diſtant towards the north; nay, there are ſome mountainous countries, as in *Samen*, where the cold is more dreadful than the heat. Nevertheleſs there falls none, or very little ſnow in theſe parts, only a certain ſmall ſort of hail ſometimes covers the ground, which at a diſtance looks like ſnow. *Ludolp.* hiſt. of *Ethiop.* L. I. c. 5.

AN intelligent perſon, that was for many years conſul of the Engliſh Nation at *Tripoli* in *Barbary*, being aſked ſome queſtions about the air, and the winds in thoſe parts, anſwered me, that when in ſummer time the wind blew over the great ſandy deſerts, that reach very far into the country, the wind, and the ſand it brought along with it, oftentimes felt as hot as the ſteams, that come out of an oven, when the mouth is opened, inſomuch, that he could not, without great inconvenience, turn his face towards the quarter whence the wind blew.

AN ingenious gentleman, that was employed in the French colony, on the coaſt of *Afric*, and lived in thoſe parts about five years, anſwered me, that in the iſland of St. *Louis*, or near it, at a certain ſeaſon of the year, when the hot winds blew from the continent, the ſand on the ſhores would be ſo ſcorching hot, that he was not able to ſtand upon it, but it would, through the ſoles of his ſhoes, ſcorch his feet, unleſs he walked very faſt. And then the air ſeemed to him to be thick, and, as he expreſſed it, heavy and hot, as if it came out of an oven. And when the wind blew from a wood, where divers elephants and other wild beaſts lay dead, the ſteams of their carcaſſes would make the air ſo ſtinking and offenſive, that it was ſcarce ſupportable.

In ſummo ejus montis, Idæ ſc. faſtigio ſacellum eſt, quod ædificiolo duntaxat conſtat ſaxis ſibi invicem impoſitis, & ſine calce cohærentibus, fornicis in modum conſtructo, ad tectum præbendum. Sublimi adeo loco eſt, & à vehementioribus ventis interdum ita perflato, ut lapilli inde transferantur. Paulo infra id ſacellum planities conſpicitur montibus undique cincta, in quâ multa ſunt paſcua, ubi arietes & capræ Cretenſes æſtate pingueſcunt. Si quis ex ſummo montis vertice undique proſpiciat, parum aberit, quin totius inſulæ ambitum videat cum aliis vicinis inſulis, Miſo, Cerigo, ſive Cythera reliquiſque Archipelagi. Aeris intemperies in hoc monte adeo magna eſt, quemadmodum ut in cæteris præcelſis montibus, ut in ipſis caniculæ ardoribus meridie, nullo etiam ſpirante vento, ingens ſentiatur frigus: qua de cauſa nec hyeme, nec æſtate quiſquam eum incolit. Nam licet paſtores interdiu ovium greges ad paſcua agunt, noctu tamen in valles ſe recipiunt. *Petri Bellonii, Lib.* I. *cap.* 1.

In the next chapter.

Latè porro patet hic mons, ejuſque radices utrinque maris littora, ut ante diximus, attingunt; nam licet urbi Candiæ ſunt vicinæ, meditullium tamen inſulæ occupat ipſe mons, adeo in ſublime evectus, ut nives ejus verticem perpetuo tegant; tamque frigida aura mediis etiam æſtatis ardoribus iſthic eſt, ut vix ferri queat; tametſi in convallibus magnus ſit æſtus.

Contigit id meæ experientiæ, quod etiam aliis contigiſſe audivi, ut aſcenderem ad ſummitatem uſque montis Veneris, qui omnium in Patavino agro altiſſimus eſt, ibi per totum diem habui aerem ſereniſſimum, ſed infra circiter medium montis vidi nubes, quæ me viſione vallium prohibebant, veſperi autem, poſtquam de illo monte deſcendi, inveni factam eo die infera parte magnam pluviam, cum in montis cacumine nihil pluiſſet; ex eo intellexi me tranſiiſſe per mediam aeris regionem, in qua eſt facta pluvia, nec tamen eam ſenſi frigidiſſimam, imò vix aliquam animadverti differentiam frigidioris & calidioris aeris, nam æſtivum tempus erat, pro æſtivo tempore eram veſtitus, nec tamen tantum frigoris, quod me læderet, ex eo loco percepi; pars igitur illa non eſt abſolutè frigida, ſed ſolùm comparatione inferi aeris calidioris. *Jacobi Zabarelli de regionibus aeris,* c. 8.

Idem de Alpibus proprio exemplo edoctus teſtatum reliquit Bartholinus Syſt. Phyſ. Inſtit. Succinct. de Terra, Aere, & Igne, c. 4. Reſp. 1.

DOCTOR *B.* anſwered me, that being at and near *Morocco*, he could ſee mount *Atlas* covered with ſnow, though it was then in the heat of ſummer, and exceſſively hot where he was.

AN intelligent traveller, that had viſited ſome high mountains, and particularly the *Alpes*, and the *Pico* of *Teneriffe*, anſwered me concerning this prodigious hill, that he found it very cold in aſcending towards the top; and that as for the mount *Cenis*, one of the famouſeſt of the *Alpes*, when he paſſed over it into *Italy*, though it were in *Auguſt*, and the weather very clear, yet he felt at the top a wind ſo cold, that he could ſcarce poſſibly endure it, and ſeemed to him the coldeſt, that in all his various travels he had ever felt; and yet ſome of the mountains ſeemed much higher being then covered with ſnow.

AN intelligent gentleman, that had been a traveller into the *Eaſt-Indies*, told me, that he never ſaw nor heard of any ſnow or ice in *Guinea*, but that in ſome parts of *Barbary*, where in the plains and vallies he found the heat ſcorch inſupportable, he could ſee the top of the mountains covered with ſnow, in which ſtate they continued all the year.

A MAN of letters, that lived in many countries of the *Eaſt-Indies*, being aſked by me divers queſtions, partly about other things, and partly about the temperature of the air in ſeveral regions, gave me, among other anſwers, this, that on the high mountain in the iſland of *Ceylon*, notwithſtanding the heat of the country, there was ſnow; and the like he ſaw on the tops of the mountains of *Congo*, though in the lower parts of the country they never have, that he heard of, either ice, ſnow, or hail.

ABOUT Midſummer, 1688, I placed in the cave a glaſs, with ſpirits, which ſtood above temperate about $\frac{1}{2}$ of one of the ſmall diviſions: another glaſs placed without, in a common room, ſtood at hot.

THE Chriſtmas following I placed the ſame glaſſes in the ſame places, and the glaſs in the cave ſtood, as before, about temperate; that without ſtood at froſt.

THE cave is cut into the bottom of a clift, that fronts to the ſea: the earth is about 80 foot above it, and it is cut right in about 130 foot.

THE other day two gentlemen belonging to the province of *New-Hampſhire* in *New-England*, (whence they came not long ſince) and employed by that colony to his majeſty here, anſwered me, that in the winter the coldeſt wind, that blows in the country, is the north-weſt; and being aſked again, what was their hotteſt wind in ſummer, they told me, it was likewiſe the north-weſt. At which anſwer being ſurprized, I aſked them, whether they could give any reaſon of ſo odd a phænomenon. Whereto they anſwered, that they aſcribed it to the large tract of the continent, and the great woods that lay to the north-weſt; which woods, they ſaid, in the winter had their branches, through which the wind paſt, all laden with ſnow: and in the ſummer, they ſaid, the cloſe air of the vallies, and the thick ſteams, that filled it, would conceive ſo intenſe an heat, that ſometimes in the heat of ſummer, when a ſudden puff of wind blew upon their faces from thoſe ſultry vales, it ſeemed to them, as if it came out of the mouth of a furnace, and would be ready to overcome them with the faintneſs produced by the heat and vapours it brought along with it.

Balbini hiſt. Bohem. L. 1. c. 9. De montibus,

De montibus ad Bavariam ſtantibus mira eſt Alberti Chanovii noſtri narratio: poſt Bergreichenſteinam (oppidum fodinis hodieque nobile) eſſe montes non tam ſitu (alii enim ad ſeptentrionem, alii ad meridiem latus obvertunt) quam cælo & temporibus adverſantes, vallibus

libus latiſſimis montes illos dirimentibus; monſtri inſtar eſt (quod ſe vidiſſe, & anno 1639. in rem præſentem veniſſe religioſiſſimus ille & apoſtolicus vir aſſerit) in altero monte ſæpius æſtatem, in altero appoſito hiemem dominari, ita ille ſiccus æſtivat, hic altiſſimis nivibus obſitus à viatore ſuperari non poteſt; ob eamque cauſam meſſes ipſæ variant, & dum in montibus ad nos obverſis demeſſa ſunt omnia, altera montium parte ſeges vireſcit: mirius illud, quod in Bieſſinenſibus & Czachrovienſibus agris in tractatu Piſnenſi, contiguis, quos unus tantum ſulcus dirimit ac dividit, deprehenditur: Czachrovienſes adhuc hibernant, cum in Bieſſinenſi cælum ardeat; ibi caput attollit humo frumentum, cum Czachrovii adoleſcit in culmum; elemento quoque diſpari, illud riget, hoc tepet & fervet, eâque ex cauſâ, dum Czachrovienſes bene pelliti ingrediuntur, Bieſſinenſes pellibus onerari ſe ſentiunt, villoſque deponunt. Aliquid tale anno 1652. mihi quoque accidiſſe memini: nam cum Glacio Zambergam in Bohemia contenderem, & Glacio ob nives altiſſimas certum vehiculi genus, quod trahas dicimus, ſumpſiſſem, ſuperatis montibus, qui comitatum Glacenſem à Bohemia dividunt, ſubitò alia rerum facies apparuit: altero enim montium latere viridia omnia reperimus, ſic ut trahæ nulli jam rei & uſui eſſent, & currum petere cogeremur, niſi in luto natare placuiſſet; at accolæ montium illorum quotannis id ſibi accidere confirmabant, ut unum latus montium profundiſſimæ nives contegerent, quando alterum latus lectiſſimos flores proferret, & cum ibi omnia ventis verti viderentur, apud ſe è floribus ſuaviſſimos odores efflari.

& de valle Lauezka, p. 29. Chanovſki in veſtigia Bob. pier, c. ult. Montes parte altera æſtatem, altera hiemem reſerunt. Id. ibid.

I LEARNED, by enquiry of an ingenious gentleman, who ſeveral times went into the Hungarian gold-mine at *Cremnitz*, that when he was drawn up out of the deep pit, or perpendicular groove, whoſe depth exceeded 100 feet; when he had aſcended above half the way, he found the air ſenſibly warm, and ſo it continued, till he came by many foot nearer the day, as the workmen call the orifice of the pit. And when I aſked, whether this notable and ſudden heat did not proceed from ſome mineral, through which he paſſed in that region of the earth, or part of the groove, he anſwered me, that he believed it did, in regard he was there ſurrounded with a vein or bed of native vitriol, ſome of one colour, ſome of another, which he found to be ſoft under ground, though it ſoon after hardened in the air: and of theſe differingly coloured ſorts of vitriol he brought up thence ſeveral pieces, ſome of which he preſented me. And when I aſked, whether the new heat he found in that part of the mine, did not proceed from its being much nearer than the lower part to the air, which at that time was hot; and whether he found the heat to increaſe as he came nearer the day; he anſwered in the negative, and told me, that after he had in his aſcent left beneath him that warm region, he found himſelf cold again in the ſuperior part of the groove, to which the vitriolate region did not reach.

I REMEMBER on this occaſion, that aſking an intelligent perſon, who had more than once croſſed the torrid zone, what expedient they uſed in his ſhip, to keep their beer and other liquors cool enough to be drinkable in thoſe ſultry climates; he anſwered, that their way was to take the bottle they mean to uſe, and wrap it about with a coarſe linen cloth dipped in the ſea-water, and then in ſome more convenient place of the ſhip hang it in the wind, which beating freely and inceſſantly upon it, would in no long time cool it to be potable enough. And this gentleman, who was an obſerving perſon, added farther, that having ſometimes for curioſity ſake taken away a bottle before it had been expoſed above half the uſual time, he was able to find by the taſte, that part of the beer or wine, that was next the ſides of the bottle to be refrigerated, whilſt the more inward parts of the liquor did yet continue hot.

THE *Czar*'s chief phyſician confirmed to me, that in the year 1664, or 63, extraordinary dry and great ſcopes of land were ſet on fire, and miſerably waſted by the great heat of the ſun. And he added, that the very laſt year he found the like to

have happened in *Norway*, particularly in a place called by us *Bear-haven*; where having ſeen the ruin of divers wood houſes burnt, and enquiring into the cauſe, he was anſwered, that the weather being very dry and hot, not only the graſs and other vegetables were ſcorched up, but thoſe wooden houſes among others were ſet on fire, which was confirmed to him by the governor of the place, and countenanced by this circumſtance, that he ſaw the country covered with a freſh and verdant livery of new graſs, brought up inſtead of that which was burnt, by ſome rains, that fell a while before.

A TRAVELLER and ſcholar being aſked by me, whether at *Mozambique*, which is thought the hotteſt place in the known world, he had never obſerved the houſes to be ſet on fire with the mere heat of the ſun? he anſwered me, that in the three months he ſtayed there, he ſaw no ſuch thing, but the inhabitants affirmed it to be not very unfrequent; and as he paſſed to and fro, ſhewed him divers houſes that had been ſo burnt; which was the leſs ſtrange, becauſe the houſes are not built of ordinary ſtone, whereof they have none there, but fetched from another place he named, where the ſtone is mingled with a ſubſtance, much of the nature of a ſulphur vivum. And he added, that he himſelf had divers times ſeen the ſtones ſo heated in hollow places, that muſket-bullets being expoſed there to the direct beams of the ſun, were in no very long time melted. He ſaid farther, that much of the exceſſive heat of *Mozambique* proceeded from the ſoil, which is exceeding bare and dry, conſiſting of white ſand, and that it is not covered with graſs, nor ſhaded with trees.

AN obſerving traveller, that had been at *Mozambique*, being for the moſt part, where it is not ſhaded with trees, ſandy, he found the ſun, which was almoſt in the zenith, to heat the ground ſo much, that he was not able to ſtand ſtill for ſome time, but was fain to keep walking to avoid burning the ſoles of his feet.

Un gentilhomme de mes amis plein de merite et digne de creance me mande, entre pluſieurs choſes extraordinaires, qu'il à obſervées proche de Barege aux Pyrenées, qu'il y à des ponts de niege d'un rocher à l'autre pardeſſous leſquelles paſſent des torrents. Il en a vu un, qui embreſſe deux torrents, et qui a vint neuf toiſes de long et autant de large par deſſus. Il y a par deſſous ce pont neuf toiſes et demi entre les naiſſances de la voute, les ponts ſont tellement forts, qu'il eſtime que du canon y paſſeroit, et il a fait rouler de groſſes pieces par deſſus.

Le tremblement de terre, que ſouffrit la Syrie l'an 750. *ne fut gueres moins ſurprenant; puiſque la terre s'eſtant ouverte de toutes partes, pluſieurs villes furent abîmées, d'autres renverſées, et quelques unes, qui eſtoient elevées ſur des hauteurs, tranſportées dans des plaines eloignées de ſix mille de leur ſituation. On en peut dire autant da froid extreme, qui l'an* 753 *glaça le Pont-Euxin à la longueur de cent mille, et toute l'eſtendue de la mer voiſine, juſqu' à* 30 *coudées de profondeur, quoy qu'on ne fût encore qu'au commencement de l'automne. Journal de Sçavans* III. 1685.

ASKING an intelligent perſon, that lived a good while in *Guinea*, how they did to keep their water cool in ſo hot a place, he told me, that in ſome corner of their huts they were wont to make holes in the ground, in which they buried over night the long earthen jars, or other veſſels, ſo as that the orifice of the veſſels might be lower (though not very much ſo) than the level of the ground. By this means the water would become drinkable, with ſome coolneſs, from the beginning of the morning to nine or ten of the clock, after which it would grow diſtaſtefully hot. He added, that when they were abroad in the fields, he did as well cool his water, by putting it into callibaſhes, and hanging them all night upon the branches of trees, eſpecially where they were expoſed to the wind.

FEB-

FEBRUARY. Since now I have ſpoken ſo much of the cold, I hope it will not be too coldly taken, if in a few words I make it ſome way to appear unto our readers.

WE made three differences of the cold, all according to the places: in our houſe, in the woods, and in the open air, upon the ice, in our going to the ſhip.

FOR the laſt, it would be ſometimes ſo extreme, that it was indurable; no clothes were proof againſt it, no motion could reſiſt it. It would, moreover, ſo freeze the hair on our eye-lids, that we could not ſee; and I verily believe, that it would have ſtifled a man in a very few hours: we did daily find by experience, that the cold in the woods would freeze our faces, or any part of our fleſh that was bare; but it was yet not ſo mortifying as the other. Our houſe on the outſide was covered two third parts with ſnow, and on the inſide frozen and hung with icicles. The clothes on our beds would be covered with hoar froſt, which in this little habitacle was not far from the fire. But let us come a little nearer to it. The cook's tubs, wherein he did water his meat, ſtanding about a yard from the fire, and which he did all day ply with melted ſnow-water; yet in the night-ſeaſon, whilſt he ſlept but one watch, would they be firm frozen to the very bottom: and therefore was he fain to water his meat in a braſs kettle cloſe adjoining to the fire; and I have many times both ſeen and felt, by putting my hand into it, that ſide, which was next the fire, was very warm, and the other ſide an inch frozen. I leave the reſt to our cook, who will almoſt ſpeak miracles of the cold. The ſurgeon, who had hung his bottles of ſyrups, and other liquid things, as conveniently as he could, to preſerve them, had them all frozen. Our vinegar, oil and ſack, which he had in ſmall caſks in the houſe, were all firm frozen. It may further in general be conceived, that in the beginning of *June*, the ſea was not broken, and the ground was yet frozen; and thus much we found by experience in the burying of our men; in ſetting up the king's ſtandard towards the latter end of *June*; and by our well, at our coming away in the beginning of *July*, at which time, upon the land, for ſome other reaſons, it was very hot weather. Capt. *James*.

Obſervations on the top of the Pyreneans.

Monſieur *L. J.* confirmed to me what he had formerly told me, that upon the higheſt mountain of the Pyreneans, called *Pic de Midi*, he aſcended at the end of *Auguſt*, or the beginning of *September* (in the morning) to the very top, where, he and his company ſpread a tent, and ſtaid till the evening: he ſays, he found the air temperate where the ſun did not beat; but on that ſide of their bodies, whereon the ſun ſhone, the heat was exceeding great, and was offenſive, even to them, that ſat in the tent of oiled cloth, if they ſat too near the ſunny ſide of the tent: they ſometimes had wind at the top of the hill, which they found to blow cool enough, (and found it very cold, when they returned to the bottom.) This hill is ſo high, that it may be ſeen from *Montauban*, which is 27 leagues diſtant.

WHEN I aſked, whether the air in thoſe places, where the ſun did not beat, was conſiderably cold? he told me, that the exerciſe they had been put to in aſcending the top of the hill (for the moſt part of the way they rid up) kept them from being very competent judges of that; but they found the wind northerly, though weak, yet very cooling; and the north ſide of the mountain was even then covered with ſnow, and ſcarce at all paſſable.

AN ingenious phyſician Dr. *B.* that has been in divers of the inland parts of *Africa*, among other anſwers, that he returned to the queſtions that I aſked him, about the temperament of the air in thoſe parts, gave me this memorable one, that having had occaſion at *Morocco* to uſe ſome good dried fine jalap, that he had brought with him out of *England*, he found it by the heat of the air to be melted, and by conſequence to be impulverable, in which ſtate it continued whilſt he lived in that country; but

when he was returned to *Tangier*, he found it both there, and in the neighbouring parts, pulverable again.

P. Francesco Berretto relatione della provincia di Malabar. f. 52.

Nel capo di Comorino ſi termina coſi l' eſta, come l' inverno dalla parte, di la dal capo verſo Notte, & dal' altra parte correſpond il tempo aſſai contrario è diverſo, di maniera che, chi va navigando, per quella coſta nel meſe di Ottobre, ſino ad Aprile, naviga nel eſta, è non puo in tutto queſto tempo paſſare il capo per eſſer ivi la ſtagione dell inverno, et il Padre, che reſiede nelle Chics ch'appartengono al Capo di Comorino ne alcune la ſtate, il che è coſa di gran meraviglia, eſſendo cio nel medeſſimo tempo nella diſtanza ſolamente di due, è tre miglia.

An eminent virtuoſo anſwered me, that in *Tirol* he had viſited a very deep mine, into which he deſcended three hundred Klaſters, which by his computation makes about eighteen hundred of our feet: that he paſſed not through, that he took notice of, one hot region by the way. That at the bottom of the mine he breathed very freely, becauſe of the air ſhafts, by which acceſs was given laterally to the ſuperior air; and that being thinly clothed with one of the digger's habits, he found at the bottom the air temperate, as to heat and cold, though it were then ſummer-ſeaſon of the year: ſo that notwithſtanding what is ſaid of antiperiſtaſis, no intenſe cold was retreated thither, to ſhun the heat of the ſuperior air.

An ingenious gentleman, very converſant in our Engliſh mines, of one of which he is owner, anſwered me, that the deepeſt mine he had particularly viſited, was a tin mine, whoſe depth was ſixty-ſix fathoms, that is almoſt four hundred foot. That deſcending into this mine in ſummer, he found it very cold at the bottom, and the greateſt part of the way going down, without perceiving any hot region. And when I aſked him, how ſoon he began to find a ſenſible cold in deſcending, he told me, that he found it within two fathom or leſs of the orifice of the pit; and that in this and divers other mines he perceived a ſenſible cold to begin before he got down a yard, or perhaps half a yard beneath the upper part of the faſt, as the mine-men call the ſolid earth, in which they diſtinguiſh from the looſe earth, that lyes above it; and is, if I may ſo call it, the ſcurf of the earth, that is far more light and porous than the other, though it be upon this looſe earth that plants grow, and into which even great timber trees themſelves ſhoot, and ſpread their roots, ſeldom or never reaching to, or penetrating into the faſt, though this lye ſometimes near enough to the external ſurface of the cruſty earth.

An exact Relation of the Pico Teneriff, *taken from Mr.* Clappham.

ABOUT the 20th of *Auguſt*, 1646, Mr. *Clappham*, together with Mr. *Philip Ward*, *John Webber*, *John Cowling*, *Thomas Bridge*, and *George Cove*, all of them very conſiderable merchants, and worthy of credit, with one guide, ſervants and horſes to carry their wine and proviſions, did ſet out from *Oratava*, a port-town in the iſland of *Teneriff*, ſituated on the north, at two miles diſtance from the main ſea: they travelled from twelve at night till eight in the morning, by which time they got to the top of the firſt mountains towards the *Pico de Teraira*; here, under a very great and conſpicuous pine-tree they brake their faſt, dined, and refreſhed themſelves till two in the afternoon, and then proceeded through much ſandy way, over many lofty mountains, but naked and bare, and not covered with pine-trees, as their firſt night's paſſage was, which expoſed them to exceſſive heat, till they arrived to the foot of the *Pico*, where they found many huge ſtones, which ſeemed to have been fallen down from ſome ſuperior part. But before we proceed farther to

give any account of this journey, give me leave here to interſert the opinion of Dr. *Pugh*, a perſon of very great reputation, at this time in the city, who lived twenty years himſelf on the place, both in the quality of a phyſician, and a merchant, and was very curious and inquiſitive into all that was in the iſland: his opinion is, that the whole iſland of *Teneriff*, being a ground mightily impregnated with brimſtone, did in former times take fire, and blow up all, or near upon all at the ſame time; and the many mountains of huge ſtones calcined and burnt, which appear every where about the iſland, eſpecially in the ſouth-weſt parts of it, were raiſed and heaved up out of the bowels of the earth, at the time of the general conflagration; and the greateſt quantity of this ſulphur lying about the centre of the iſland, raiſed up the *Pico* to the height, at which it is now ſeen. And he ſays, that any one upon the place, that ſhall carefully note the ſituation and manner of theſe calcined rocks, how they lye for three or four miles almoſt round the bottom of the *Pico*, and in ſuch order one above another, almoſt to the very ſugar-loaf (as it is called) as if the whole ground, riſing up together with the accenſion of the brimſtone, the torrents and rivers of it did with a ſudden eruption, roll and tumble them down from the reſt of the rocks, eſpecially (as we ſaid before) to the ſouth-weſt; for on that ſide, from the very top of the *Pico*, almoſt to the ſea-ſhore, lye huge heaps of theſe burnt rocks, one under another; and there remain to this time the very tracts of the rivers of brimſtone, as they ran over all this quarter of the iſland, which has ſo waſted the ground beyond recovering, that nothing can be made to grow there, but broom. But on the north ſide of the *Pico*, few or none of theſe ſtones appear; and he concluded hence, that the vulcano diſcharged itſelf chiefly to ſouth-weſt. He adds farther, that mines of ſeveral metals were broken and blown up at the ſame time; theſe calcined rocks reſembling ſome of them iron ore, ſome ſilver, and others like copper, particularly at a certain place in theſe ſouth-weſt parts, called the *Azuleios*, being very high mountains, where never any Engliſh but himſelf (that he ever heard of) was. There are vaſt quantities of a looſe blueiſh earth, intermixed with blue ſtones, which have on them a yellow ruſt, as that of copper and vitriol, and likewiſe many little ſprings of vitriolate waters; here he ſuppoſes was a copper-mine. And he was told by a bell-founder of *Oratava*, that out of two horſe-loads of earth, he got as much gold as made two large rings: and a *Portugueſe* told him, who had been in the *Weſt-Indies*, that his opinion was, there were as good mines of gold and ſilver there, as the beſt in the *Indies*. There are likewiſe hereabouts nitrous waters, and ſtones covered with a deep ſaffron-coloured ruſt, and taſting of iron. And farther he mentions one Mr. *Gilbert Lambell*, a friend of his, who of two lumps of earth or ore, brought from the top of this ſide the mountain, made two ſilver ſpoons. All this he confirms from the late inſtance of the *Palm* iſland, eighteen leagues from *Teneriff*, where a vulcano was fired about twelve years ſince, the violence whereof made an earthquake in this iſland ſo great, that he and others ran out of their houſes, fearing they would have fallen upon their heads: they heard the noiſe of the torrents of flaming brimſtone, like thunder, and ſaw the fire as plain by night, for about ſix weeks together, as a candle in the room; and ſo much of the ſand and aſhes brought from thence, by the wind, by clouds, fell on his hat, as filled a ſand-box for his ink-horn. Thus far he.

To reſume therefore the narrative of their journey; about ſix a clock this evening, they began to aſcend on the *Pico*; but being now a mile advanced, and the way no more paſſable for their horſes, they quitted and left them with their ſervants. In this mile's aſcent ſome of their company grew very faint and ſick; and from Dr. *Pugh*'s report of eighteen in his company, that went up about the middle of *Auguſt*, long after this, but ten got up, and theſe had all drank very plentifully below; the reſt

to

ſo diſordered by fluxes, vomitings, and aguiſh diſtempers, they could go no farther: their horſes hair ſtood upright, like briſtles, with the vehement cold, who ſtood ſhaking, and refuſed to eat any thing till they came down. But calling for ſome of their wine, which was carried in ſmall barrels on a horſe, they found it ſo wonderfully cold, that they could not drink it, till they had kindled a fire to warm it, although yet the temper of the air was very calm and moderate; but when the ſun was ſet, it began to blow with violence, and grew ſo cold, that taking up their lodging under certain great ſtones in the rocks, they were conſtrained to keep great fires before the mouth of them all night. About four in the morning they began to mount again, and being come about a mile up, Mr. *Cowling*, one of the company, failed, and was able to proceed no farther. Here begin the black rocks. The reſt purſued their journey till they arrived to *Sugar-Loaf*, where they begin to travel again in a white ſand, being foreſhod with ſhoes, whoſe ſingle ſoles are made a finger broader than the upper leather, to encounter this difficult and unſtable paſſage, till they are half way up; and a ſpaniel, that went up afterwards with Dr. *Pugh*, (as he relates) went crying all the way, having his ſkin burnt off his feet; and then being aſcended as far as the black rocks, which are all flat, and lye like a pavement, they climbed within a mile of the very top of the *Pico:* but Mr. *Clappham*, who was the foremoſt, would have perſuaded Mr. *Cove* to deſcend again, as imagining the top of all on fire; but at laſt overcoming that apprehenſion, and perſiſting, they gained the ſummit, where they found no ſuch ſmoke as appeared a little below, but a continual breathing of a hot and ſulphureous vapour, which made their faces extremely ſore.

In this paſſage they found no conſiderable alteration of air, and very little wind; but being at the top, it was ſo impetuous, that they had much ado to ſtand againſt it, whilſt they drank the king's health, and fired each of them a piece: here they alſo broke faſt, but found their ſtrong waters had quite loſt its force, and was become almoſt inſipid, whilſt their wine was rather more ſpirituous and briſk than it was before.

The top on which they ſtood being not above a yard broad, is the brink of a pit called the *Caldera*, which they judged to be about a muſket ſhot over, and near fourſcore yards deep, in ſhape like a cone, within hollow like a caldron, and all over covered with ſmall looſe ſtones, mixed with ſulphur and ſand, from heat; and ſtirred up with any thing, puffs and makes a noiſe, and ſo offenſive, that Dr. *Pugh* was almoſt ſtifled with the ſudden emanation of vapours, upon the removing of one ſtone of theſe; theſe ſtones are ſo hot, as they are not to be eaſily handled: they deſcended not above four or five yards into the *Caldera*, in regard of its ſliding from their feet, and the difficulty; but ſome have adventured to the bottom. Other obſervable materials they diſcovered none, beſides a clearer ſort of ſulphur, which looks like ſalt upon the ſtones.

From this famous *Pico* they could ken the grand *Canaries*, fourteen leagues diſtant; *Palma* 18, and *Gomera* 7 leagues; which interval of ſea ſeemed to them no larger than the river of *Thames* about *London:* they diſcerned alſo the *Hierro*, being diſtant above twenty leagues, and ſo to the utmoſt limits of the ſea much farther.

So ſoon as the ſun appeared, the ſhadow of the *Pico* ſeemed to cover not only the whole iſland, and the grand *Canaries*, but the ſea to the very horizon, where the top of the *Sugar-Loaf*, or *Pico*, viſibly appeared to turn up, and caſt its ſhadow into the air itſelf, at which they were much ſurpriſed. But the ſun was not far aſcended when the clouds began to riſe ſo faſt, as intercepted their proſpect, both of the ſea, and the whole iſland, excepting only the tops of the ſubjacent mountains, which ſeemed to pierce them through.

Whether

WHETHER theſe clouds do ever ſurmount the *Pico*, they could not ſay; but to ſuch as are far beneath, they ſometimes ſeem to hang above it, or rather wrap themſelves about it, as conſtantly when the north-weſt winds blow: this they call the Cap, and is a certain prognoſtic of enſuing ſtorms.

MR. *John Webber*, one of his company, who had made a journey two years after, arriving at the top of the *Pico* before day, and creeping under a great ſtone to ſhroud himſelf from the cold air, after a little ſpace, found himſelf all wet, and admiring whence it ſhould proceed, perceived it at laſt to come from a perpetual trickling of the water from the imminent rocks above him.

MANY excellent and very exuberant ſprings they found iſſuing from the tops of moſt of the other mountains, guſhing out in great ſpouts, almoſt as far as the huge pine-tree which was mentioned.

HAVING ſtayed ſome time upon this top, they all deſcended by the ſandy way, till they came to the foot of the Sugar-loaf, which being ſteep, even almoſt to a perpendicular, they ſoon paſſed: and here they meet a cave of about ten yards deep, and fifteen broad, being in ſhape like an oven or cupola, having a hole at the top, which is near eight yards over; by this they deſcended (an active Spaniard ſhewing them the way) by a rope, which their ſervants held at the top, whilſt the other end being faſtened about his middle, he ſwings himſelf, till being over a bank of ſnow, he ſlides down and lights upon it. They are forced to ſwing thus in the deſcent, becauſe in the middle of the bottom of this cave, oppoſite to the overture at the top, is a round pit of water, reſembling a well, the ſurface whereof is about a yard lower than the ſnow, but as wide as the mouth at the top, and is about ſix fathom deep, as Mr. *Lambell* reports, who plumbed it. They ſuppoſe this water not a ſpring, but diſſolved ſnow, or water blown in; for ſome years it lyes ſo full, one cannot get into the cave for water trickling through the rocks.

ABOUT the ſides of the grott, for ſome height is ice, and icicles hanging down to the ſnow: but being quickly weary of this exceſſive cold place, and drawn up again, they continued their deſcent from the mountains, by the ſame paſſages they went up the day before, and ſo about five in the evening arrived to *Oratava*, from whence they ſet forth: their faces were ſo red and ſore, that to reduce them and cool them, they were forced to waſh and bathe them in whites of eggs, *&c.*

THE whole altitude of the *Pico* in perpendicular is vulgarly eſteemed to be two miles and a half.

No trees, herbs, or ſhrubs, in all the paſſage, but pines; and amongſt the white ſands a kind of broom, being a buſhy plant; and at the ſide where they lay all night, a kind of cardon, which has ſtems of eight foot high, the trunk near half a foot thick, every ſtem growing in four ſquares, and emerging from the ground like tuffets of ruſhes; upon the edges of theſe ſtems grow very ſmall red buttons or berries, which being ſqueezed, produce a poiſonous milk, which lighting upon any part of a horſe, or other beaſt, fetches off the hair from the ſkin immediately: of the dead part of this they made their fires all night. This plant is alſo univerſal over the iſland, and is haply, and as I conjecture, a kind of euphorbium.

IN ſome part of this iſland alſo there grows a crooked ſhrub, which they call Legnan-vell, which they bring for *England* as a ſweet wood. There are likewiſe apricots and peaches, in ſtandards, which bear twice a year: pear-trees alſo which are as pregnant; almonds of a tender ſhell, palms, plantanes, oranges and lemons, eſpecially the pregnadas, which have ſmall ones in their bellies, from whence they are ſo denominated. Alſo they have ſugar-canes, and a little cotton and colloquintida; the roſes blow at Chriſtmas; there are good carnations, and very large, but tulips will

not grow or thrive there: ſampier clothes the rock in abundance, and a kind of clover the ground. Another graſs growing near the ſea, which is of a broader leaf, ſo luſcious, as it will kill a horſe, that eats of it, but no other cattle. There is alſo an herb which they make thread of. Eighty ears of wheat have been found to ſpring from one root, but it grows not very high; the corn of this is tranſparent and bright, like unto the pureſt yellow amber; and one buſhel has produced 130 in a ſeaſonable year.

THE canary-birds (which they bring to us in *England*) breed in the barrancos of gills, which the water has fretted away in the mountains, being places very cold. There are alſo quails, partridges larger than ours, and exceeding beautiful; great wood-pigeons, turtles at ſpring, crows, and ſometimes from the coaſts of *Barbary* appears the faulcon. Bees are carried into the mountains, where they proſper wonderfully.

THEY have wild goats on the mountains, which climb to the very top of the *Pico* ſometimes. Alſo hogs, and multitudes of conies: camels are brought from *Lancerote*, beſides other cattle.

FISH. The cherna, a very large and excellent fiſh, better taſted than any we have in *England*. The mero, dolphin, ſhark, lobſters without the great claws, muſcles, periwinkles, and the clacas, which is abſolutely the very beſt ſhell-fiſh in the world; they grow on the rocks, five or ſix under one great ſhell, through the top whereof they peep with their nebs, from whence (the ſhells being broken a little more open with a ſtone) they draw them forth. There is likewiſe another fiſh like an eel, which has ſix or ſeven tails of a ſpan in length, united to one head and body, which is alſo as ſhort. Beſides theſe they have turtles and cabridos, which are preferable before our trouts.

THE iſland is full of ſprings of pure water, taſting like milk; and in *La Laguna*, (where the water is not altogether ſo limpid and clear) they percolate it through a kind of ſpungy ſtone cut in form of a baſon.

THE vines which afford thoſe excellent wines, grow all about the iſland, within a mile of the ſea; ſuch as are planted farther up, are nothing eſteemed, neither will they thrive in any other iſlands.

FOR the Guanchios, or the ancient inhabitants, Dr. *Pugh* gives this full account.

SEPTEMBER 3. about twelve years ſince, he took his journey from *Guimar*, a town inhabited for the moſt part by ſuch, as derive themſelves from the old Guanchios, in the company of ſome of them, to view their caves, and the bodies buried in them. This was a favour they ſeldom permit to any, (having in great veneration the bodies of their anceſtors, and likewiſe being moſt extremely againſt any moleſtation of the dead) but he had done many ſeveral eleemoſinary cures amongſt them, (for they are generally very poor, yet the pooreſt thinks himſelf too good to marry with the beſt Spaniard) which endeared him to them exceedingly, otherwiſe it is death for any ſtranger to viſit thoſe caves or bodies.

THESE bodies are ſewed up in goat-ſkins, with thongs of the ſame, with very great curioſity, particularly in the incomparable exactneſs and evenneſs of the ſeams; and the ſkins are made very cloſe and fit to the bodies: moſt of theſe bodies are entire, the eyes cloſed, hair on the head, ears, noſe, teeth, lips, beard, all perfect, only diſcoloured, and a little ſhriveled; likewiſe the pudenda of both ſexes. He ſaw about three or four hundred in ſeveral caves; ſome of them are ſtanding, others lye on beds of wood, ſo hardned by an art they had, (which the Spaniards call *curar*, to cure a piece of wood) which no iron can pierce or hurt. He ſaid, that one day being a hunting, a ferret (which is in uſe there) having a bell about his neck, ran after a coney into a hole, where they loſt the ſound of the bell; the owner being afraid he ſhould

ſhould loſe his ferret, ſeeking about the rock and ſhrubs, found the mouth of a cave, entring in, was ſo affrighted, that he cried out: it was at the ſight of one of theſe bodies, very tall and large, lying with his head upon a great ſtone, his feet ſupported by a little wall of ſtone, the body reſting on a bed of wood, as before was mentioned.

THE fellow being now a little out of his fright, entered in, and cut off a great piece of the ſkin, that lay on the breaſt of his body, which the doctor ſays was more flexible and pliable than ever he felt any kid leather glove, and yet ſo far from being rotten, that the man made uſe of it for his flail many years after.

THESE bodies are very light, as if made up of ſtraw: and in ſome broken limbs, he obſerved the nerves and tendons, and alſo ſome ſtrings of the veins and arteries very diſtinctly.

HIS great care was to enquire of theſe people, what they had amongſt them of tradition, concerning the embalming and preſervation of theſe bodies? From ſome of the oldeſt of them (above a hundred and ten years of age) he received this account: that they had of old one particular tribe of men, that had this art amongſt themſelves only, and kept it as a thing ſacred, and not to be communicated to the vulgar; theſe mixed not with the reſt of the inhabitants, nor married out of their own tribe, and were alſo their prieſts and miniſters of religion: that upon the conqueſt of the Spaniard, they were moſt of them deſtroyed, and the art loſt with them, only they held ſome traditions yet of a few ingredients, that were made uſe of in this buſineſs.

THEY took butter of goat's milk, (ſome ſaid hog's greaſe was mingled with it) which they kept in the ſkins for this purpoſe; in this they boiled certain herbs; 1ſt, A ſort of wild lavender, which grows there in great quantities on the rocks. 2dly, An herb called jara, of a very gummy and glutinous conſiſtence, which now gtows under the tops of the mountains only. 3dly, A kind of a cyclamen, or ſow-bread. 4thly, Wild ſage growing plentifully in this iſland. Theſe, with ſtones bruiſed and boiled in the butter, rendered it a perfect balſam. This prepared, they firſt unbowelled the corps; and in the poorer ſort, to ſave charges, they took out the brain behind: and theſe poor alſo were ſewed up in ſkins with the hair on, whereas the richer were (as was ſaid before) put up in ſkins ſo finely and exactly dreſſed, as they remain moſt rarely pliant and gentle to this day. After the body was thus ordered, they had in a readineſs a lixivium, made of the bark of pine-trees, with which they waſhed the body, drying in the ſun in ſummer, and in ſtoves in winter, this repeating very often. Afterwards they began their unction with the balſam, both without and within, drying it again, as before: this they continue till the balſam had penetrated itſelf into the whole habit, and the muſcles in all parts appeared through the contracted ſkin, and the body became exceeding light; then they ſewed them up in the goat-ſkins, as already mentioned. He was told by theſe ancient people, that they have above twenty caves of their kings and great perſons, with their whole families, yet unknown to any but themſelves, and which they will never diſcover. Laſtly, he ſays, that bodies are found in the caves of the grand *Canaries*, in ſacks, and quite conſumed, not as thoſe in *Teneriff*. Thus far of the bodies and embalming. Anciently when they had no knowledge of iron, they made their lances of wood, hardened as before, ſome of which the doctor has ſeen: he has alſo ſeen earthern pots ſo hard, that they cannot be broken, of theſe ſome are found in the caves, and old barrancos, and uſed by the poorer ſort of people, that find them, to boil meat in; likewiſe they did curar ſtone itſelf, that is to ſay, a kind of ſlate now called tabona, which they firſt formed to an edge or point, as they had occaſion to uſe them, either as knives, or lancets to let blood.

THEIR food was barley roaſted, and then ground with little mills, which they made of ſtones, and mixed with milk and honey; this they ſtill fed on, and carried it on their backs in goat-ſkins.

TO this day they drink no wine, nor care for fleſh; they are generally very lean, tall, active, and full of courage.

HE himſelf has ſeen them leap from rock to rock, from a very prodigious height, till they came to the bottom, ſometimes making ten fathom deep at one leap. The manner is thus:

FIRST, they tertiate their lance, (which is about the bigneſs of a half-pike) that is, they poiſe it in their hand; then they aim the point of it at any piece of a rock, upon which they intend to light, ſometimes not half a foot broad; at their going off they clap their feet cloſe to the lance, and ſo carry their bodies in the air; the point of the lance firſt comes to the place, which breaks the force of their fall; then they ſlide gently down by the ſtaff, and pitch their feet upon the very place they firſt deſigned, and from rock to rock, till they come to the bottom.

THEIR novices ſometimes break their necks in learning. He added ſeveral ſtories to this effect, of their great activity in leaping down rocks and clifts, and how eight and twenty of them made an eſcape from the battlement of an extraordinary high caſtle in the iſland, when the governor thought he had made ſure of them.

HE told alſo, (and the ſame was ſeriouſly confirmed by a Spaniard, and another Canary-merchant then in the company) that they whiſtle ſo loud, as to be heard five miles off; and that to be in the ſame room with them when they whiſtle, were enough to endanger breaking the tympanum of the ear: and added, that he being in the company of one, that whiſtled his loudeſt, could not hear perfectly for fifteen days after, the noiſe was ſo great.

HE affirms alſo, that they throw ſtones with a force as great as that of a bullet, and now uſe ſtones in all their fights, as they did anciently.

MR. *Sydenham* told me this day, that upon the 18th of *Auguſt*, he and his company began their journey toward the pike of *Teneriff*, ſetting out from *L'Oratava*, a town ſeated on the lower part of the mountain, from which town to the ſea there are three miles of way always deſcending.

HE began his journey on Sunday about 10 a clock at night, and travelled till five in the afternoon of the Monday following, reſting two hours by the way; the ground was continually riſing, and during this time they travelled about 10 miles of their way upon mules.

RESTING upon Monday till 12 a clock at night, they reſumed their journey, and travelled till about 9 in the morning, at which time they arrived at the top of the ſugar-loaf, or higheſt pile of the mountain.

THEY went up on the ſouth ſide of the hill, on which ſide there was no ſnow, though on the north ſide there were much. They ſtayed about two hours on the top of the ſugar-loaf, and then returned to that part of the hill, where they had lodged the night before.

I ASKED Mr. *Sydenham*, what was the eſtimate made by the moſt knowing perſons of the iſland, of the height of the hill? and he told me, that the guides accounted it to be one and twenty miles high from the town, which, as was noted before, is ſeated three miles above the ſea. And he added, that a ſeaman with great confidence affirming himſelf to have accurately enough meaſured by obſervations made in a ſhip, and to have found the perpendicular height of the hill to be about ſeven miles.

I ASKED him alſo from what diſtance the top of the ſugar-loaf could be ſeen at ſea, according to the common opinion of ſeamen? he anſwered, that the diſtance was wont to

to be reckoned threeſcore ſea leagues, of three miles to a league, adding, that he himſelf had ſeen it above forty leagues off, and yet it appeared exceeding high, and like a bluiſh pyramid, manifeſtly a great deal higher than the clouds. And he alſo told me, that ſometimes men could from thence ſee the iſland of *Madeira*, though diſtant from it 70 leagues; and that the great *Canary*, though 18 leagues off, ſeemed to be very near them, as if they might leap down upon it.

He told me, that the higher part of the region of ſnow was two miles, or two miles and a half lower than the foot of the ſugar-loaf; and that on the upper part of the hill they felt no wind.

Mr. *Sydenham* told me, that being at the top of the ſugar-loaf, drinking the king's health, he endeavoured to ſhoot off a birding-piece he had carried up with him, but though he ſnapped it above twenty times, he could not make it go off; whereas when he came down into the ordinary air, the firſt time he tried to ſhoot, it went readily off. I aſked him, whether he had taken notice, that the flint ſtruck out any ſparks of fire or no at the top of the hill, and whether he had mended and altered the flint coming downwards? To the firſt he anſwered he did not remember; to the other, that he remembered he did not.

He alſo told me, that having carried up a borracha of ſack, when they came to the top of the mountain, they drank divers healths very freely, but could not find themſelves heated, or ſenſibly diſcompoſed by the wine; whereas when they were come down into a thicker air, they manifeſtly felt the heady operation of the liquor, which then made their guide and one of their company drunk.

He deſcribed the ſugar-loaf to be in the midſt of a barren plain, in the upper part of the mountain, and to be exceeding ſteep. The top of the ſugar-loaf is made ſhelving inward almoſt like a diſh. But in many places of it there appear little holes (regularly placed) as it were ſo many little vents to a great fire burning in or below the bowels of the mountain. He told me, that the guide diſſuaded him from going to the middle of this ſhelving top, affirming it to be exceeding dangerous: but he ventured to thruſt the ſcouring ſtick of his gun ſomewhat deep and rudely into one of thoſe holes, from whence there aroſe a hot ſteam, which had like to have killed him, and hindred him from further trials. He added, that the top of the mountain ſeemed to be little elſe than ſtones and ſulphur, and that there were great ſtore of pieces of brimſtone, which are gueſſed to be ſublimed up from the internal parts of the hill.

Being aſked, whether he was ſick or no in the aſcent? he ſaid, that both he and all his company, which were about a dozen men, were ſick for three or four hours, when they came into the ſubtile and piercing air of the upper part of the mountain; but as they went down again, they were not ſick. And being aſked, what kind of ſickneſs it was they felt? he ſaid, it was like ſea-ſickneſs.

He told me, that the ſack they carried up with them to refreſh themſelves, ſeemed to them at the top of the mountain ſo very cold, that they were not able to drink above two or three drops at a draught, by reaſon of the operation of the exceſſive cold upon their teeth. He added upon my enquiry, that his feet were not more than ordinarily warm, and yet one of the two pair of pumps he carried up with him were burnt off his feet by the brimſtone.

When I aſked him about the difference of ſeaſons at the ſame time in the ſame mountain, he told me, that he paſſed over one of them by name.

On the one ſide of which it was exceſſively hot near the top or ridge, as well, though not quite ſo much, as in the lower regions on the ſide of the mountain; but within a mile or two on the other ſide of the ridge he found winter-weather as to cold and ſharpneſs, and yet there was ſnow as well on the other ſide as on this.

To what depth the water will be frozen in hard winters.
To what depth the earth will be frozen in that ſeaſon.
Whether Muſcovian ice be conſiderably, or at leaſt ſenſibly harder than Engliſh ice.
Whether by caſting up water, or by ſpitting, the liquor will freeze before it comes to touch the ground.
Whether brandy, ſack, *&c.* will freeze in *Ruſſia*.
Whether inſtruments of iron and ſteel be much more brittle there than here.
Of the cracking of the timber in wooden houſes, and the cauſes of it.
Of the preſervation of fleſh, fiſh, herbs, eggs, *&c.* in hard weather.
Of the curing of thoſe whoſe noſe, cheeks, *&c.* are frozen.
Of the ſymptoms of thoſe, that are frozen to death.
Of the keeping of dead bodies.

TITLE XX.

Of the Air in reference to Light, its Perſpicuity, Opacity, Reflections, Refractions, Colours, Light, and Lightning.

A VERY learned traveller affirmed to me, that having occaſion to reſide ſometimes on the *Riviera* or coaſt of *Genoa*, he had often obſerved, that from a high place he could both morning and evening clearly diſcern the iſland of *Corſica*, and ſometimes alſo other places in that ſea, though he could not ſee them at noon, how fair and clear ſo ever the weather was, when the ſun was in or near the meridian.

His late majeſty king *Charles* the ſecond, doing me one day the honour to diſcourſe about ſeveral marine obſervations, was pleaſed among other things to acquaint me with this rare phænomenon. He was one day walking upon the beach on the ſtrand, not far from *Dover*, to enjoy the freſh air, and the proſpect of the ſea, when caſually looking forwards to the verge of the viſible horizon, he was very much ſurpriſed to diſcover there a new coaſt, with riſing and falling grounds, newly, as it were, emerged out of the ocean, in a place, where no ſuch thing had been ſeen before. The ſtrangeneſs of this unlooked-for apparition made him ſuſpect ſomething of illuſion offered to his eyes by the beams of the ſun, that ſhone upon the neighbouring objects; wherefore he rubbed his eyes, and the new ſcene not vaniſhing, he called to his royal highneſs the duke of *York*, (who was preſent when his majeſty was pleaſed to make me the relation) and to ſome of the attending courtiers, that were neareſt at hand, to make them partakers and witneſſes of this delightful ſpectacle, which, after it had been gazed on a little while, did ſomewhat ſlowly diſappear, as if it had ſunk down again into the ocean. Of the cauſe of this rare phænomenon, I ventured to propoſe to the king this conjecture: that the place, where it was ſeen, lying the ſame way that the coaſt of *France* did, and that coaſt being but a little too far off to be diſcerned before, it might very well happen that either by action of the ſun, or rather by ſubterraneal ſteams, the air interpoſed between the ſhore and his majeſty's eyes was filled with vapours and exhalations, that made it much more refractive than formerly; and by help of this ſupervening refraction, the French coaſt, that lay beyond it, was raiſed and as it were lifted up, in reference to the ſight, and ſo became viſible as long as that new refraction laſted: and when the ſteams, that occaſioned it, were either got up too high, or were by the winds or ſun too much diſſipated or diſperſed, the apparition ceaſed, together with the unuſual refraction that cauſed it. And in favour of this conjecture

jecture I alledged that familiar experiment, in which a piece of gold, or the like convenient object, being put into the bottom of an empty cup, and the eye being ſo placed, that the object is but juſt hid from it by the interpoſition of the ſide of the cup, if water be poured into the veſſel, though neither the eye nor the object be at all removed, yet the piece of gold will be plainly ſeen, becauſe the ſurface of the water, which is a thicker medium than the air, breaking the rays, that tend from the object towards the beholder's eye, according to the laws of refraction, that is from the perpendicular they are ſo bended, that thoſe fall now into the pupil, that, if it were not for the water, would either fall upon the ſide of the cup, and ſo be hindered from paſſing forward; or elſe would fall upon the eye-lids or eye-brows, or ſome other part above the pupil, and ſo would not make the object viſible.

THE duke of *York* was alſo pleaſed to tell me, that he was ſomewhat ſurprized, when being near the borders of *Scotland*, in a ſeaſon, that did not promiſe much fair weather, he ſaw one morning the ſky very red, and thereupon ſaid, that he feared they ſhould have foul weather, according to the uſual prognoſtic of countrymen and mariners: but ſome of the Scotiſh nobility, that attended his highneſs, told him, that in that country ſuch red mornings did not bode a foul day, but rather promiſe a fair one, which prediction of theirs was juſtified by the event. Upon which occaſion I enquired of a very intelligent Scotiſh nobleman, how far the obſervation held in his country? to which he anſwered, that with a due limitation it was moſt commonly true; for though when the redneſs ſeems to be very near the ground, and appears in ſomewhat narrow ſtreaks of an intenſed red, it ſignifies bad weather; yet if the morning redneſs appears elevated in the air or ſky, eſpecially if the wind be eaſterly, it uſually foretels a fair day.

Some Obſervations of Capt. James, *in his Northern Voyage, Mr.* J. T. *and others.*

FEBRUARY. I practiſed ſome obſervations by the riſing and ſetting of the ſun, calculating the time of his riſing and ſetting, by very true running glaſſes. As for our clock and watch, notwithſtanding we ſtill kept them by the fire-ſide in a cheſt, wrapped in clothes, yet were they ſo frozen, that they could not go. My obſervations by theſe glaſſes I compared with the ſtars coming to the meridian: by this means we found the ſun to riſe twenty minutes before it ſhould; and in the evening to remain above the horizon twenty minutes (or thereabouts) longer than it ſhould do: and all this by reaſon of the refraction. Captain *James*.

MARCH. This evening the moon roſe in a very long oval alongſt the horizon.

APRIL. The weather continued with this extremity until the fifteenth, at which time our ſpring was harder frozen than it had been all the year before. I had often obſerved the difference betwixt clear weather and miſty refractious weather, in this manner: from a little hill, which was near adjoining to our houſe, in the cleareſt weather, when the ſun ſhone with all the purity of air that I could conceive, we could not ſee a little iſland, which bare off us ſouth ſouth-eaſt ſome four leagues: but if the weather were miſty (as aforeſaid) then we ſhould often ſee it from the loweſt place. This little iſland I had ſeen the laſt year, when I was on *Danby* iſland. The 13th I took the height of it inſtrumentally, ſtanding near the ſea-ſide, which I found to be 34 minutes, the ſun being 28 degrees high. This ſhows how great a refraction here is. Yet may this be noted by the way, that I have ſeen the land elevated, by reaſon of the refractious air, and nevertheleſs the ſun hath riſen perfect round.

JANUARY 6. I obſerved the latitude with what exactneſs I could, (it being very clear ſun-ſhine weather) which I found to be 51, 52. This difference is by reaſon, that here is a great refraction.

JANUARY

JANUARY 21. I obſerved the ſun to riſe like an oval alongſt the horizon; I called three or four to ſee it, the better to confirm my judgment, and we all are agreed, that it was twice as long as it was broad. We plainly perceived withall, that by degrees as it got up higher, it alſo recovered roundneſs.

ATTENDING upon Sir *Peter Wych*, in his journey for *Warſaw* the beginning of *June* $16\frac{6}{7}\frac{8}{8}$, whilſt we lay about three Poliſh miles from the city, attending the preparations for his reception there, we had very clear and extreme cold weather; and for two days together we obſerved the ſun and two parhelions, or three ſuns, from above ten a clock to near twelve, not the leaſt cloud appearing in the air, but that ſo ſerene, that we took notice of the icy ſpangles in the air, flying about like atoms in the ſun's beams. This is alſo worth taking notice of; that whereas in ordinary froſty weather any ſmooth iron, or other metal, whether heads of ſticks, pomels of ſwords, or barrels of guns, being brought out of the open air into a warm room, there will preſently, firſt a dulneſs in the glaſs, and then drops of water appear: at this time there would immediately appear the likeneſs of an hoar froſt. Now, whether the particles of cold be ſo ſubtile as to pierce or enter into poliſhed metal, I will not determine; though the experience of wetting one finger with his ſpittle, and forthwith laying it to iron, when it freezes hard, by its immediate adheſion, even in the moment of touching it, would make ſome way for the affirmative. That ſame month returning back from *Warſaw*, I ſaw, upon my journey, the ſun riſe with a large pillar, coloured like a rain-bow, perpendicular over it, out of a clear horizon; and I remember monſieur *Hevelius* told me, he obſerved it once ſet with the like, N.

IN *Cornwall* they obſerve in their driving home levels or ſink, the waters do alſo manifeſtly partake of the minerals; for in ſome mines they are ſanative, where iron is obſerved, and in others apt to cauſe wounds to feſter and rankle. As the firſt was moſt manifeſt at *Karne-Key*, the latter at *Reliſtian*, both famous tin-works.

ASKING of a chemiſt, that travelled with a famous virtuoſo of my acquaintance over part of the *Alpes*, that is ſaid to be much ſubject to thunders, divers queſtions about thunder, I had, among other anſwers, this, that he and my friend being together at the top of a forked mountain, between whoſe parts there lay a valley, that ſeemed almoſt covered with a thick cloud; and though the weather were clear at both the tops, he obſerved, that the ſubjacent cloud being big with thunder, the lightning appeared quite through it, and ſeemed to lye deep in it, ſo that caſting his eyes down upon the cloud, he fancied, that what he ſaw, was (to uſe his own compariſon) as if a ſhining fiſh were moving to and fro very ſwiftly in a ſomewhat troubled water. If I had ſeaſonably had the relation, I had enquired of my friend about it; but I was the more inclined to believe it, becauſe I remember, that paſſing over a part of the *Alpes*, leſs high than that where the recited obſervation was made, though it was very fair weather, and a clear ſky at the top of the mountain where we were, yet a great way beneath us we ſaw dark clouds, through part of which we afterwards in our deſcent were obliged to paſs, though then (whether part of the matter had been in the mean while diſcuſſed, I examine not) it ſeemed to us little different from a thick fog, which when we had paſſed thorough, we found the weather fair and clear enough to the foot of the mountain.

MEETING with an inquiſitive nobleman, that lived long at *Naples*, I aſked him, whether he had ever ſeen any of thoſe famous apparitions, that are ſaid ſometimes to ſhew themſelves in or near the *Sicilian* ſtreight, and is known by the name (if I miſtake not) of *Morgane?* to this he anſwered me, that during the ſpring-time, he had once the curioſity to try, whether this tradition had ſo much ground as was commonly believed; and that accordingly on ſeveral fair mornings he roſe before the ſun, and looked

looked ſolicitouſly along the coaſt, without ſeeing any thing that anſwered his expectation: but not being diſcouraged by theſe diſappointments, he one morning perceived, as he thought, two ſteeples in a neighbouring town, where he knew there was but one; which phænomenon inviting him to continue his curioſity, he choſe the firſt fair and cloudleſs morning to riſe early on; and caſting his eyes towards the lately mentioned town, and the coaſt it was not remote from, he was ſurpriſed with a delightful proſpect of a new town beyond the other, and incomparably greater than it, and furniſhed, as it ſeemed to him and a doctor of phyſick that accompanied him, with walls and towers, and ſteeples and houſes, and other things, that were delightful, as well as wonderful to behold. But he anſwered me, that the colours were not near ſo lively as the figures, being for the moſt part ſomewhat dim, though adorned here and there with ſome redneſs: but this odd ſpectacle, as it was not invariable during the whole time it laſted, did not continue very long; for when the ſun was gotten up to ſuch a height above the horizon, as made his beams powerful, they quickly confounded all theſe airy ſtructures in a kind of chaos, and made the fantaſtic city vaniſh.

Moist vapours are not the only cauſe or ſign of the opacity of the air, ſince that dry blighting eaſt wind, which from the effects country people call a red wind, makes the air at a diſtance ſeem bluiſh and thick. This is the wind, which theſe two years laſt paſt has been ſo pernicious to apples, and indeed to all ſorts of trees, not only to blaſt the fruit, but the very leaves of ſuch trees as it met withal, juſt in the tender (as the woodmen call it) *i. e.* when they are newly expanded out of the buds. Mr. *J. T.*

That air is ſometimes more clear and tranſparent, and ſometimes more dark, and, as it were, muddy, being clogged and opacated with terreſtrial ſteams, is every man's obſervation. But there are ſome phænomena, that depend upon the denſity, diaphaneity, *&c.* of the air, that are not ſo vulgarly taken notice of: for beſides thoſe, that require ſkill in the doctrine of refractions, on which therefore I ſhall not now inſiſt; there are ſome others, that may be worth your notice, which I ſhall give a taſte of.

Considering the differing accounts, that are given by good authors, of the number of the fixed ſtars, and comparing them with ſome obſervations of our own, I was thereby, and upon ſome other grounds, induced to ſuſpect, that the differing and unheeded conſtitutions of the air might occaſion a difference in aſſigning the number of the ſtars; which made me enquire of ſeveral navigators and travellers, ſome into the torrid zone, and others into the frigid ones, what difference they found in contemplating the ſtars in thoſe climates, and in ours; and by this enquiry, I learned, that in ſome places, where the air is very pure, celeſtial obſervations may be more happily made. And particularly becauſe I ſuppoſed, that intenſe cold, by precipitating the darkning vapours out of the air, may probably make it more defecate and clear, I deſired an ingenious phyſician, that travelled in *Muſcovy*, to take notice of any thing, that ſhould favour or diſfavour this conjecture. In compliance with which requeſt of mine he informed me, that travelling one night in a ſled in the more mediterranean parts of *Ruſſia*, the weather being extraordinary cold, he was invited to quit his ſled a little to conſider the ſky, where he ſaw ſo many ſtars, and ſo much brighter than he had ever ſeen before, that he was almoſt as much ſurpriſed as delighted with ſo glorious a ſpectacle, which he ſhewed to ſome of his fellow-travellers, that ſhared in his wonder.

And this brought into my mind, that remembring, that the ingenious captain *James* being forced to winter in *Charlton* iſland, which, though but of the latitude almoſt of *Cambridge*, is but little, if at all, leſs cold than *Nova Zembla* itſelf, I ſhould probably find ſomething pertinent to our preſent ſubject in ſo diligent an obſerver. I reſorted to his voyage, where I met with theſe notable obſervations.

JANUARY 30 and 31, there appeared in the beginning of the night more ſtars in the firmament than ever I had ſeen before, by two thirds. I could ſee the cloud in cancer full of ſmall ſtars; and amongſt the Pleiades a great many ſmall ſtars. About ten a clock the moon did riſe, and then a quarter of them was not to be ſeen. The wind for the moſt part of this month hath been northerly, and very cold, *&c.* Captain *James*, p. 62.

The Ruſſian emperor's phyſician confirmed to me, by word of mouth, what he had ſome years ſince told me in a letter, that one night, which was exceeding cold and clear, being awakened out of his ſleep by a ſhake, that had like to have overturned his ſled, he looked out and ſaw more ſtars by far than ever he ſaw in *England*, or the neighbouring parts of *Europe*, and particularly, that he ſaw many about the ſeven ſtars, or the Pleiades, and divers others he had not ſeen before in ſeveral other parts of the ſky. He farther told me, that theſe ſtars ſeemed far more beautiful and bright than was uſual, inſomuch that he doubts not, that if it had not been for the ſnow, ſome of them would have caſt a diſcernible ſhadow. For confirmation, he ſaith, that the phænomena were not only taken notice of by him, but by others, that travelled with him; and that though he often gazed at the ſky, ſince that time he never could ſee there near ſo many ſtars, nor ſo bright.

DECEMBER 4. I had not time the laſt week to tell you of ſomething, that to us, that have not been long in this country, ſeems ſtrange, but the people of this place ſay happens very often.

ON the 29th of the laſt month, after I had written and ſent away my letters, looking out of the ducheſſes's window, to ſee what weather it was, I ſaw towards the N. E. alongſt the horizon, it looked as light, and juſt as if it had been break of day, (it was then about a quarter paſt eleven) and gave as great a light: I went then into the drawing-room, and looking out of that window, could look more northerly, and ſaw it was more light due N. and ſaw ſeveral ſtreaks of light, like the tail of a blazing ſtar, all pointing N. and S. one of which was as long or longer than that we ſaw laſt year, for it reached from the horizon, and paſſed between *Charles*'s wain and the N. ſtar, and reached up juſt over our heads. The ſmall ones ſometimes diſappeared; and then we ſaw others of the ſame dimenſions appear in other places; they were all near the great one: two of them ſeemed as if their light had come from the two guards in *Charles*'s wain; and when they vaniſhed, others appeared more ſouth. I went to the other ſide of the houſe, and ſaw that the light reached from the W. or W. N. W. by the N. to the E. or E. N. E. I did not go out, becauſe it blew very hard, and was very wet, contenting myſelf to ſee it out of the houſe, but ſent *Geo. Man* up the hill, who ſaw the ſame, and it was ſo clear they could ſee the Frith.

ABOUT the new moon before, there was ſuch a light as this ſeen by lord *Belcarras*, as he came in the night from St. *Andrew*'s to his houſe, and by the ſeamen of the yacht at *Leith*, and by ſome here in town: but though the ſky was not then ſo clear, there being broken clouds, yet it gave ſuch light, as they could read very plainly, as they told me: that began about 7, and laſted till 9. This laſt I did not ſee till after 11, and at a quarter of 12 it began to leſſen, at which time I went to bed, and the rails were then no more to be ſeen. Tell Dr. *Flamſtead* of this, and know of him, whether he has ſeen or heard of ſuch kind of things.

THIS was from his royal highneſs the duke of *York*, then high commiſſioner in *Scotland*.

AN intelligent gentleman, that lived in *Africk*, being aſked by me, how far off he was able to ſee the top of the *Pico* of *Teneriff* at ſea? replied, that by the eſtimate of the captain of the ſhip, it was near 50 leagues, and yet it appeared to him ſo high above ſome clouds, and ſo near, that he was fain to caſt his head up to ſee it.

TITLE

TITLE XXI.

Of the Operation of the Air on the Conſiſtency of Animal Subſtances.

AS on the one ſide the ſchools teach the air to be a ſimple and elementary body, that is, only hot and moiſt: ſo on the other ſide, the generality of men are ſo accuſtomed to judge of things by their ſenſes, that not finding the air to be a viſible body, they aſcribe leſs to it than even the ſchoolmen do; and what is inviſible, they think to be next degree to nothing. And indeed both the one ſort of men and the other are wont to conſider the air only as a receptacle, that barely harbours the viſible and palpable bodies committed to it, or as it were depoſited in it, without acting upon them, unleſs it be perhaps a little upon the account of its manifeſt qualities, heat and moiſture. But for my part, who look upon the air under another notion, and think it may as well alter as receive the bodies, that lye expoſed to it; I am apt to allow it, in reference to ſome bodies, certain other faculties and powers, among which ſome may be called generative and maturative, and others corruptive; and this not only in reſpect of animals and other bodies of a ſlighter texture, but even of ſalts and minerals themſelves.

AN obſerving man, that had ſailed to and fro between *Europe* and the *Eaſt-Indies*, anſwered me, among other things, about their way of tranſporting cheeſe: that the cheeſe they uſed to take along were *Cheſhire*, of a very conſiderable thickneſs, which they incloſed in leaden boxes fit for them, and thereby were able to preſerve them ſound till they came to the *Eaſt-Indies*. But in caſe they were not able, or neglected to make uſe of ſuch boxes, he ſeveral times obſerved, that cutting a cheeſe in two, when they were any thing near the equinoctial, that moſt part of it would be very dry and brittle, and ſeemed as if it were ſpoiled; whereas the parts about the middle were ſo fat and ſoft, as if all the unctuous parts, that were wanting in the dried portion of the cheeſe, had retired thither, and was between cream and cheeſe. Which conjecture was not contradicted by this, that if they cut ſome of theſe cheeſes, when having left the torrid zone behind them, and had made a good progreſs in the temperate zone, they found their external portion good, and the conſiſtence of the cheeſe uniform enough.

QUERE, whether the moiſt particles, that fly in the air, be not the great cauſe of all corruption of bodies, ſince *Acoſta* ſays, that in *Peru*, where it ſeldom rains, all things, like dead bodies, keep a great while uncorrupted? The like may be obſerved of *Egypt*, if it be not to be rather imputed to the nitrous ſalt, with which the air of that country ſo much abounds. Mr. *J. T.*

A MAN of letters, that divers times croſſed the line in great Portugal ſhips, anſwered me, that when they came near it and under it, he obſerved among other things, that there was a very manifeſt change made in the conſiſtence of their biſket; that moſt of their meat, and even their ſalt fiſh was much impaired, ſo that they were ſcarce able to eat it; and that their pilot, who had been 23 times in the *Indies*, aſſured them he obſerved, when they came to the equinoctial, that freſh water would not there be at all troubled or ſtinking, but clear and ſweet, as if it were but newly put into the caſk.

DOCTOR *Stubbes* being enquired of by me concerning, *&c.* told me, that in *Jamaica* the ſilken ſtuffs, that were brought thither, will rot even whilſt they keep their colour, if they be ſhewn to the air; though if they be not ſhewed thereto, but kept up cloſe, they were not obſerved to rot, or be diſcoloured.

TITLE XXII.

Of the Operation of the Air on the Conſiſtency of Vegetable Subſtances.

MAY 16. We opened a ſmall glaſs receiver ground to a plate of glaſs, in which there had been included for three years and ſome months, (though I know not how many) the half of a lemon cut tranſverſly, together with a mercurial gage: the lemon kept its colour pretty well, and its ſhape very well, ſave that at the orifice the upper part of the pulp was depreſſed, ſeeming as it were dried up by the receſs of the liquor contained in it; which liquor did now ſtagnate upon the glaſs plate. When this began to be disjoined from the upper glaſs, there ruſhed in, not without noiſe, a pretty deal of external air, which argued, that the air afforded by the included lemon in ſo long a time, had not been near ſufficient to fill the cavity of the receiver. Neither the half lemon nor the liquor had any ill ſcent, or other ſign of putrefaction or corruption; neither of them had the leaſt mould, which gave me a ſuſpicion, as far as it could be grounded upon this experiment, that ſuch a mould, as might have been expected, being (as may be gueſſed by the microſcope) a congeries of a very ſmall kind of vegetables, could not, any more than many greater ones, be produced without the concurrence of the air. The liquor was clear enough, and without fæces, being of colour between brown and reddiſh. It contained an acid taſte; and when I put a little of it upon ſyrup of violets, it turned it to a purpliſh colour; and, which is more, being put upon ſmall fragments (not powder) of red coral, preſently began manifeſtly to corrode them, and that in the cold.

To the heat and piercing moiſture of the air combined together may be referred the obſervation of an intelligent ſcholar, from whom, when I aſked him, what he had taken notice of about theſe qualities, when he ſailed under or near the line, (which he did ſeveral times) he told me, that divers paſtils or lozenges, that he was wont to carry in his pockets, were ſo diſſolved, that they ſpoiled his pockets, and obliged him to cut them out; though the paſtils of the ſame kind did never loſe their old conſiſtence till he came near the equator, nor keep their new conſiſtence after he had paſſed ſome degrees beyond it, but grew ſolid again as before.

TITLE XXIII.

Of the Operation of the Air on the Conſiſtency of Mineral Subſtances.

INQUIRING of an ingenious Swediſh gentleman, that was a great dealer in the metals his country abounds with, whether the great cold of ſharp winters in thoſe northern climates had not a ſenſible operation upon iron; I learned from him, that in the chief copper mine (which he had curiouſly viſited) being to draw up the ore from an exceeding great depth, they faſtened their baſkets, not as they uſe in other mines, to iron chains, but to ropes made of ox or bull-hides; and that chiefly for this reaſon, that during the hard winter-froſts, that are there uſual, the links of their iron chains were very ſubject to be broken by the great cold joined to the weight of the ore, to the great danger, and oftentimes the deſtruction of the poor workmen, that were digging beneath: which inconvenience was avoided by employing leather, which the cold could not make brittle, inſtead of iron.

ASKING an ingenious maſter of a glaſs-houſe, whether he had not obſerved, that glaſſes, though as well nealed as is ordinary, would ſometimes of themſelves break with a noiſe long after; he anſwered me affirmatively; adding, that particularly having

ing one time had an occaſion to lay by, for about half a year or longer, a numerous parcel of glaſſes, when he came to take them out, he found, that about a fourth part of the whole batch was frozen of themſelves; and that in moſt or all of them, the cracks proceeded from ſome ſeeming ſtone or great grain of ſand, which yet indeed was not ſand, but ſome part of ſalt, that had not obtained a ſufficient comminution.

A LEARNED gentleman, that is owner of an iron mine, informs me, that he has a houſe in *Suffolk*, within 6 miles of the ſea; and though the houſe be but 80 years old, yet the iron bars of the window, that look towards the ſea, are ſwelled, and (as he calls it) rotten, being brittle, and eaſy to be crumbled into powder. And when I aſked him, whether the wind, that came from the ſea to theſe windows, were not ſouthern, he anſwered affirmatively. And to confirm what I was ſaying of the operation of ſea-ſalt upon iron, he told me, that having had occaſion to cauſe many bars of iron to be laid in a place upon the neighbouring ſhore, above the high-water-mark, a great ſtorm chanced to increaſe the tide ſo far as to drench thoſe bars for ſome hours after; which remaining in the air, they were very much impaired, great thick flakes being eaſy to be ſtruck off from them, when they came to be hammered.

A VERY experienced maſon informed me, that the cathedral of *Saliſbury* is made of *Purbeck* ſtone, which in the air grows ſofter, and will moulder away; and ſo will ſome *Blechington* ſtone, though not expoſed to wet; whereas the ſtones dug up at *Painſwick*, within four miles of *Glouceſter*, being very ſoft and friable at firſt, will by lying in the air (as he has particularly obſerved) acquire a cruſt hard and glaſſy like marble; and the oftner it is waſhed, the ſooner will it acquire this hard and yellowiſh cruſt, which reaches but a very little way (ſcarce the thickneſs of half a crown) beneath the ſurface contiguous to the air.

TITLE XXIV.

Of the Air in Reference to Fire and Flame.

A GENTLEMAN of my acquaintance being aſked by me about the burning of candles in grooves (or futts) that are not furniſhed with air-ſhafts, he told me, that the depths I deſired to be informed of were very uncertain, and varied conſiderably, according to the different nature of the ſoil, and perhaps other circumſtances; ſo that ſometimes a candle will go out much ſooner, and ſometimes it would continue burning, though it were let down to the depth of eight, ten, or more fathom. That when they come into cloſe ground, though their candle will burn at firſt, yet after a while working, (more eſpecially if the ſtone be full of mundick) the duſt raiſed by their working will make their candles go out, ſo that they muſt leave working for a time, except they will be at the charge of conveying down air by pipes. I mention this as different from other ſorts of damps. *N.*

Experiments touching the Relation between Flame, Air.

THE burning of candles, *&c.* under a glaſs bell.

THE burning of ſpirit of wine under a glaſs bell.

THE burning of match, touchwood, ſponck, *&c.* under a bell.

THE keeping of animals under the ſame inſtrument whilſt the flame is burning.

THE burning of bodies to aſhes in ſealed glaſſes.

THE doing the like in exactly cloſed receivers.

THE burning of cotton in a ſealed glaſs.

THE burning of the mixture of flames under water in an E. R.

THE burning of ſpirit of wine and oil of turpentine in glaſs veſſels with ſlender necks.

THE experiment of burning gunpowder.
ANOTHER of the piſtols not firing in an E. R.
THE burning of a ſaline ſubſtance in an E. R.
THE burning of mixtures of ſalt-petre in an E. R.

TITLE XXV.

Of the Air in Reference to Fermentation.

Novemb. WE took a ſmall handful of raiſins, and having put them into a bolthead, (not large, but half filled with water) we drew out the air, and then we removed the portable and exactly cloſed receiver, and put it on the digeſtive furnace, that the warmth of that place might promote the fermentation in ſpite of the unfavourableneſs of the ſeaſon of the year. After a while there appeared ſigns of fermentation by the emerging of the raiſins, which ſwam for ſome days on the top of the water, moſt of them beſet with numerous bubbles; nor did above very few of them ſubſide at laſt, though after ſome days the bubbles grew fewer and fewer, and there appeared a ſediment at the bottom of the glaſs.

A FORTNIGHT after they were firſt ſealed up, the upper part of the glaſs was accidentally broken whilſt I ſtood by, whereupon the external air ruſhed in with ſome noiſe; and I taking the veſſel in my hand, perceived the ſurface of the liquor to be overſpread with bubbles, almoſt like the froth of bottle-drink: there ſeemed to me to come out at the little orifice made, where the apex was broken off, a viſible fume, which had a ſomewhat languid ſmell. The liquor was high coloured of the raiſins, and ſeemed to have extracted ſomething from them, that gave it a better conſiſtence than that of water.

TITLE XXVI.

Of the Air as the Receptacle of Odours.

TITLE XXVII.

Of the Operation of the Air on the Odours of Animal Subſtances.

MAY 23. We opened an exhauſted receiver, wherein was pretty ſtore of verjuice, or green and ſour grapes. And though they had lain there, we are ſure, about three years, and poſſibly much longer, yet there appeared no mouldineſs at all upon any of them: but the ſurfaces of the uppermoſt grains were ſomewhat diſcoloured, perhaps by a ſaline and confuſedly formed effloreſcence, which having looked upon through a glaſs, and alſo taſted, I gueſſed to be a kind of tartar. The like liquor, that the grains had afforded, had an acid taſte, and would in the cold corrode coral; but the grains ſmelled ſomewhat muſty. In all this time the verjuice had produced ſo little air, that we could ſcarce take notice of it by the mercurial gage, that had been ſhut up with it.

I INQUIRED of my lord of *Sandwich*, and a couple of gentlemen that accompanied him, whether it be true, which is reported of the purity of the air at *Madrid*, that though they have no houſes of office, but every night throw out their excrements into

into the ſtreets, yet by the next morning there remains no more ſmell of them. To which I was anſwered, that it was true the excrements were ſo diſpoſed of, but that *Madrid* is the ſtinkingeſt town they ever came into; yet that it was difficult to diſcern in the morning any peculiar ſmell of what had been caſt into the ſtreet by night: but they jointly affirmed, that the place, where the embaſſador's numerous family reſorted to make water in, did not ſmell of piſs; and that they often obſerved the dogs and cats, that lay dead in the ſtreets, were deprived of ſtench: and his lordſhip ſuppoſed, that the ſtench of a dead mule would in few hours vaniſh.

TITLE XXVIII.

Of the Operation of the Air on the Odours of Vegetable Subſtances.

MAY 16. At the ſame time we opened another ſmall receiver, wherein above three years before ſome large pieces of orange had been included: the rinds of theſe were much diſcoloured, their ſurfaces being almoſt black. They had ſcarce afforded any liquor, and yet we could not perceive the leaſt mould in any of them, nor had they a putrid ſmell.

TITLE XXIX.

Of the Operation of the Air on the Odours of Mineral Subſtances.

TITLE XXX.

Of the Operation of the Air on the Taſtes of Animal Subſtances.

HE anſwered me, that they could very well preſerve meat, as beef, without ſalting it, as long as the froſt laſted, that is, during the whole winter. But when it was once thoroughly frozen, they could not dreſs it ſo as to make it reliſh like good meat. Mr. *Nickſon.*

TITLE XXXI.

Of the Operations of the Air on the Taſtes of Vegetable Subſtances.

TITLE XXXII.

Of the Operations of the Air on the Taſtes of Mineral Subſtances.

TITLE XXXIII.

Of the Operations of the Air on the Colours of Animal Subſtances.

ENQUIRING of a man of letters, that had the curioſity to travel into the inland parts of *Braſil*, whether in that country the air had not a great influence upon the colours of clothes; he told me it had, and even upon black; inſomuch that a kind of black taffety, which is the uſual wear of the better ſort, will, after it hath been worn a very few days, degenerate into an ironiſh colour: yet he anſwered me, that in the ſhops, where it is carefully kept from the air, the taffety continued of a good black.

NOR is it only upon the colour of ſtuffs, but of animals too, that he ſays the Braſilian air has an operation? for he ſays, that at a place 50 leagues beyond *Parigua*, there is a region, where white people do in a very ſhort time grow baſannez (or tawny) though a little way out of that particular region, as for inſtance beyond it, they quickly recover their wonted colour,

HE told me, that upon *Charleton* iſland they have flocks of certain birds, which the Engliſh there call partridges, though they reſemble ours more in bulk than ſhape, being ſomewhat like wild pigeons, but a good deal bigger: theſe he ſays are white in the winter, and gray in the ſummer.

TITLE XXXIV.

Of the Operations of the Air on the Colours of Vegetable Subſtances.

A LEARNED man, that was phyſician to the governor of *Jamaica*, being at his return aſked divers queſtions by me, concerning that iſland, gave me, among others, the following anſwer. Lignum vitæ, ſaid he, and moſt other trees at *Jamaica*, when they are newly cut down, wherever you cut the wood, that part, which is expoſed to the air, will quickly grow green, though that which is a little beneath it be yellow, or of another colour; and this lignum vitæ, when green, is as ſoft as oak, or ſofter; and many other *Jamaica* woods, that are ſoft, when newly cut down, will afterwards ſo harden in the air, that ordinary tools will make no impreſſion upon them; and the nails, that pierced them eaſily before, can no more be forced out of them; and this is chiefly conſpicuous in the cabbage-tree, which being a wood ſoft enough when it is cut down, the pith, which is very copious, will quickly rot of itſelf, and the reſt of the tree ſerves for a pipe of perhaps 100 foot long, that will not corrupt under ground, but grow almoſt as hard as iron.

ENQUIRING of an inquiſitive traveller, what he had obſerved about the power of the air, which I had been informed was great, in working upon divers bodies at the iſland of St. *Jago*; he told me that he and his company had not ſtayed long enough there to make much obſervation of that kind; but, that ſeeing aloes growing plentifully there, they had gathered ſome plants of it, whoſe juice he found, as I have here in *Europe*, to be very clammy, and exceſſively bitter, and, which was wondered at, of a very dark colour; but having carried them in the ſhip towards the equinoctial, they found for a time the juice to be altered, having loſt almoſt all its bitterneſs, and acquired a green colour.

STAINS of linen will beſt go out at the time of the year, when the fruits or plants,

whoſe juice made them, are in their prime: this a gentlewoman aſſured me ſhe had tried in new linen ſtained with juice of quinces; and the lady *N. N.* affirmed, that ſhe had particularly tried it in ſtains made with the juice of hops, which ſhe ſays are the worſt ſtains of all; and which having in vain tried to get out of her linen, ſhe laid up her linen in her cheſt, and at the time of the year, when hops flouriſh, ſhe found the ſtains vaniſh of themſelves.

TITLE XXXV.

Of the Operations of the Air on the Colours of Mineral Subſtances.

A CONSIDERABLE inſtance of the changes, that the contact of air is able to produce even upon ſolid minerals, I gave thoſe, that ſaw it, by the following experiment. We took one part of lapis calaminaris, and about four parts of good ſalt-petre; theſe being well powdered and mixed, were put into a ſtrong crucible, and kept in a vehement fire ſome hours, by which means the matter, as we expected, was alcalized: upon the thus prepared lapis calaminaris we poured a convenient quantity of fair water, which afforded us a ſolution, that was ſomewhat muddy, but appeared of a deep red: this we poured into a wide-mouthed glaſs, which we ſet in a window, that it might be the more acceſſible to freſh air. There, after a while, our darkiſh red ſolution turned quite green, and more diaphanous than before; but, continuing for ſome days to keep the glaſs in the ſame window (which reſpected the ſouth) we found our green ſolution to loſe its colour by degrees, and at laſt to be reſolved into a tranſparent liquor, and a ſubſiding powder, that was not at all green, but red, or like brick-duſt. Theſe changes of colour ſucceeded in more than one parcel of our mineral ſolution.

We took a very ſtrong ſpirit of vinegar, and boiled it a while on crude filings of copper, without finding, that it was manifeſtly coloured by that operation, nor yet by letting it lye ſome hours in the ſame glaſs egg, wherein it had been boiled. Wherefore, ſuppoſing this want of colouration to depend upon the air's not co-operating in the beſt manner it might eaſily be made to do, we poured the liquor and the filings together into a broad flat glaſs (which we placed in a window ſhelving) ſo that though the filings were wet, yet but one part of them was covered to any depth by the menſtruum. This done, we obſerved, as was expected, that the filings, expoſed to the air, changed colour, and became of a greeniſh blue; whilſt thoſe, that were under the liquor, manifeſted no change of colour, but kept that, which belongs to copper, till the menſtruum evaporating by degrees, they alſo being acceſſible to the air, acquired the ſame colour with the former vinegar. Q. Whether in a longer time the coloration would not have been made?

We took ſome filings of copper, and divided it into two parcels; one we put into a flat and ſhallow glaſs with a wide mouth, and the other into a glaſs vial, whoſe neck was of the breadth uſual to ſuch veſſels. Upon each of theſe parcels of filings we poured a convenient quantity of one and the ſame ſtrong ſolution of ſal armoniac made in fair water, and without covering each of the veſſels, let them ſtand by one another for a competent time. Of which trial the event was ſuch as was expected; namely, that the liquor in the vial was but faintly coloured, when that in the open glaſs, that had a large ſurface expoſed to the free air, was very richly tinged. And this circumſtance is not to be forgotten, that whereas all the lower part of the ſolution was of a deep blue, almoſt like ultra-marine, that part which was contiguous to the air, was covered over with a kind of film like thin ice, which was of a very differing blue, exceedingly like that of the finer ſort of turquoices.

We

We took two ſmall parcels of filings of copper, and put each of them into a ſmall piece of paper, with the edges turned upward, and then put upon each of them three drops of good ſpirit of ſal armoniac. One of theſe papers we left in the window; the other we put into a ſmall receiver, which, by help of our engine, was emptied in little more than a minute of an hour. At the end of two minutes, after the putting on of the ſpirit, there appeared a manifeſt blue on ſome parts of that paper, that was left in the window; but that, which was in the exhauſted receiver, being deprived of the air, that ſhould befriend its operation, continued there full a quarter of an hour or more (by a minute clock) without appearing to be at all coloured: wherefore taking off the receiver, we removed the paper to the ſame window, where the other ſtood, and within about two minutes it began to diſcloſe a blueneſs, which within about two minutes more was conſiderably heightned.

Into a ſlender vial, wherein we put a convenient quantity of the volatile or urinous ſpirit of the lees of wine (elſewhere by us deſcribed) which was of a yellow colour, we let fall ſome filings of copper; and ſtopping the glaſs well, we drew a tincture, which according to expectation was manifeſtly green, but not of the pleaſanteſt and moſt tranſparent ſort of green liquors: then ſuffering the vial to reſt in a window for many days, we obſerved, that the liquor did then but ſlowly return to a yellow colour, which when it had acquired, without any mixture of greenneſs, we opened the vial for a very little while to let in the air, and then ſtopped it well again; the admitted air quickly began to change the ſurface of the liquor into a green colour; which, though ſlowly, extended itſelf downwards, till it had tinged the whole liquor. This colour afterwards, by long ſtanding, did by degrees grow to a pale yellow.

The 19th of *Auguſt* preſented me with ſome phænomena, that made me almoſt deſpair of reducing all thoſe of our variable liquors to a ſettled theory. For coming that day at about ten a clock in the forenoon to a cloſet, where I kept ſeveral vials furniſhed with this liquor, I perceived one of them, that ſtood in the window, that had once almoſt quite loſt its colour, to have re-acquired a very fair blue, at leaſt as deep as that of the ſky in a fair day. This vial I the rather watched, becauſe I had taken notice, not without ſomewhat wondring at it, that for two days before, inſtead of loſing, according to cuſtom, the little remains of colour, that after many days ſtanding it yet retained, the colour began again to increaſe, though the vial were conſtantly kept ſtopped as before; and that, which made this regaining of the colour ſeem more ſtrange, was, that there ſtood juſt by it another vial furniſhed with the ſpirit, and with filings taken out of the ſame parcels, yet the liquor of this parcel continued colourleſs. Wherefore, ſuſpecting, that ſome accident might have happened, whereby ſome little portions of air might have inſinuated themſelves thorough the cork of the altered liquor, I caſt up my eyes to another vial, that ſtood in ſo high a place, that it was not eaſy to reach it, and where it had long reſted, and loſt its colour: but upon this view I was confirmed, that the change lately mentioned in one of the vials was not from the cork, but from ſome unobvious cauſe: for though this upper vial was furniſhed with a good glaſs ſtopple; yet the liquor it contained was again grown cæruleous, though the liquor of another vial, that ſtood juſt by it, continued colourleſs. Wherefore, to ſatisfy myſelf farther, I preſently went to a private place where I had in a cavity made in the thickneſs of a wall ſet aſide two vials, that ſeveral days before had quite loſt their colour; and my former ſurprize was increaſed, when I found that one of them, which was ſtopped with a cork, continued colourleſs; yet the other that had a glaſs ſtopple, and ſtood juſt by it, had regained a fair cæruleous colour. Both theſe were fitted for trial, with the ſame ſpirit and filings, and the ſame day with the others abovementioned; and the heat of the weather had ſo little influence

ence upon this effect, that this day was remarkably cold, being made ſo by a northern wind, which made me obſerve it more ſo than I had found it for ſome time before.

I MUST not forget on this occaſion, that I was invited by the foregoing phænomena, to look upon ſome ſpirit, not oil of amber, that I had kept in a vial for ſeveral days upon filings of copper, and had ſometimes expoſed to the air by unſtopping the glaſs, and found, that though formerly the ſpirit kept its native colour better than I deſired, yet it had acquired a green colour, which whether it will loſe again by longer ſtanding, time muſt determine.

THE ſlender vial, with ſpirit of honey, mentioned N°. the though it had been wont to exchange its yellow colour for a blue, by the contact of the external air in a very ſhort time, and ſometimes within a minute or two: yet being opened this afternoon, in the ſame place where it uſed to be ſo, did not in above an hour's time turn blue, but remained a tranſparent yellowiſh colour.

THE vial, with a glaſs ſtopple, mentioned N°. 945. being for divers weeks left unſtirred in the window where it ſtood before, I ſeveral times obſerved it to loſe and regain colour; and though ſometimes it would only appear of a more faint or a more rich blue, yet ſometimes alſo it would appear either quite or almoſt colourleſs, and, perhaps, in a day or two after, it would be again as blue as the ſky. And this, though I could not find, that any thing in the weather was the true cauſe of this change, ſince the liquor would not only gain, but loſe colour in colder weather; and ſo it would alſo do in warmer: but on Michaelmas day I found it to have attained a deep blue; and though ſince it has been now and then ſomewhat more dilute, yet during all the paſt month of *October*, I remember not to have ſeen it any thing mere colourleſs: and this day being the firſt of *November*, I found it to have reſumed a high colour, though a vial with a glaſs ſtopple, which had for many weeks ſtood juſt by it, and formerly did divers times correſpond with it in its changes, has continued all the laſt month of a very pale blue, without either deepning its colour, or growing quite colourleſs.

AN inquiſitive gentleman of my acquaintance, being aſked by me about a mountain in *Wales*, called where ſolid ſtones are ſaid to change their colour very oddly, told me, that within ſight of that hill, in a large piece of ground, that was then newly put under tillage, he ſaw good numbers of ſtones that looked like flints, and were full as hard, if not harder; the colour of moſt of them was dark, the reſt gray: theſe ſtones, which, when the ground was newly turned up, were ruſt-coloured, he obſerved afterwards to grow lighter and lighter coloured; ſo that after three or four years, being invited by this obſervation to take notice of it at his coming to that place again, he found theſe ſtones almoſt all of them turned white. About which phænomenon, queſtioning the ancient inhabitants, with ſome expreſſions of wonder, they ſeemed to make little of it, and aſſured him, in the neighbouring mountain, almoſt all the ſtones, that were expoſed to the air, underwent the like changes, and within a few years were blanched.

HAVING put ſome *mercurius ſublimatus dulcis*, and *vitriolum Romanum* (tied up in ſeveral papers apart) into one box, at the end of twenty two months I found the ſublimate mercury wholly changed into a ſubſtance ſo like antimony, that ſome not ignorant of the *materia medica* have taken it for the ſame; and the ſuperficies only of the vitriol had acquired the ſame colour, but was not at all altered within. This from a credible relator.

TITLE XXXVI.

Of the Air deſtroying or introducing other leſs obvious Qualities into Animal Subſtances.

TITLE XXXVII.

Of the Air deſtroying or introducing other leſs obvious Qualities into Vegetable Subſtances.

AN intelligent gentleman, that ſtayed a year in *Guinea*, related to me, that he and his company found the great heat and moiſture of the air to diſpoſe bodies ſo to putrefaction, that he obſerved the white ſugar to be ſometimes full of maggots: and found, that divers drugs, ſalves, and other medicinal things that were brought with him, had quite loſt their virtue; and ſome of them, eſpecially ointments, were verminous. And he added, that in the iſland St. *Jago* (one of thoſe of Cabo-verde) they laid ſtore of ſweetmeats upon tables to the heat of the ſun, to dry up the ſuperfluous moiſture, which in ſtrange abundance they had contracted the preceding night, which otherwiſe would quite ſpoil the ſweetmeats, and bring them to putrify.

OXFORD, though ſeated for the moſt part of it on a gravelly hill, I have known to be very diſagreeable to ſome moiſt ſplenetic and valetudinary bodies, whom I have heard complain, that they could not be ſo well there as elſewhere, eſpecially in the ſpring; ſo that I take the air of that place to be generally moiſt. Mr. *J. T.*

AIR too dry, though ſufficiently hot, is not favourable for the production of divers inſects; for I have obſerved theſe two laſt dry ſprings, that there have been no ſoft garden-ſnails to be found abroad, and very few fleas bred in the houſe, which I impute to extraordinary long dryneſs of the air, for want of moiſt vapours to nouriſh them; ſince in wet ſummers we always ſwarm with ſnails, gnats, fleas, *&c.* whereas this year we have few or none.

TITLE XXXVIII.

Of the Air deſtroying or introducing other leſs obvious Qualities into Mineral Subſtances.

Zwelfer, pag. 800.

OBSERVANDUM etiam, quod antimonium diaphoreticum quocunque modo, ſive cum ſolo nitro aut addito etiam tartaro, paratum ſit, tractu temporis aeri expoſitum pravam & quaſi malignam induat naturam, ſumptumque intra corpus cordis anguſtias, cardialgias, lipothymias, vomituſque, & ſimilia prava ſymptomata procreet, quæ facilè tamen evitabimus, ſi vel ſingulis diebus vel tribus menſibus recenter illud conficiamus, vel jam paratum antimonium diaphoreticum vetuſtum, additâ portiunculâ nitri, aut etiam abſque nitro, per unam vel alteram horam Vulcano tradamus, penituſque igniamus, iterumque, ſi nitrum additum fuerit, edulcoremus, & parumper reverberemus.

To prove, that it proceedeth from a natural cauſe, this one, though ſtrange, yet true experiment, will ſuffice. Take of the earth of *Egypt*, adjoining to the river, and preſerve it carefully, that it neither come to be wet nor waſted; weigh it daily, and you ſhall find it neither more nor leſs heavy until the 17th of *June*, at which day it beginneth to grow more ponderous, and augmenteth with the augmentation of the river, whereby they have an infallible knowledge of the ſtate of the deluge, proceeding, without doubt, from the humidity of the air, which having a recourſe through all paſſible places, and mixing therewith, increaſeth the ſame as it increaſeth in moiſture.

Purchas's 2d part, *lib.* vi. *cap.* 8. A vulgar experiment generally affirmed, as by *Alpinus in Med. Egypt. lib.* iv. *cap.* 8. who long lived here upon the teſtimony of *Paulus Moucilus*, the French conſul, *Baptiſtæ Elianus* a Jeſuit, and *John Tarot* an Engliſhman.

A LEARNED phyſician of the college of *London* confeſſed to me, that he found by his own obſervation, that antimonium diaphoreticum, being kept ſome years, though in a covered veſſel, acquired a vomitive quality, which it had not before; and that having long kept in a ſtopped glaſs a parcel of his own ceruſs of antimony, of which he uſed to give 12, 15, or more grains, without finding it emetic; he found, that in proceſs of time it was ſo degenerated, that when he gave four or five grains, it would cauſe vomits.

EARTH laid up together in the air, for four, five or ſix years, does make far better pots for cloſeneſs, and holding of the fire, than that, which has lain but one ſeaſon above ground, though that itſelf be much better than that, which is newly dug up, which will be very apt to crack in the fire, or when it comes to wet; as alſo thoſe bricks, that lye at the top of the furnace, and therefore are not ſo thick covered as they burn, and are apt to deceive builders, when they come to be expoſed to the rain and weather.

TITLE XXXIX.

Of the Air in Reference to the Propagation and Vegetation of Plants.

AN ingenious traveller, that frequented the Pyrenean mountains, eſpecially that, which many count the higheſt of them, and is known by the name of *Pic de Midi*, affirmed to me, that he, as well as ſeveral others, had manifeſtly obſerved a ſcarce credible difference between that ſide of thoſe mountains, that regards *France*, and that, which reaches to *Spain*: for at the ſame time the former was verdant and flouriſhing, and yielded a delightful proſpect to the traveller, as well as plentiful proviſions to the inhabitants; the Spaniſh ſide of the hills was parched, and ruſſet, and barren, and looked diſmally, like a wilderneſs: which great difference of countries, obſervable in the ſame hills at the ſame time of the year, he imputed to the fierce, parching, and ſometimes blaſting winds that beat upon the Spaniſh ſide, and made that look ſo ſqualid, whilſt the hills, that ſuffered this miſchief on one ſide, did by their height check theſe hurtful winds, and ſkreening from them the French ſide of the mountains, left them to enjoy advantages, that the ſoil and climate furniſhed them with.

TITLE XL.

Of the Air in Reference to the Generation, Life, and Health, of Animals.

DE vita igitur ac morte, & iis pene omnibus, quæ huic conſiderationi affinia ſunt, dictum eſt. De ſanitate verò morboque non ſolum medici, ſed & phyſici eſt, cauſas quadantenus referre. Quatenus verò hi differant, & quatenus diverſa contemplantur, ignorare Ariſtot. de Reſpirat. cap. 21. & parag. 87.

non convenit. Equidem quòd confinis ſit quadantenus hæc medici phyſicique tractatio, & res ipſa teſtatur. Nam & medici, quicunque paulò elegantiores & diligentiores ſunt, de natura dicunt, & artis ſuæ principia inde ſumere dignantur; & phyſici omnes fere, qui conanimatis aliquid habent, tractationem naturæ uſque ad medicinam perſequuntur.

AUGUST 13. The temperature of the air, both as to ſalubrity and other regards, may be derived as well from the ſubterraneal ſteams, as the ſuperficial effluviums of the earth, and both theſe ſorts of ſteams being variouſly tranſported and ſhuffled, and compounded by the winds and other motions of the air, upon the mixtures of them, the local qualities of the air, in differing places, may be ſuppoſed to reſult.

ABOUT three months before the late great plague began in *London* (in the year 1665) there came to Dr. *M.* a patient of his, to deſire his advice for her huſband; and the doctor having inquired what ailed him, ſhe anſwered, that his chief diſtemper was a ſwelling in his groin, and upon that occaſion added, that her huſband aſſured her of his being confident, that the next ſummer the plague would be very rife in *London:* for which prediction he gave this reaſon, that in the laſt great plague he fell ſick of that diſeaſe, and he then had a peſtilential tumour; ſo in two other plagues, that ſince happened, though much inferior to that great one, each of them had a riſing in his body to be its forerunner; and now having a great tumour in the forementioned place, he doubted not but it would be followed by a raging peſtilence, which accordingly enſued. Having heard much talk of ſomething of this nature, as related by the doctor, I enquired of him how much of it was true, and received for anſwer the foregoing narrative.

You did not perhaps expect, that the mere local motion of the air ſhould be mentioned by me among the cauſes of the effects of its changes: and indeed the phænomena I have yet met with reducible to this kind have been but very few, notwithſtanding which I ſhall take notice, that this local motion may in certain caſes operate on other bodies, either as it turns the air into a wind, or as the tremulous motion of the air is modified into ſound, or as the air is put into a vehement and diſorderly motion by thunder.

As to the firſt of theſe it is evident, that upon the vehemence or ſlackneſs, and the places whence and where the changing wind happens to blow, there may divers effects enſue, eſpecially in animated bodies. And this not only as the wind is accompanied with cold and heat, or moiſture, or dryneſs, but (to reſtrain ourſelves to inſtances more cloſely pertinent to our preſent purpoſe) as the wind is flowing air, or an aereal ſtream, for only as ſuch it may ventilate the places, through which it paſſes, and by expelling the ſtagnant air, and introducing other air, may contribute to many of thoſe changes (eſpecially as to the health of animals) that we ſee to depend upon the alteration of air, and perhaps among the more tender ſort of animals, there may be found ſome, in which the motion of the external air, though excluded by walls and windows, may have a conſiderable and immediate operation: for I have learned by enquiry from ſome curious natives of *Languedoc* (where I had the curioſity to look after ſilk-worms, abounding in that province) that in caſe it happened, when the worms having eaten their fill began to diſpoſe themſelves to work their ſilken eggs; in caſe, I ſay, it then happened to be thundering weather, a great part of the worms, eſpecially the leſs vigorous, would be deſtroyed.

HE affirmed to me, that in ſome mines of above a thouſand foot deep, he ſaw horſes, that had been let down by ropes to the third part of the depth, that is, above a hundred yards; and that ſeveral of them died either in the letting down, or by the change of the air; yet ſeveral of them ſurvived, and were employed about the engines

gines belonging to the mines, and ſeemed not to have any ſenſible inconvenience as to reſpiration, though in the receptacles they wrought in, they were furniſhed with air but from the groove, through which they were let down, and by a moderately big ſhaft.

An ingenious traveller, that has had the curioſity to viſit the mines of ſeveral countries, as *Bohemia*, *Saxony*, *Swedeland*, *&c.* anſwered me, that the deepeſt mine he ſaw in *Bohemia* was of about 2000 of our feet.

An intelligent perſon, that was for many years conſul of the Engliſh nation at *Tripoli* in *Barbary*; and at another time governor of the caſtle (called) of the Coaſt, belonging to the Engliſh African company in *Guinea*, being diſcourſed with by me, about the diſeaſes incident to that very unhealthy place, and about the worms, that bred in men's legs, told me, that the great noxiouſneſs of the air was not conſtant, but frequently ceaſed, and returned within no long compaſs of time; inſomuch that all his men would continue in health for many days together, and then on a ſudden divers of them would fall ſick, eſpecially of fevers and fluxes, that uſually killed them in forty-eight hours or leſs.

Dr. *C.* chief phyſician to the Ruſſian emperor, confirmed to me, that being in *Ruſſia* in the winter, when the froſt was very hard, and the eaſt or north-eaſt wind blew cold, if he turned his face toward the wind, and walked againſt it, (which at other times he was wont, and took a delight to do) he found himſelf unable to fetch his breath, and almoſt ſtifled, as if the air were very thick, or rather a great ſtiffneſs brought upon the organs of reſpiration, whereby he was unable to move them as at other times, ſo that he was fain to turn his head from the wind, that he might be able to fetch his breath.

An obſerving perſon being aſked about a tradition of ſeamen, that the lice of Europeans die when the ſhips paſs the line; anſwered me, that he did not find it to be true, as it is wont to be delivered; but this he plainly obſerved in ſeveral of our Engliſh, with whom he ſailed, that all the lice quitted their bodies, and got up into their heads, whence they diſperſed themſelves again, when the ſhip had left the equator a pretty way behind it.

But I remember, that another acquaintance of mine, that divers times paſſed the equinoctial in Portugal ſhips, which uſed to go to the *Indies* well crowded with people, many of them more poor than cleanly, anſwered me, that he had heedfully obſerved thoſe people's numerous lice to die away as they croſs the line, though in no long time after the ſame ſort of cattle would begin to moleſt them again.

His royal highneſs the duke of *York*, at his return out of *Scotland*, having been pleaſed to diſcourſe with ſome of us, that had the honour to be then near him, of ſome obſervations he made in his journey, mentioned among other things, that agues were very unfrequent in *Scotland*, which yet that year were very rife over almoſt all *England*. This gave me afterwards the curioſity to inquire of a ſtudious perſon, who is one of the chief of the Scotiſh nobility, what he knew about the unfrequency of agues in his country. To which his lordſhip replied, that as to quartan agues it was generally taken notice of, inſomuch that when news was brought, that a gentleman, whom he named, fell ſick of that diſeaſe, amongſt them in the country it was looked upon as a ſtrange and remarkable thing. And though divers perſons bring quartans out of *England* to *Edinburgh*, yet they ſo ſeldom keep them long there, that a Scotiſh phyſician, whom he named to me, offered to lay five to one of the quick recovery of ſeveral patients of his, if they would make ſome reaſonable ſtay in that city.

Roderici Fonſ. de Sanit. tuend. pag. 105, 106.

Aer autem corrigetur cauſa corruptionis ablata, & quod jam inductum eſt mali extinguendo: ſi igitur ex nimio humore aer putreſcit, ignibus accenſis, qui omni putredini remedio ſunt, exſiccandus, ſic ignes, per vias & domus fiant ex odoratis plantis, qualis Laurus eſt, Myrtus, Pinus, Cupreſſus, Roſmarinus, & reliquæ ejus generis, qua ratione peſtem Athenis Hippocrates extinxit; vapores præterea maligni per aeram ſparſi diſſipandi ſunt, id quod à magnis ventis fieri ſolet. Sic Olyſſiponi, cum trium dierum ingens procella veniſſet, peſtis extincta nuper, eſt & in Maroco ingens peſtilentia vento quodam evanuit; qui veluti è fornace (adeo calidus erat) exire videbatur, aerem autem nos imitando ventos commovere poterimus; ſi bombardarum ſtrepitus multos fieri curemus; ſi verò vapores ex paludibus ac ſtagnantibus aquis fieri videntur, eas reſiccare aut novare oportet frequenter, maximè per æſtatem. Renovantur autem novis ſupervenientibus aquis, quas è fluminibus per canales traducere oportet; aut ſiccandæ ſunt factis rivulis & foſſis, per quæ ſuperfluant ad flumina; quod cum primus magnus Etruriæ dux Coſmus Piſis feciſſet, & magna animi contentione nunc faciat Ferdinandus, factum eſt, ut ſaluberrimus ejus urbis aer per omne anni tempus ſit redditus: verum ſi cadaverum inhumatorum multitudo aerem inficit, magna & profundæ facta fovea ſepeliantur; ſi ab immunditie, & excrementis, quæ per urbem & domos ſparguntur, id quod, ut reor, Bizantii, & Olyſſiponi, in cauſa eſt, cur peſtis adeo ſæviat, ac duret, mundare oportet omnia; viæ ac domus quotidiè, vel ſaltem ſemel in ſeptimanâ, repurgandæ.

1. Joh. Beguinus in Tyrocin. Chymic. Lib. II. cap. 13. *Dignum admiratione eſt, quod quamvis in vicinià Hydriæ comïtatûs Goricienſis, ubi reperitur copioſe mercurius, ſingulis ferè annis lues peſtifera graſſatur, illa tamen ſemper immunis ab hac manere ſoleat; idque viri provectæ ætatis ſe obſervaſſe, & à majoribus ſuis accepiſſe, mihi ſanctè confirmarunt. Hinc patet, mercurium eſſe ſummum omnis putredinis ac corruptionis alexipharmacum.* 2. Michael Majerus in luſu de mercurio. *Argentum vivum eſt plurimorum morborum alexipharmacum, &, ut teſtantur quidam, ipſius peſtis (cum eo loco, ubi mercurius effoditur, & tractatur, nunquam aut rariſſimè hoc contagium graſſetur) dummodò maneat in ſuâ propriâ naturâ, & non à ſalibus aut aquis corroſivis inficiatur, ac venenoſus reddatur.*

A very ingenious phyſician, that travelled much in the *Eaſt-Indies*, and viſited ſome iſlands in the *South Sea*, to which our Engliſh were not permitted to have acceſs, being aſked of me ſome queſtions about the effects and changes of the air in thoſe parts, related to me, that having made ſome ſtay in the famed iſland of *Ternate*, he learned, that the Dutch (who had maſtered the inhabitants) did, upon a compoſition made with the king for his damages, cut down almoſt all the numerous clove-trees, that grew in that iſland, that thereby they might keep up the high rate of that ſpice, as indeed they have done. Whereupon there happened a change in the temperature of the air, that gave cauſe to conclude, that the exhalations of the bloſſoms which (being dried) afford the cloves, were not only very pleaſant, but very healthful too: for no long time after the exciſion of theſe fragrant trees, the iſland became very unhealthful, which this phyſician very probably imputed to the corroſive and noxious ſteams, which plentifully iſſuing out from a kind of vulcan, or ſmoking, and ſometimes burning hill, depraves the air of that iſland that is but little, but had their hurtful effects formerly prevented by the aromatic and benign emanations of thoſe numerous bloſſoms and trees, that richly impregnated the air, and by their volatile and oily ſalts, oppoſed and hindred the effects of the ſulphureous and other ſharp ſteams of the vulcan. And my relator aſſures me, that this change of the air's conſtitution was ſo remarkable and acknowledged, when he was there, that whereas formerly ſick and valetudinary perſons uſed to be ſent thither from *Batavia* to recover their

their health by the goodneſs of the air (as we often ſend conſumptive perſons into *France*) the air at his being in *Ternate* had been for divers years ſo unhealthful, that the Dutch were fain (from *Batavia*, or other more healthy places) to ſend men twice a year to relieve the garriſons, and bring back the many ſick they uſually found at their arrival in that formerly healthy iſland.

An obſerving phyſician lately returned from *Tangier*, anſwered me, that though otherwiſe it be a healthy place, he took notice, that it was not unuſual for new comers to find themſelves feveriſh for many weeks, or ſome months after their arrival, eſpecially if the piercing eaſterly wind happened to reign. This, he ſays, he found in himſelf, not only by a conſtant heat and ſome other ſymptoms, but by that main one of the preternatural quickneſs of his pulſe. He added, that this diſeaſe, though very mild, held him near four months; when the eaſterly winds happened to blow, on which his feveriſhneſs ſo depended, that he could eaſily, when he awaked in the morning, know, without aſking, whether that wind blew or not.

May 16. We put into a ſmall receiver five or ſix little ants, which ran about very briſkly; but the air being pumped out, they preſently loſt their motion, which they ſoon recovered upon the reſtoring of the air to them. Then the air was again withdrawn, and the inſects thereby brought to lye (ſome upon their backs) as ſtark dead: in which condition they were ſuffered to remain about five or ſix hours; after which the air being let in upon them, they nevertheleſs continued ſeemingly dead for many minutes, (as we gueſſed between 15 and 30) but at length all recovered, running nimbly up and down the glaſs, though it were late at night.

Si patrono queſte barche dalla coſta della peſcaria, è vanno all iſola di Ceilam, nella coſta della quale per la lunghezza di venti miglia, tre ſole miglia lontane da terra, ſette braccia abbaſſo arrivando ſino alli dieci nel fondo, ſi ritrova infinita quanta di madreperle, eſcono per queſta peſca la barche la matina col vento di terra, & arrivando al poſto delle madreperle, gettare l'ancore, è fermareſi in quel poſto, cominciano à tuftarſi nel mare i marinari, de quali ogni barca ne ha quindeci, è venti, è ciaſcuno di eſſi ſi lega nel mezzo, con una ſune, della quale ha cura uno, che reſta in barca è con un'altra ſune legandoſi una pietra alla gamba, un'altro ha pure cura di quella, e cingendoſi un' ſacco di cuoio dinanzi, metiendoſi le guante alle mani, coſi legato ſi tufta con violenza nel mare, lentando quelli le funi, è col peſo della pietra, va con grandiſs' violenza giu, & arrivato ch' e ſcioltaſi dalla gamba quella ſune, con la quale ſta legata la pietra, reſta egli libero, & la pietra viene ſubito tirata ſoprada quello, che n'ha cura, et il marinaro poi comincia con molta ſollecitudine à pigliare quelle madreperle, che li vengono dinanzi, e le mette nel ſacco, e ſentendoſi mancare la reſpiratione, tocca la ſune, con la quale ſta legato nel mezzo, e quello ſubito con grandiſs' velocita lo tira et arrivando nella barca, ſcaricando le madre perle ripiglia fiato, è dopo torna a legarſi di nuovo la pietra, e di nuovo ſi tufta come ſopra's e detto, e ſempre coſi per tutta la giornata. Et e tanto faticoſa queſta peſca, ch'eſſendo, tanto profunde le madre perle nel mare, molti mancando loro la reſpiratione ſi trovano affogati. *Relatione della Provincia di Malavar. pag.* 64 & 65.

It is, by long obſervation and often repeated experience, found certain, that if any foreigner lye on ſhore all night at *Johanna*, they ſeldom miſs to be taken with ſickneſs there, or within a few days after their departure from the iſland, and are commonly ſeized with putrid fevers, whereof moſt die in two or three days, though thoſe, that have remained upon the place all day long, for ſeveral days together, are almoſt always ſafe, if they go on board of ſhip every night about a mile, or a little further from the ſhore. The iſland abounds with the greateſt variety of plants and trees, that can be almoſt imagined in that circumference, and is generally exceſſive hot in the day time, but cold after ſun-ſet. Whence it may poſſibly be ſuppoſed,

ed, that the moſt volatile parts of thoſe promiſcuous (and probably many of them poiſonous) plants, exalted in the day time by degrees, and ſuddenly condenſed at night, may by inſpiration infect the maſs of blood much after the ſame manner as in peſtilential airs. The inhabitants themſelves are very much ſubject to fevers, (of what ſort I could not learn) for which they cut or ſcarify their breaſt or abdomen in ſeveral places: but they obſerve, that few live, except their fever terminates in a conſiderable number of botches in divers parts of the body. There is one hill there remarkable for height, which is ſeldom or never free from thick fogs or clouds hovering over the top of it, ſometimes higher, ſometimes lower, according as the weather alters.

Upon the coaſt of *Cormandell*, and moſt maritime places of the *Eaſt Indies*, there are ſometimes (I think yearly) fogs ſo thick (notwithſtanding it is then very hot) that all, or moſt inhabitants from other nations, and the tenderer ſort of the natives, are neceſſitated to keep their houſes, with the doors and windows faſt ſhut, there being little or no commerce at that time.

At *Balaſſore* in the bay of *Bengale*, and in divers other parts in that country, there happens, after great rains, ſo great corruption of the air, that the ſtinking ſmell is very nauſeous to the inhabitants; which I preſume may be chiefly occaſioned by a great number of frogs, and other reptiles (wherewith thoſe places abound) left upon the dry places after the inundation, and then putrified by the exceſſive heat of the ſun. At this time there is great ſickneſs and mortality amongſt the natives, chiefly by violent fevers.

In the return of Engliſh ſhips from the *Eaſt Indies*, they generally put their ſick people on ſhore at St. *Helena*, where they find ſo ſenſible alteration, that although carried thither, there are few, that do not recover ſo much ſtrength, as to walk about in two or three days, which, in all probability, muſt chiefly be attributed to the alteration of air, not of food, there being in moſt ſhips much the ſame benefit of freſh proviſion for thoſe, that are diſeaſed.

Le chemin plus court de Moſul a Bagdad eſt par la Meſopotamie; mais on n'y trouve aucun village, & le Samiel y regne toute l'eté depuis Moſul juſques à Sourat; ce qui oblige à prendre l'eau ſur le Tigre, où ce vent ne ſouffle point. Le nom de ce vent eſt compoſé des mots, ſam et jel, c'eſt à dire poiſon et vent, comme qui diroit vent de poiſon. Ce pourroit être le vent urens, dont parle Job xxvii. 21. *Lorſque quelqu'un à reſpiré ce vent, il tombe mort ſubitement, quoi qu'il en ait quelques uns, qui ont le temps de dire qu'ils brûlent au dedans. D'abord qu'on eſt mort, on devient tout noir, et ſi on tire le mort par le bras, où par la jambe, où par un autre endroit, la chair quitte les os, et reſte entre les mains de ceux, qui la touchent.* Thevenot dans le bibliotheque univerſel: Tom. XIII. *p.* 266.

Doctor *Collins* relates, that in *Muſcovy* their horſes are much ſubject to a very ſcurvy diſeaſe, whoſe Ruſſian name I have forgot, from which the natives are wont to preſerve them, by keeping goats in their ſtables: and being aſked by me, whether he had this by tradition, or upon his own trial? he affirmed, that he had found it true himſelf, and that he therefore was wont to keep goats in his own ſtable.

The ingenious Mr. *Rycaut*, Engliſh conſul at *Smyrna*, being aſked of me, whether at *Smyrna* as well as at *Aleppo*, he obſerved, that the plague, that uſes to rage in the former part of the ſummer, degenerates into other diſeaſes about the latter end of *June*, and beginning of *July*; he anſwered me, that at *Smyrna* the obſervation does not hold ſo much as at *Aleppo*; but yet at *Smyrna* they generally obſerve, that about that time of the year, though exceeding hot, the malignity of the plague does notably

notably leſſen, for it is not quite ſo infectious, nor near ſo generally mortal, as it was in the former part of the ſummer. When many years ago I heard of this ſtrange phænomenon of the peſtilence at *Aleppo*, I began to think, whether a poſſible, though not perhaps the true cauſe of it may not be ſuch as this; that the peſtilential corpuſcles, that rove up and down in the air, during the former part of the ſummer, require ſuch a bulk or groſſneſs to enable them to exerciſe their pernicious operations; but when the weather grows to be exceeding hot, that heat of the air becomes able to diſſipate thoſe corpuſcles, and deprive them of that bulk, that we have ſuppoſed neceſſary to their deſtructive efficacy. For illuſtration of this conjecture, we may take notice of the ſmoke, that iſſues out of the weik of a candle newly blown out; for whilſt the ſooty-corpuſcles retain their bigneſs and texture, they are able to offend the noſtrils very much by their ſtink, and ſometimes to cauſe convulſive motions and abortions in teeming women: but if you apply a flame to this ſmoke, it preſently diſcuſſes this fuliginous matter, and diſſipates it into particles of quite another nature, which by this means are deprived of all their offenſive ſmell, and ſome other ill qualities. It may alſo be ſaid, that the great increaſe of heat in *July* may enable the ſun beams, by penetrating the earth deeper, and agitating its lower parts ſtronger, and producing creviſſes, and other new or formerly obſtructed paſſages in the upper parts of it, may elevate into the air divers ſaline and other new corpuſcles, which may either divide or diſſipate the peſtilential ones, or elſe by aſſociating themſelves with them, make up new concretions, differing from the peſtilential corpuſcles, in bulk, ſhape, texture or motion, in moſt or all of theſe, by which means the morbific corpuſcles being much altered, their operations on the human bodies they invade may be ſo too, and the diſeaſes they produce may become leſs malignant, or degenerate into ſome other diſeaſe. And if it be demanded, why this does not happen elſewhere as well as at *Aleppo* and *Smyrna?* it may be anſwered, that the concourſe of cauſes may not be the ſame, and particularly, that the ſoil of thoſe two places may be peculiarly diſpoſed to emit peſtilential corpuſcles of ſuch a determinate nature, with ſuch a degree of heat, and diſſipable by a greater, or with a more intenſe heat, to afford alſo exhalations capable to correct the former, as it is delivered by good authors, and ingenious men have confirmed it upon their own obſervation, that yearly, at grand *Cairo*, in the heat of ſummer the plague ceaſes to be mortal, and almoſt to be infectious, when the *Nile* begins to overflow; which wonderful change I ſhould not ſo much aſcribe to a frigeration of the air, that uſually accompanies the ſwellings of the waters, (ſince peſtilences rage in much cooler weather, than can be ſuppoſed in ſo hot a climate as that of *Egypt* in *July*) as to ſome nitrous and other corrected exhalations, that are plentifully emitted by the freſhly arriving waters.

THERE is an account, that has not, that I know of, been taken notice of, upon which the ſupervening coldneſs and heat of the air may *pro tempore* very much alter the qualities of it, in reference to the bodies and health of men: for the air being a fluid body as well as water, and impregnated with ſalts of different kinds, ſome merely ſaline, and others aſſociated with ſulphureous and other kinds of particles; it ſeems not improbable, that what happens in that groſſer fluid water, impregnated with differing ſorts of ſalts, and altered by ſucceſſion of heat and cold, takes place alſo in the air. I purpoſely tried in water, that by diſſolving in it convenient quantities of two differing ſalts, though whilſt the liquor was hot, or perhaps ſo much as luke-warm, they would ſwim together undiſtinguiſhably in the liquor, and ſo were in a capacity to act jointly, and, as the ſchools ſpeak, *actione communi*, on divers occaſions; yet when the liquor was cold, and ſometimes when there was only a conſiderable remiſſion of the heat, the ſaline particles of one kind, being not capable of being any longer

 ſuffi-

ſufficiently agitated by ſo faint a degree of heat, would convene into grains or cryſtals; and loſing their fluidity and motion, viſibly ſeparate themſelves from the other kind of ſalts, which yet continued fluid in the water, where it could now act but by its own particular qualities, and not as formerly, *actione communi.*

THE cleareſt inſtance I found of this obſervation, was afforded me by an experiment made with the ſolutions of alum and nitre; a relation of which I find among my adverſaria, in the following terms.

EQUAL parts of alum and nitre being diſſolved in the ſame portion of fair water; and the liquor being in good meaſure evaporated, the earthen veſſel, that contained it, was ſet in the cold, by which means, at the bottom and the lower part of the ſides, the alum appeared to be firſt coagulated in many octaedrical grains, no cryſtals of nitre yet being viſible. Afterwards, upon a further evaporation of the water, and the removal of the veſſel from the fire, there appeared more grains of alum, but as yet no nitre: wherefore having yet further evaporated the liquor, at length the nitre ſhot plentifully into fine little cryſtals of the ſhape proper to that ſalt.

THIS is the account my note-book contains of this trial, which ſeems to invite us to conjecture, that of the numerous ſorts of ſaline corpuſcles, that rove up and down in the air, whilſt it is well heated by the ſun, or other cauſes, ſome ſorts may, by the abſence of that heat, or ſome ſupervening cauſes of coldneſs, be made to ſeparate from the others, which were thereby contemperated, or perhaps enabled to co-operate to divers purpoſes, that they were not fit for alone; and to form concretions, which, though not ſingly viſible, may be too great to be kept in a ſtate of fluidity by the diminiſhed heat of the air.

A MOUSE lived ten minutes at leaſt with a quarter air, and three afterwards.

TITLE XLI.

Of heavy Bodies ſuſtained in or taken up into the Air.

TITLE XLII.

Of Dew.

TITLER XLIII.

Of Rain.

AN eminent virtuoſo informed me, that in the country of *Campen*, he had ſeen divers pits, that are digged for turf, or rather peat, which were not deep for the moſt part, but reached to a kind of quick-ſand, upon which the rain falling did by degrees, in ſome years, form a kind of ſlimy earth or clay, which was much of a martial nature; and being ſkilfully handled, would yield good iron.

THE

THE ſame perſon aſſured me, that he had divers times diſtilled the water of *Campen* in new and fine glaſſes, and ſtill found them to leave a conſiderable quantity of ſtony matter at the bottom, notwithſtanding the rectification.

Quicquid erit, ſine fuco ſignificat, velut Rottenberg, Sileſiæ compaſtum appellant, perinde Mileſſow temporum prognoſtes jure merito dici poſſet. Vidi ex proximo totum aliquando montem denſiſſimis nebulis contectum, eâ prorſus imagine, qua mons Sinai Moyſe in nebula latente depingitur, at cæteri circum montes innubes & hilares, velut rerum gerendarum ignari, ſtabant, ſol ipſe formoſiſſimus ibat; at accolæ locorum domum fugiebant, pecora urgebant, meque, ut domum protinus reciperem, properarem, & equos currum trahentes concitari juberem, monebant, neque horæ quadrans interceſſit, jam cælum obduci, ſol contegi, eripi omnis aſpectus. L. I. c. 8. *De Mont. Bohemiæ, p. 26. A Mileſſow montis temporum præſagia capiuntur.*

VIRG. *Immenſum cœlo ruit agmen aquarum;*
——ruit arduus æther,
Et pluvia ingenti ſata læta, boúmque labores.
Diluit, implentur foſſæ,

& quæ divinus poeta proſequitur. At contra etiam accidere vidi, ut cæteri fumârint montes, Mileſſow nihil ſe commovente, nihil aut nubilum aut turbidum minante; incolæ rogati, nihil eſſe magnopere timendum à cæteris ſpondebant, hunc unum intuendum eſſe, horum nubila omnia à Mileſſow quodammodo devorari.

TITLE XLIV.

Of Hail.

ON ecrit de l'iſle en Flandres le 25 May, ſtyle nouveau, qu'il tomba dans cette ville la une graiſle, dont les moindres grains eſtoient comme des oeufs de pigeon. Cet orage a paſſé ſur la citadelle & la ville, & n'a pas laiſſé une vitre entiere du coſte du vent: les maiſons ſont toutes decouvertes, & les arbres rompus, les bleds coupez, & les perdrix & les lievres morts. On a peſé pluſieurs grains de cette graiſle, dont les uns eſtoient d'un quarteron, de demi livre, de trois quarterons, et les plus gros d'une livre, & davantage. Il y en avoit un entr' autres, qui avoit dans le milieu une eſpece de matiere brune, qu'on mit dans le feu, qui fit faire un grand bruit. Il y en avoit un, qui eſtoit diaphane, lequel eſtant mis aupres du feu, fondit tout auſſi toſt comme du plomb, quoy qu'il fut beaucoup plus dur que les autres.

TITLE XLV.

Of Snow.

TITLE XLVI.

Of other Things falling out of the Air.

EO ipso anno, quo dux Eboracensis postremo rediit è Scotia Londinum, depluere tanta copia pisciculi halecibus colore, figurâ, sapore quam simillimi, in superiore Gallocidiæ in Scotia parte non procul à mari, ut duo terræ jugera ad Robertum Murray de Brughton equitem pertinentia nunc Londini, ut audio, degentem, cooperuerint. Rem autem totam sereniſſimo duci Eboracensi prius de eadem ab eo interrogatus, quod tum certior ab aliis de hâc pluvia factus esset, tanquam testis oculatus, ut qui aliquos horum pisciculorum videram, confirmavi: is porro ingenioſiſſime, summâque veri specie nodum ita solvit, ut diceret hos pisciculos unà cum aquis furentium ventorum gyro in turbinem actis evectos esse nubes, è quibus non procul inde pondere rursus suo relapsi fuerint in vicinam terram.

TITLE XLVII.

Promiscuous Experiments and Observations of the Air.

TITLE XLVIII.

Desiderata in the History of the Air, and Proposals towards supplying them.

GENERAL

GENERAL HEADS
FOR THE
NATURAL HISTORY
OF A
COUNTRY, Great or Small;

Drawn out for the Uſe of

TRAVELLERS and NAVIGATORS.

Printed firſt in the *Philoſophical Tranſactions*, No. XI. p. 186. No. XVIII. p. 315. and No. XIX. p. 330. and afterwards reprinted with *other Directions for Navigators by another Hand*, at *London* 1692, in 12mo.

THE things to be obſerved in ſuch a hiſtory, may be variouſly (and almoſt at pleaſure) divided: as into ſupraterraneous, terreſtrial, and ſubterraneous, and otherwiſe; but we will at preſent diſtinguiſh them into thoſe things, that reſpect the heavens, or concern the air, the water, or the earth.

1. To the firſt ſort of particulars belong the longitude and latitude of the place (that being of moment in reference to the obſervations about the air, *&c.*) and, conſequently, the length of the longeſt and ſhorteſt days and nights, the climate, parallels, *&c.* what fixed ſtars are, and what not ſeen there; what conſtellations it is ſaid to be ſubject to; whereunto may be added other aſtrological matters, if they be thought worth mentioning.

2. ABOUT the air may be obſerved its temperature, as to the firſt four qualities (commonly ſo called) and the meaſures of them; its weight, clearneſs, refractive power; its ſubtlety or groſſneſs: its abounding with, or wanting an eſurine ſalt; its variations according to the ſeaſons of the year, and the times of the day; what duration the ſeveral kinds of weather uſually have; what meteors it is moſt or leaſt wont to breed; and in what order they are generated; and how long they uſually laſt: eſpecially, what winds it is ſubject to; whether any of them be ſtated and ordinary, *&c.* what diſeaſes are epidemical, that are ſuppoſed to flow from the air: what other diſeaſes, wherein that hath a ſhare, the country is ſubject to; the plague, and contagious ſickneſſes: what is the uſual ſalubrity or inſalubrity of the air; and with what conſtitutions it agrees better or worſe than others.

3. ABOUT the water may be obſerved the ſea, its depth, degree of ſaltneſs, tides, currents, *&c.* Next, rivers, their bigneſs, length, courſe, inundations, goodneſs, levity (or their contraries) of waters, *&c.* Then, lakes, ponds, ſprings, and eſpecially mineral waters, their kinds, qualities, virtues, and how examined. To the waters belong alſo fiſhes, what kinds of them (whether ſalt or freſh-water fiſh) are to be found in the country; their ſtore, bigneſs, goodneſs, ſeaſons, haunts, peculiarities of any kind, and the ways of taking them, eſpecially thoſe that are not purely mechanical.

4. In the earth may be obſerved,

1. Itſelf.

2. Its inhabitants, and its productions, and theſe external, and internal.

First, in the earth itſelf may be obſerved its dimenſions, ſituation, eaſt, weſt, north and ſouth; its figure, its plains and valleys, and their extent; its hills and mountains, and the height of the talleſt, both in reference to the neighbouring valleys or plains, and in reference to the level of the ſea: as alſo, whether the mountains lye ſcattered, or in ridges; and whether thoſe run north and ſouth, or eaſt and weſt, *&c.* what promontories, fiery or ſmoking hills, *&c.* the country hath, or hath not; whether the country be coherent, or much broken into iſlands: what the magnetical declination is in ſeveral places, and the variations of that declination in the ſame place (and, if either of thoſe be very conſiderable, then, what circumſtances may aſſiſt one to gueſs at the reaſon, as ſubterraneal fires, the vicinity of iron mines, *&c.*) what the nature of the ſoil is, whether clay, ſandy, *&c.* or good mould; and what grains, fruits, and other vegetables, do the moſt naturally agree with it: as alſo, by what particular arts and induſtries the inhabitants improve the advantages, and remedy the inconveniencies of their ſoil: what hidden qualities the ſoil may have (as that of *Ireland*, againſt venomous beaſts, *&c.*)

Secondly, above the ignobler productions of the earth, there muſt be a careful account given of the inhabitants themſelves, both natives and ſtrangers, that have been long ſettled there: and in particular, their ſtature, ſhape, colour, features, ſtrength, agility, beauty (or the want of it) complexions, hair, diet, inclinations, and cuſtoms that ſeem not due to education. As to their women (beſides the other things) may be obſerved their fruitfulneſs or barrenneſs, their hard or eaſy labour, *&c.* and both in women and men muſt be taken notice of what diſeaſes they are ſubject to, and in theſe whether there be any ſymptom, or any other circumſtance, that is unuſual and remarkable.

As to the external productions of the earth, the enquiries may be ſuch as theſe: what graſſes, grains, herbs (garden and wild) flowers, fruit-trees, timber-trees, (eſpecially any trees, whoſe wood is conſiderable) coppices, groves, woods, foreſts, *&c.* the country has or wants: what peculiarities are obſervable in any of them: what ſoils they moſt like or diſlike, and with what culture they thrive beſt. What animals the country has or wants, both as to wild beaſts, hawks, and other birds of prey; and as to poultry, and cattle of all ſorts; and particularly, whether it have any animals that are not common, or any thing that is peculiar in thoſe that are ſo.

The internal productions or concealments of the earth are here underſtood to be the riches, that lye hid under the ground, and are not already referred to other enquiries.

Among theſe ſubterraneal obſervations may be taken notice of, what ſorts of minerals of any kind they want, as well as what they have; then, what quarries the country affords, and the particular conditions both of the quarries and the ſtones; as alſo, how the beds of ſtone lye, in reference to north and ſouth, *&c.* what clays and earths it affords, as tobacco-pipe-clay, marls, fullers-earths, earths for potters wares, boluſes, and other medicated earths; what other minerals it yields, as coals, ſalt-mines, or ſalt-ſprings, alum, vitriol, ſulphur, *&c.* what metals the country yields, and a deſcription of the mines, their number, ſituation, depth, ſigns, waters, damps, quantities of ore, goodneſs of ore, extraneous things, and ways of reducing their ores into metals, *&c.*

To theſe general articles of enquiries (ſaith their propoſer) ſhould be added, 1. Enquiries about traditions concerning all particular things relating to that country, as either peculiar to it, or at leaſt uncommon elſewhere. 2. Enquiries, that require learning

ing or ſkill in the anſwerer: to which ſhould be ſubjoined propoſals of ways, to enable men to give anſwers to theſe more difficult enquiries.

WHAT is the proportion of ſalt, that is in the water of differing ſeas? and whether in the ſame ſea it be always the ſame? and if it be not, how much it differs?

WHAT is the gravity of ſea-waters in reference to freſh waters, and to one another; whether it vary not in ſummer and winter, and on other ſcores? and whether in the ſame ſeaſon its gravity proceed only from the greater or leſſer proportion of ſalt that is in it, and not ſometimes from other cauſes? and what are the differing gravities of the ſea-water, according to the climates *.

WHAT are the odors, colours and taſtes, obſervable in ſea-water?

WHAT is the depth of the ſea in ſeveral places, and the order of its increaſe and decrements? and whether the bottom of the ſea does always riſe towards the ſhore, unleſs accidentally interrupted?

OF the bottom of the ſea, and how it differs from the ſurface of the earth, in reference to the ſoil, and evenneſs or roughneſs of the ſuperficies; and the ſtones, minerals and vegetables to be found there?

WHAT the figuration of the ſeas from north to ſouth, and from eaſt to weſt, and in the ſeveral hemiſpheres and climates?

WHAT communication there is of ſeas by ſtreights and ſubterraneal conveyances?

OF the motion of the ſea by winds, and how far ſtorms reach downwards towards the bottom of the ſea?

OF the grand motions of the bulk or body of the ſea; eſpecially of the tides; their hiſtory as to their nature and differences.

WHAT power the ſea hath to produce or haſten putrefaction in ſome bodies, and to preſerve others; as wood, cables, and others, that are ſunk under it?

OF the power aſcribed to the ſea to eject dead bodies, ſuccinum, ambergreaſe?

OF the ſhining of the ſea in the night?

WHAT are the medical virtues of the ſea, eſpecially againſt hydrophobia?

WHAT is its virtue to manure land? and what are the plants, that thrive beſt with ſea-water?

The particulars whereof (ſaith the author) are here omitted; Sir *Robert Moray* and Dr. *Wallis* having by their more accurate inquiries about tides made them needleſs.

Articles of Enquiries touching Mines.

THE firſt, the neighbouring country about the mines.
THE ſecond, the ſoil where the mines are.
THE third, the ſigns of mines.
THE fourth, the ſtructure and other particulars belonging to the mines themſelves.
THE fifth, the nature and circumſtances of the ore.
THE ſixth, the reduction of the ore into metal.

Queries about the firſt Title.

1. WHETHER the country be mountainous, plain, or diſtinguiſhed with vales? And in caſe it be mountainous, what kind of hills they are; whether high or low, or indifferently elevated? Whether almoſt equal, or very unequal in height? Whether

* This laſt clauſe containing a difficult query, and that may ſeem ſomething odd, Mr. *B.,l.* thinks fit to note, that having recommended this matter, among others, to a learned phyſician, that was ſailing into *America*, and furniſhed him with a ſmall hydroſtatical inſtrument, to obſerve from time to time the differences of gravity he might meet with; this account was returned him, that he found by the glaſs, the ſea-water to increaſe in weight, the nearer he came to the line, till he arrived at a certain degree of latitude, as he remembers it was about the 30th, after which the water ſeemed to retain the ſame ſpecific gravity, till he came to the *Barbadoes* or *Jamaica*.

fruitful or barren, cold or temperate, rocky or not; hollow or ſolid? Whether they run in ridges, or ſeem confuſedly placed; and, if the former, what way the ridges run, north or ſouth, *&c.* and whether they run any thing parallel to one another?

2. WHETHER the country be barren or fruitful? and, if any way fruitful, what it produces, and what it moſt abounds with?

3. WHAT cattle it nouriſhes, and whether they have any ſuch thing peculiar in point of bigneſs, colour, ſhape, longevity, fitneſs or unfitneſs to make good meat, *&c.* as may be rather aſcribed to the peculiar nature of the place, than to the barrenneſs of the ſoil, or other manifeſt cauſes?

4. WHETHER the natives, and other inhabitants, live longer or ſhorter than ordinary? Whether they live more or leſs healthy? Whether they be ſubject to any epidemical diſeaſes, that may very probably be imputed to the mines; and what theſe diſeaſes are, and what remedies are found ſucceſsful?

5. WHETHER the country be or be not furniſhed with rivers, brooks, ſprings, and other waters; and how theſe waters are conditioned?

6. WHETHER the air be dry or moiſt, hot or cold, clear or foggy, thick or thin, heavy or light; and eſpecially, whether the weather be more or leſs variable than ordinarily; or whether it be ſubject to great and ſudden changes, that may probably be imputed to the mineral and ſubterraneous ſteams; and what they are?

About the ſecond Title.

7. WHETHER the ſoil, that is near the ſurface of the earth, be ſtony; and, if it be, what kind of ſtones it abounds with? Whether it be clayey, marley, chalky, *&c.*? And, if it be of ſeveral kinds, how many they are; and by what properties they are diſtinguiſhed?

About the third Title.

8. BY what ſigns they know or gueſs, that there is a mine in ſuch a place?

9. THESE ſigns are either upon the ſurface of the earth, or beneath it.

To the former belong theſe queries.

10. WHETHER the ground be made barren by metalline or mineral effluviums?

11. WHETHER it be obſerved, that trees and other greater plants ſeem to have their tops burnt, or other leaves or outſides diſcoloured? or whether there be any plants, that do affect to grow over ſuch mines; and whether it have been tried, that other plants, that would proſper in the adjacent places, will not be made to grow or thrive?

12. WHETHER the ſtones and pebbles, that are waſhed by the brooks, ſprings, or other waters, have any coloured ſubſtance left upon them; and if they have, of what colour, weight, *&c.* theſe adherences are?

13. WHETHER the waters of the place propoſed do by their taſte, ſmell, ponderouſneſs, *&c.* diſcloſe themſelves to contain minerals? and, if they do, what minerals they or their reſidences, when they are evaporated away, do appear to abound with, or to participate of?

14. WHETHER ſnow will not lye, or froſt continue ſo long, or dew be generated or ſtay upon the ground in the place propoſed, as on other neighbouring grounds?

15. WHETHER the dew, that falls on that ground, will diſcolour white linen or woollen cloths, ſpread over night on the ſurface of the ground, and employed to collect the dew? And whether the rain, that falls there, and may be ſuppoſed to come thither from elſewhere, will diſcolour ſuch clothes, or afford any reſidence of a mineral nature?

16. WHETHER

16. WHETHER the place be more than ordinary ſubject to thunder and lightning, and to ſudden ſtorms or earthquakes, as likewiſe to nocturnal lights and fiery meteors.

17. WHETHER miſts uſe to riſe from grounds ſtored with minerals? What is obſervable in them, and what minerals they ſignify, and may be ſuppoſed to be produced by?

18. WHETHER the virgula divinatoria be uſed to find out the veins of propoſed mines; and, if it be, with what ſucceſs?

19. WHAT other ſigns above ground afford probability of mines, or direction for following a vein over hills, vallies, lakes, rivers, *&c?*

THE ſecond ſort of ſigns belonging to theſe queries are ſuch as follow.

20. WHETHER there be any clays, marles, or other mineral earths, yellow or liquid matters, that uſually give notice of the ore? and if there be more than one, how, and at what depths, they are wont to lye reſpectively? Of what thickneſs and conſiſtence they are; and in what order the diggers meet with them?

21. WHETHER there be any ſtones or marchaſites to be found near, or not very far from the ſurface of the ground, by which one may have ground to expect a mine? As is often obſerved in the tin mines of *Cornwall*, over which ſuch kind of ſtones are divers times found lying above ground.

22. WHETHER all ſtones of that kind do equally ſignify that mine? And, if not, how the ſignificant ſtones are to be known, as by colour, bigneſs, ſhape, weight, depth under ground, *&c.?*

23. WHETHER there be any earths of peculiar kinds, as to colour, conſiſtence, *&c.* that indicate a mine beneath or near them; and if there be, what they are, and what is their conſecution, if they have any?

24. WHETHER heat or damps give any aſſurance or a probability of finding a mine?

25. WHETHER water of any kind met with in digging, eſpecially at this or that depth, do betoken a mine?

26. WHETHER there be any ſigns of the nearneſs of the mine, and what they are?

27. WHETHER there be any ſigns of one's having miſſed the mine, either by being paſt above, or beneath, or having left it on either hand, and what they are?

28. WHETHER there may be any ſigns, not only of the diſtinct and determinate kind of metals or minerals, but of the plenty and goodneſs of the vein, and what they are?

29. WHETHER there be any ſigns of the depth of the vein beneath the ſurface of the earth, and what they are?

30. WHETHER there be any proper or peculiar ſigns, that ſhow it to be hopeleſs, or at leaſt unlikely to find a vein in the place where it is digged for, and what thoſe are?

About the fourth Title.

31. WHAT is the depth of the ſhaft or groove (which though named in the ſingular number, the queſtions about it are generally applicable) till you come at the vein or ore?

32. WHETHER the vein run, or lye horizontally, or dip? And, if it dip, what inclination it hath, how deep the loweſt part lyes, and conſequently how much deeper than the uppermoſt? As alſo, what its flexures, if it have any, are? And whether it runs directly north or ſouth, eaſt or weſt; or ſeem rather to have a caſual tendency, than any determinate one by nature? And how far it reaches in all?

33. WHAT is the wideneſs of the groove at the top, and elſewhere? Whether

the groove be perpendicular or crooked; and if crooked, after what manner, and with what diſtance it winds?

34. How the groove is ſupported? What are the kinds, length, bigneſs, and way of placing the timber, poles, *&c.* that are employed to ſupport it? And how long the wood will laſt, without being ſpoiled with the ſubterraneous fumes and waters? And what wood laſts longeſt?

35. What air-ſhaft belongs to the mine? Whether it be ſingle or more than one? Of what breadth the air-ſhaft is at the orifice? Whether it be convenient enough, or not? How near it is placed to the groove, and in what poſition? And if there be ſeveral air-ſhafts, what their diſtances and ſituation are in reference to the groove, and to each other? Or how air is ſupplied, if there be no air-ſhafts?

36. Whether they meet with any waters in the mine? And, if they do, how copious they are; at what depths they occur, how they are qualified, and what way they ſpring, *&c.?*

37. Whether they are conſtant or temporary? whether they increaſe or diminiſh notably in ſummer or winter, or at any other time of the year, and if they do, at what ſeaſon that is; how long it is wont to laſt; and the proportions of increaſe and decreaſe?

38. What expedients and engines are employed to free the mines from water? The materials, the parts, the bigneſs, the ſhapes, the coaptation; and in ſhort, the whole ſtructure, number, and way of applying the inſtruments, that are made uſe of to free the mines from water?

39. What are the conditions, number, *&c.* of the adits?

40. Whether the mine be troubled with damps, and of what kind they are; whether they come often or ſeldom at any ſet time, or altogether irregularly; what ſigns forerun them; what miſchief they do; what remedies are the moſt ſucceſsfully employed againſt them, as well in reference to the clearing of the mine, as to the preſervation and recovery of the workmen?

41. What methods the mine-men uſe in following the vein, and tracing their paſſages under ground (which they call plumming and dialling) according to the ſeveral exigencies? And whether they employ the inſtruments, made with the help of the loadſtone, the ſame way that is uſual; and if not, wherein they differ in the uſe of the ſame inſtruments; or what inſtruments they ſubſtitute in their place?

42. What ways they take to ſecure themſelves from the uncertainty, incident to the guidance of magnetic needles from the iron-ſtone or ore, that they may meet with under ground? (or which yet perhaps there is not ſo great danger, as one may imagine; as far as I could find by a trial, I purpoſely made in a groove, where I was ſure there wanted not iron-ore.) And what other ways may be uſed to direct miners without the help of a loadſtone?

43. How the miners deal with the rocks and ſpars they often meet with, before they come at the ore? Whether they uſe fire to ſoften, calcine, or crack them? How they employ it, and with what meaſure of ſucceſs?

44. What ways and cautions they uſe to free the mine and ſecure the workmen from the inconveniencies and danger accruing from the uſe of much fire in it?

45. What inſtruments they uſe to break the rock, *&c.* And how thoſe inſtruments are conducive, and how long they laſt?

46. How the mine men work, whether naked or clothed? And what lights they uſe to work by, what materials they are made of, what meaſure of light they give, how long they laſt? And by what ways they are kept burning in that thick and foggy air?

47. How veins are followed, loſt, and recovered? And how ſeveral miners work

on

on the ſame vein? And what is the beſt way of getting all the ore in a vein, and moſt conveniently?

48. How they convey out their ore and other things, that are to be carried out of the mine? Whether they do it in baſkets drawn up by ropes, or upon men's backs; and if this laſt-named way, what kind of veſſels they uſe for matter, ſhape, and capacity? And whether the workmen delivered them one to another, or the ſame workmen carry them all the way? And whether the diggers deſcend and aſcend by ladders of wood, or of ropes, *&c.?*

About the fifth Title.

49. WHETHER the ore runs in a vein, or lye diſperſed in ſcattered pieces; or be divided partly into a vein, and partly into looſe maſſes; or like a wall between two rocks, as it were in a clift, or be interſperſed in the firm rock, like ſpeckled marble? Or be found in grains like ſand or gravel; as ſtore of excellent tin is ſaid to be found in ſome parts of *Cornwall* at the ſides and in the channels of running waters, which they call .....; or whether the ore be of a ſofter conſiſtence, like earth or loam, as there is lead ore in *Ireland* holding ſtore of ſilver; and iron ore in the north parts of *Scotland* and elſewhere? And what is obſervable in it as to weight, colour, mixture, *&c.?*

50. WHETHER any part of the metal be found in the mine perfect and complete? (As I have had preſented me good valuable copper, and pieces of perfect lead, that were taken up, the one at *Jamaica*, and the other by an acquaintance of mine, that took them out of the ground himſelf in *New England*.)

51. WHETHER the mine affords any parcels of metal, that ſeem to grow like plants? (As I have ſometimes ſeen ſilver growing, as it ſeemed, out of ſtone, or ſpar almoſt like blades of glaſs; as alſo great grains of a metal, which appeared to me, and which thoſe that tried ſome of it, affirmed to be gold, abounding in a ſtony lump, that ſeemed to conſiſt chiefly of a peculiar kind of ſpar.)

52. WHETHER the vein lye near, or much beneath the ſurface of the earth, and at what depth?

53. WHETHER the vein have or have not any particular concomitants, or coats (if I may ſo call them;) and, if any, what they are, and in what order they lye? (As the veins of lead ore with us, have frequently annexed to them a ſubſtance called ſpar, and next to that another called caulk.)

54. WHETHER (beſides theſe coats) the vein have belonging to it any other heterogeneous ſubſtance? As in tin-mines we often find that yellow ſubſtance, which they call mundick.)

55. WHAT are the principal qualities of theſe extraneous ſubſtances? (As that ſpar is white, but tranſparent, almoſt like coarſe cryſtal, heavy, brittle, eaſily diviſible into flakes, *&c.* Caulk is of a different texture, white, opacous, and like a ſtone, but much more ponderous. Mundick I have had of a fine golden colour; but, though it be affirmed to hold no metal, yet I found it in weight, and otherwiſe, to differ from marchaſites: and the mine men think it of a poiſonous nature.)

56. WHETHER the vein be incloſed every way in its coats, or whether it only lye between them?

57. WHETHER the vein be every way of an uniform breadth, and thickneſs; and, if it be, what theſe dimenſions are; and, if not, in what places it varies, and in what meaſure? (The like queſtions are to be made concerning the ſpar, caulk, and other teguments or mixtures of the ore.)

58. WHETHER the vein be uninterrupted, or in ſome places broken off; and

whether it be abruptly or not; and whether it be by vales, brooks, gullets, &c.

59. How wide the interruptions are; what ſigns whereby to find the vein again; whether the ulterior part or diviſion of the vein be of the ſame nature, and hold on in the ſame courſe, as to its tendency upwards or downwards, or horizontally, northward, ſouthward, &c. with the vein, from which it is cut off?

60. WHETHER, in caſe the laſt end of the vein be found, it terminate abruptly, or elſe end in ſome peculiar kind of rock or earth, which does, as it were, cloſe or ſeal it up, without leaving any crack or cranny, or otherwiſe? And whether the terminating part of the vein tend upwards, downwards, or neither? And whether in the places, where the vein is interrupted, there be any peculiar ſtone or earth, that does, as it were, ſeal up the extremity of it?

61. WHETHER it be obſerved, that the ore in tract of time may be brought to afford any ſilver or gold, which it doth not afford, or more than it would afford, if it were not ſo ripe? And whether it have been found, that the metalline part of the vein grows ſo, that ſome part of the mine will afford ore or metal in tract of time, that did not ſo before? And whether to this maturation of the mine, the being expoſed to the free air be neceſſary; or whether at leaſt it conduce to the acceleration of it, or otherwiſe?

62. WHETHER all the ore contained in the mine be of the ſelf-ſame nature and goodneſs; and, if not, what are the differing kinds, and how to be diſcriminated and eſtimated?

63. WHAT is the fineneſs and goodneſs of the ore, by which the mine is wont to be eſtimated? And what are the marks and characters, that diſtinguiſh one ſort from another.

64. WHAT proportion of metal it affords? (As in our iron mines it is obſerved, that about three tons of iron ſtone will afford one ton of metal: and I have had lead ore, which an ingenious man, to whom I recommended ſuch trials, affirmed to me to afford three parts in four of good lead.)

65. WHETHER the ore be pure in its kind from other metals, and, if not, of what metals it participates, and in what proportion? Which is eſpecially to be enquired into, in caſe the mine be of a baſe metal, that holds a noble metal: (as I have known it obſerved, that lead ore, that is poor in its own metal, affords more ſilver than other: and I remember, that the ore lately mentioned, being rich in lead, ſcarce afforded us upon the cupel, an atom of ſilver. And *Mattheſius* informs us, that a little gold is not unfrequently found in iron ore. And I have by me ſome gold, that never endured the fire, taken out of a lump of tin ore.)

About the ſixth Title.

66. WHAT are the mechanic and previous operations, as beating, grinding, waſhing, &c. that are uſed to ſeparate the ore from the heterogeneous bodies, and prepare it for the fire? Or whether the ore requires no ſuch preparation? (as it often happens in lead, and ſometimes in iron, &c.)

67. WHETHER mercury be made uſe of to extract the nobler from the baſer metals? (as is their practice in *Peru*, and other parts of the *Weſt Indies*.)

68. WHETHER the leaving the ore expoſed to the open air and rain for a good while, be uſed as a preparative? (as I have ſeen done in iron ſtone.)

69. WHETHER the burning and beating of the ore be uſed to prepare it for the furnace? (as is practiſed in iron, and almoſt always in copper:) and in caſe they uſe more than once, how often they do it; (for copper ore is in ſome places waſhed eight or

or ten times, and in others twelve or fourteen) and with what circumſtances: as how long the ignition laſts at a time, whether the ore be ſuffered to cool of itſelf, or be quenched? Whether it be waſhed betwixt each ignition?

70. What flux-powders, and other ways they have to try and examine the goodneſs of the ore in ſmall quantities?

71. Whether when they work in great, they uſe to melt the ore with any flux or additaments, or only by the force of the fire, or in any way between both? (as throwing in of charcoals, when they melt iron-ſtone, does not only ſerve to feed the fire, but perhaps by the alcali of its aſhes to promote the fuſion; ſo lime-ſtone, *&c.*)

72. What kind of furnaces they uſe to melt the ore in, whether they be all of one ſort and bigneſs, or if differing?

73. What are the ſituation, materials, dimenſions, ſhape, bigneſs, and in ſhort, what is the whole ſtructure and contrivance of the furnace? If there be any thing peculiar and remarkable? What tools are uſed in ſmelting, their figures, uſe, *&c.* and the whole manner of working?

74. What kinds of fuel, and what quantities of it, are wont to be employed in the furnace, within the compaſs of a day, or week? How much is put in at a time? How often it is renewed? And how much ore in a determinate time, as a week, or a day, is wont to be reduced to metal?

75. In caſe an additament be employed, what that is, and in what proportion it is added? Whether it be mingled with the ore, before that be put into the fire, or caſt in afterwards, and if ſo, at what time, *&c.?*

76. Whether the ore be melted by a wind, excited by the fire itſelf, as in wind-ovens? Or by the courſe of waters? Or actuated by the blaſt of bellows; and if ſo, whether theſe bellows be moved by a wheel, turned by water running under it, or falling on it? And what are the dimenſions, ſituation, *&c.* of the bellows?

77. What contrivance they have to let or take out the metal, that is in fuſion, and caſt it into bars, ſows, pigs, *&c.?*

78. What clay, ſand, or mould they let it run or pour it through? and after what manner they refrigerate it?

79. Whether or no they do either to facilitate the fuſion, or to obtain the more or better metal, mingle differing ſorts or degrees of ore of the ſame metal? As in ſome places it is uſual to mingle poor and rich ore; and at *Mendip* they mix two or more of thoſe differing kinds of lead ore, that they call frim-ore, ſteel-ore, potern-ore, *&c.*

80. Whether or no, having once brought the ore to fuſion, they melt all the metal itſelf to have it the more pure? And, if they do, with what circumſtances they make the fuſion?

81. Whether they have any ſigns, whereby to know, whether the fuſion have been well or ill performed; and the metal have obtained the perfection to be expected from ſuch ore, melted in ſuch a furnace?

82. Whether they obſerve any great difference in the goodneſs of the metal, that firſt melts, from that of the reſt of the metal, which comes afterwards in the ſame or another operation? And whether the rule holds conſtantly? (For, though they obſerve in tin-mines, the beſt metal comes firſt; yet in the works of an induſtrious friend of mine, he informs me, that the beſt metal comes laſt.)

83. Whether the produced metal be all of the ſame goodneſs? And, if it be, how good it is in reference to the metal of other mines, or other parts of the ſame mine or vein? And, if it be not, what differences are obſerved between the produced portions of metal, and what diſparity that amounts to in the price?

84. What are the ways of diſtinguiſhing them, and eſtimating their goodneſs?

85. Whether

85. WHETHER they do any thing to the metal after it is once brought to a fuſion, and, if need be, melt it over again, to give it a melioration? (as when iron is refined, and turned into ſteel,) and what diſtinct furnaces, and peculiar ways of ordering the metals, are employed to effect this improvement? With a full deſcription of them and the tools in all circumſtances, obſerved in the refining of metals.

86. WHETHER in thoſe places, where the metal is melted, there be not elevated ſome corpuſcles, that ſtick to the upper parts of the furnace, or building? And, if there be, whether they be barely fuliginous and recrementitious exhalations, or at leaſt in part metalline flowers? (As in the Corniſh tin-mines, after ſome years they uſually deſtroy the thatched houſes, where the ore hath been melted, to get the ſtuff, that adheres to the inſides of the roofs, out of which they melt ſtore of excellent tin.)

87. WHETHER the metal being brought to fuſion affords any recrements? (As iron ſtone affords ſtore of a dark glaſs or ſlagg) and if it do, what thoſe recrements are? How they are ſeparated from the metal? And to what uſes they are employed?

88. WHETHER, after the metal has been once melted, the remaining part of the ore being expoſed to the air, will in tract of time be impregnated, or ripened, ſo as to afford more metal? (For this is affirmed to me of the Corniſh tin ore; and what remained after the fuſion of iron ore in the foreſt of *Dean*, is ſo rich in metal, that a tenant of mine in *Ireland*, though he had on the land he held from me, an iron mine, found it leſs profit to work it, than to ſend croſs the ſea to the foreſt of *Dean* for this already uſed ore, which having lain for ſome ages, ſince it was thrown aſide in great heaps expoſed to the air, he affirmed to yield as well great ſtore of iron, as very good; though I ſomewhat doubt, whether this be totally to be aſcribed to the air and length of time, or to the leaving of metal in the ſlaggs in old times, before great furnaces were in uſe.)

Promiſcuous Enquiries about Mines, from the ſame Author.

1. WHETHER the territory, that bears the mine, abounds with no other kind of mineral in diſtinct parts of it? (As in *Kent* near *Tunbridge*, one part of the country which is hilly, abounds all along with iron-mines; the other, which is alſo hilly, and divided from it but by a ſmall valley, abounds exceedingly (as the diggers and inhabitants told me upon the place) in quarries, which the metalline country wants, but is quite deſtitute of iron-ſtone. And ſo at *Mendip*, in one part of the hill, I ſaw ſtore of lead-mines, containing ſeveral kinds of ore of that metal: another part of the hill I found to be full of coal pits, which had ſome marchaſites, but no metal; and in another place, iron ore, and mixed with ores, which yet they did not think fit to work.)

2. WHETHER the air appear to be really cold in ſummer, and hot in winter at the bottom of the mines, by ſurer proofs than the teſtimony of our touch?

3. WHETHER they ever meet with places and ſtones actually very hot, as *Matthe-ſius* relates? And whether that ſpring not from the quenching of marchaſites?

4. WHETHER they find in the mines any mineral gelly, ſuch as the German naturaliſts call ghur? And whether in proceſs of time it will harden into a metal, or mineral concretion?

5. WHAT are the laws, conſtitutions, and cuſtoms, œconomical, political, ethical, that are received and practiſed among the mine-men?

6. WHETHER the diggers do ever really meet with any ſubterraneous demons; and if they do, in what ſhape and manner they appear; what they portend, and what they do, *&c.*?

7. WHETHER they obſerve in the trees and other plants, growing over or near the mine,

mine, not only (as hath been already intimated) that the leaves are any whit gilded or ſilvered by the aſcending mineral exhalations, but alſo, that the trees or other plants are more ſolid and ponderous? And if they have not alſo ſome diſcernible metalline or mineral concretes, to be met with in the ſmall cavities and pores of their ſubſtance?

8. WHETHER there be not ſprings, and alſo greater ſtreams of water near the mine, that riſe, and run their whole courſe under ground, without ever appearing above it?

9. WHETHER the ſubterraneous ſprings do riſe with any wind or determinate change of weather?

10. How much heavier the atmoſphere is at the bottom of the mine, than at the top? And whether damps conſiderably increaſe the weight of it?

11. WHETHER they find any ſtrange ſubſtances in the mines, as veſſels, anchors, fiſhes incloſed in ſpar or metal, *&c.*?

A

PAPER of the Hon. ROBERT BOYLE's,

Depoſited with the Secretaries of the Royal Society, *October* 14, 1680. and opened ſince his Death; being an Account of his making the Phoſphorus, *&c.*

Printed firſt in the *Philoſophical Tranſactions*, No. CXCVI. p. 583. January 1692-3.

THERE was taken a conſiderable quantity of man's urine, (becauſe the liquor yields but a ſmall proportion of the deſired quinteſcence) and of this a good part at leaſt, had been for a pretty while digeſted before it was uſed. Then this liquor was diſtilled with a moderate heat, till the ſpirituous and ſaline parts were drawn off; after which the ſuperfluous moiſture alſo was abſtracted (or evaporated away) till the remaining ſubſtance was brought to the conſiſtence of a ſomewhat thick ſyrup, or a thin extract. This done, it was well incorporated with thrice its weight of fine white ſand; and the mixture being put into a ſtrong ſtone retort, to which a large receiver (in good part filled with water) was ſo joined, that the noſe of the retort did almoſt touch the water: then the two veſſels being carefully luted together, a naked fire was gradually adminiſtred for five or ſix hours, that all that was either phlegmatic or volatile might come over firſt. When this was done, the fire was increaſed, and at length for five or ſix hours made as ſtrong and intenſe as the furnace (which was not bad) was capable of giving: (which violence of fire is a circumſtance not to be omitted in this operation.) By this means there came over good ſtore of white fumes, almoſt like thoſe, that appear in the diſtillation of the oil of vitriol; and when thoſe fumes were paſſed, and the receiver grew clear, they were after a while ſucceeded by another ſort, that ſeemed in the receiver to give a faint bluiſh light, almoſt like that of little burning matches dipped in ſulphur. And laſt of all, the fire being very vehement, there paſſed over another ſubſtance, that was judged more ponderous than the former, becauſe it fell through the water to the bottom of the receiver; whence being taken out, (and partly even whilſt it ſtayed there,) it appeared by ſeveral effects and other phænomena, to be ſuch a kind of ſubſtance as we deſired and expected. Sept. 30. 1680.

A N

A N

A C C O U N T

OF THE

Honourable ROBERT BOYLE's Way of examining WATERS, as to Freſhneſs and Saltneſs.

To be ſubjoined as an Appendix to his lately printed Letter about the ſweetned Sea-Water, *October* 30, 1683. *

Printed firſt in the *Philoſophical Tranſactions*, No. CXCVII. p. 627.

I. HAVING ſince the publication of the foregoing letter, been commanded by the king, to ſhow his majeſty an experiment of the way herein mentioned, to examine the freſhneſs and ſaltneſs of waters; I did in his preſence (and that of his royal highneſs, his grace the duke of *Grafton*, and ſeveral perſons of quality) make trial of it, both upon ſome water prepared according to the patentees way, and upon two or three natural waters, that were ordered to be brought. In all which trials (in ſome whereof his majeſty, for greater certainty, was pleaſed to employ his own hands) the ſucceſs was ſuch, as moved him to vouchſafe the experiment the honour of his ſpecial approbation, and to give me an encouraging permiſſion to communicate it, as a thing that may prove not unuſeful to the publick. This I think fit to mention, not only to procure to my way of trying waters, the high advantage of a royal, and (on philoſophical accounts) illuſtrious patronage; but that, if this method be found as beneficial as I wiſh it may, men may know, to whom they ought to acknowledge the early publication of it. This is all my haſte allows me to premiſe to the account I am going to deliver of the way of trying waters hitherto ſpoken of: which account I ſhall ſet down, as I drew it up to be diſpatched to a friend, in caſe I ſhould have his majeſty's permiſſion to impart it to him.

II. My way of examining the freſhneſs and ſaltneſs of waters, though (becauſe it is wont to be ſurpriſing the firſt time one ſees it tried, and has had the luck to be much talked of in many good companies) it is thought to be an invention very difficult, to be either found out or practiſed, is yet really no ſuch myſterious thing as men imagine it. And for my part, I hope it will be found much more conſiderable for its uſe, than I think it is for the degree of ſkill and ſagacity, that was neceſſary to devise it. For when I remembered and conſidered, that (as I have found by various trials) divers metalline and other mineral ſolutions could be readily precipitated, not only by the ſpirit of ſalt, but by crude ſalt, whether dry or diſſolved in water, it was no very difficult matter for me to think, that by a heedful application of the precipitating quality of common ſalt, one might diſcover, whether any particles of it, (at

* Which ſhould have been to the worthy doctor *John Beal*, to whom the letter this paper refers to was written, but to the author's grief, and the great loſs of the commonwealth of learning, he died before this letter was written.

leaſt

leaſt in a number any way conſiderable) lay concealed in a diſtilled water, or any other propoſed to be examined.

III. To find whether I was not miſtaken in this conjecture, as alſo becauſe it is very convenient to be as little as one can confined to one material, I employed ſeveral drugs, and thoſe not at all prepared by one menſtruum, to make the intended diſcovery. And, though two or three of my other trials had ſucceſſes, that I diſliked not when I made them, yet that, which at length I pitched upon as the moſt certain, and which therefore I meant, when I had the honour to be ſent for by his majeſty about the patentees water, was that, which I think may be beſt underſtood, as well as recommended by this ſhort narrative.

IV. I took ſome common diſtilled water in glaſs veſſels, that it might leave its corporeal ſalt, if it had any, behind it, and put into a thouſand grains of it one grain of dry common ſalt: into a convenient quantity, for example, two or three ſpoonfuls of this thus impregnated liquor, I let fall a fit proportion, for inſtance, four or five drops, of a very ſtrong and well filtrated ſolution of well refined ſilver, diſſolved in clean aqua fortis; [for a ſhift, common or ſterling ſilver will ſerve the turn: *] and I made the experiment ſucceed with ſpirit of nitre, inſtead of aqua fortis, upon which there immediately appeared a whitiſh cloud, which though but ſlowly, deſcended to the bottom, and ſettled there in a white precipitate.

V. This experiment having been ſeveral times, for the main of it, reiterated with ſucceſs, I thought fit to keep conſtant to the way of probation I made uſe of in it, (and which trials had recommended to me for between 20 and 30 years) though (by reaſon of ſome things, that haſte forbids me to mention) I pitched upon this way without at all denying, that men of ſagacity, eſpecially if well verſed in chemical operations, may upon the ſame ground that I went upon, find ſome other and cheaper ways, though ſcarce any more nice and certain of compaſſing the ſame end.

VI. After what has been hitherto ſaid, I preſume I may ſeaſonably proceed, to ſubjoin the four enſuing advertiſements.

And firſt, I ſhall give notice, that to make the experiment rather ſeverely, than at all favourably, there was uſually taken ſomewhat more than a thouſand parts of water to one of ſalt.

VII. Next I obſerved, that having let fall a few drops of our metalline ſolution into the liquor obtained from the ſea-water by the patentees way of ſweetning it, there did not preſently enſue any white cloud or precipitate, much leſs ſuch an one as had been newly afforded by the water, that was impregnated with leſs than a thouſandth part of ſalt. And if after ſome time there happened to appear, (for it is not abſolutely neceſſary it ſhould) a little cloudineſs in this fictitious liquor, it was both ſlowlier produced, and much leſs than that, which appeared in the impregnated water †.

IX. Thirdly

* This paſſage was depoſited with the Secretaries of the Royal Society, *An.* 1683. ſealed up, and opened ſince the author's death.

† VIII. And perhaps it may be proper, that I here obſerve (what is not wont to be taken notice of) that divers ſolutions of mineral bodies may be precipitated by dilution, that is, (to explain this expreſſion) when the ſolution has time enough allowed to diffuſe itſelf, through a great quantity of water, the ſaline parts are thereby ſo diluted and weakned, that they are no longer able to ſuſtain the mineral corpuſcles, they kept ſwimming before, but make with them, and the water, a confuſed and ſubſiding mixture, uſually of a whitiſh colour. This may appear, when the butter of antimony, being put into common water, is thereby quickly and plentifully precipitated in the form of that white powder, that chemiſts (not overdeſervedly) call mercurius vitæ. To which I may add, that I have alſo produced a powder of that colour, by pouring into common water a ſtrong ſolution of tin glaſs made in aqua fortis. And by the ſame way we have precipitated the tincture for ſolutions of the finer parts of julap, benjamin, true labdanum, antimonial ſulphur, and divers other bodies made in vinous ſpirits. If it were not for this power, that water

IX. THIRDLY, the uſefulneſs of this experiment is not to be eſtimated only by the examen, it helps us to make of dulcified ſea-water, but much more by the eſtimate, that by its means may be made of natural freſh waters, whether ſprings, rivers, clouds, lakes, wells, *&c.* For it being generally granted, that thoſe waters, *cæteris pāribus*, are the beſt, as well for the wholeſomneſs, as divers œconomical uſes, as waſhing, brewing, *&c.* that are freeſt from ſaltneſs, which is an adventitious, and in moſt caſes a hurtful quality in waters; by our way of examining theſe liquors, a heedful eye may in a trice diſcover, whether there be any latent ſaltneſs in them, (as moſt waters imbibe from the ſoil they have traverſed, or do ſtagnate in) and may enable one, eſpecially by the help of a little practice, to give a near gueſs, how much one water is freſher than another, as I have purpoſely tried with pleaſure in differing waters, that were ordinarily drank, even by conſiderable perſons. And if once you have attentively marked, what change four or five drops, for inſtance, of our diſcovering liquor will make in two or three, or ſome other ſmall determinate number of ſpoonfuls, (or rather of half ounces) of water; it will not be difficult for a heedful obſerver, keeping the ſame proportion between the two liquors, to make a near eſtimate, whether any natural water propoſed to him have a greater, an equal, or a leſſer degree of freſhneſs or ſaltneſs, than that water, that he has choſen for his ſtandard; and how much, in caſe there be a difference, the propoſed liquor is leſs or more free from ſaltneſs than the other.

X. AND that (to add this by the by) ſuch a difference in a liquor of ſuch frequent inward uſe as water (which is the baſis of beer, ale, mead, and ſome other common drinks) may have conſiderable effects upon human bodies in reference to health, may be probably argued from the differing effects, that waters more or leſs impregnated with ſalt have upon divers other bodies. Since moſt pump-waters, for inſtance, will not boil peas and beef, and ſome other aliments, near ſo well as ſpring-water or rain-water, which are uſually ſofter, and more free from the ſaltneſs we ſpeak of. It is commonly known to barbers and laundreſſes, that the ſame pump-water will not ſo well and uniformly, or without little curdlings, diſſolve waſh-balls and ſoap, as rain-water, and ſome running waters uſually will: nay, when I was curious of tempering ſteel, I remember it was confeſſed by the ſkilfulleſt artiſts I made uſe of, that ſome tools, (as gravers, *&c.*) made of that hardeſt of metals, would receive a differing temper, if they were quenched in pump-water, from that, which the like extinction in ſpring water or river water, would give them. But how to make our eſtimate of the freſhneſs or ſaltneſs of water come neareſt the truth, is a problem, of which I have now neither time nor conveniency enough to deliver my thoughts. And by what has been ſaid, I hope it does already ſeem ſufficiently probable, that the way above propoſed may prove of good uſe, both to navigators, that are often neceſſitated to water in unknown places, and to others, that only, or frequently drink that liquor, without having any better

has to weaken moſt ſolutions of bodies, I could have employed, inſtead of that ſilver, either quickſilver diſſolved in aqua fortis, or lead crude or calcined in the ſame liquor, or (which is more convenient) in ſtrong ſpirit of vinegar; ſince theſe, and ſome others, are found to be precipitable by ſalt water into whitiſh Powders. But though a very heedful obſerver may, for a ſhift, make uſe of theſe metalline ſolutions, to gueſs at the quality of water, as to freſhneſs and ſaltneſs; yet the precipitation, that is made by dilution, is not difficult to be diſtinguiſhed from that which is performed by a true and proper precipitant, (as in our caſe by the common ſalt, that is harboured in the pores of the water) both by the quickneſs of the effect, and the copiouſneſs of the white ſubſtance produced, and on both thoſe accounts is very much inferior to it, as may evidently appear in the very different effects, that our ſolution of——had upon the patentees water, or upon well diſtilled common water, compared with thoſe it had upon water impregnated with a thouſandth part of ſalt, and upon divers common undiſtilled waters. This advertiſement I have placed in the margin, as not thinking it fit either to omit it, or by inſerting it in the body of the writing, to give too great an interruption to the ſeries of my diſcourſe.

way than the taſte, (which is but an incompetent one) to eſtimate its freſhneſs and ſaltneſs by *.

XII. FOURTHLY (and laſtly) though both in my letter to Dr. *I. B.* and in this preſent poſtſcript, I did not for certain reaſons aſcribe to our method of examining waters, a greater nicety, than to be able to diſcover one part of ſalt in a thouſand of water, that proportion being great enough to recommend it, and expreſſed by a round number eaſy to be retained in one's memory: yet I would not have it thought, but that, if it were requiſite, our method may make more nice diſcoveries. For having ſometimes, for curioſity's ſake, put one grain of ſalt into no leſs than fifteen hundred of diſtilled water, we could manifeſtly, (though not quite ſo conſpicuouſly as before) make it appear by our way, that even this ſo lightly impregnated liquor was not devoid of ſalt, but had more of that in it, than ſome of the patentees water, that I kept by me, had; nay, I once found, that a grain of dry ſalt, being diſperſed through two thouſand, and another time, that being diſſolved in three thouſand times its weight of the ſame kind of liquor, ſo inconſiderable a proportion of ſalt was plainly diſcoverable by our precipitant.

XIII. BUT here philoſophical candour forbids me to conceal an objection, that I made to myſelf, though it be the chief, if not the only conſiderable ſcruple, that occurred to me about our way of examining waters. For I foreſaw, that it may be objected, that, whereas the experiments hitherto mentioned have been tried only upon waters impregnated with groſs or corporeal ſea-ſalt, this perhaps may not hinder, but that they may be imbued with the ſpirits of marine ſalt, which, by reaſon of their activity, may be as unhealthful to the drinker, as the groſſer ſalt itſelf. But though to this ſurmiſe I might anſwer, that a very ſmall proportion of ſpirit of ſalt may in many caſes make the water ſeaſoned with it, rather medicinal than unwholſom; yet I ſhall anſwer more directly to the objection, by ſaying, that to manifeſt its not being well grounded, I took above a thouſand grains of diſtilled water, and inſtead of corporeal ſalt, put to it one ſingle drop of moderately ſtrong ſpirit of ſalt, (for I had much ſtronger by me, that I purpoſely declined to employ) and having ſhaked it into water, I let fall into a portion of this unequally compoſed mixture ſome drops of our ſolution of ſilver, which preſently began to precipitate in a whitiſh form; inſomuch, that, for ought appeared to the eye, this trial ſucceeded better, than if the water had been impregnated with but a thouſandth part of corporeal ſalt. The like experiment was made with the patentees water inſtead of the other. And to purſue this trial a great way farther, I had the curioſity to diffuſe one drop of ſpirit of ſalt into two thouſand grains of diſtilled rain water; and upon letting fall ſome drops of our precipitant into it, I found, that the ſucceſs well anſwered my expectation. And then, to urge the trial yet farther, I added as much of the ſame diſtilled rain water, as by a modeſt conjecture

* XI. I might add on this occaſion, that, whereas experience has informed ſeveral perſons, who have conſulted it, that divers medicinal waters, that are preſumed to owe their virtues to the participation either of metalline, or of other mineral bodies, do upon trial appear to leave ſometimes little, and ſometimes nothing behind them, except a kind of common ſalt; our precipitant may much aſſiſt men to diſcover, whether a mineral water, propoſed to be examined, do or do not contain ſuch a ſalt, and if it do, whether it contain it copiouſly or no. This I have tried upon more than one of our Engliſh mineral waters, and thereby found in a trice, that one, that is reputed of another nature, contained pretty ſtore of ſaline matter: and that another (which is ſtill, for ought I have learned, of an unexamined and unknown nature) is impregnated with a ſurpriſing plenty of ſaltiſh ſubſtance. But how and with what cautions our precipitant may be the moſt uſefully employed about the examen of medicinal and other mineral waters, belongs not to this place, (but to ‖ another.) Upon which account I forbear to declare the uſe I have ſometimes made of our precipitant, in examining the freſh urine of men, the ſerum of human blood, and other bodies belonging to what the chemiſts call the animal kingdom.

‖ About the examen of mineral waters.

made it amount to at leaſt as much more. So that one grain of ſpirit of ſalt had a manifeſt operation, though not quite ſo conſpicuous as the former, upon above three thouſand grains of water, whoſe immunity from common ſalt we tried apart; and poſſibly, if the vial could have contained more, and would not have been, when filled, too heavy for our tender ballance, the diſcolouration of the mixture would have been diſcernible, though but one grain of ſpirit of ſalt had been put upon four, or even five thouſand grains of water. And that a drop of the ſaline ſpirit we made uſe of, did not equal in weight a grain of dry ſalt, I found by this, that having let fall into a counterpoiſed piece of glaſs ten drops of that ſpirit, I found them to want near half a grain of nine grains weight; which way of eſtimating I choſe, as leſs ſubject to any conſiderable error, than that of weighing a ſingle drop by itſelf.

XIV. The like trial I made by ſubſtituting above a thouſand grains of rain water, in the room of the like quantity of diſtilled water. And theſe two experiments I the rather mention, becauſe they do not only ſhow, how free the patentees water was from ſpirituous, as well as from corporeal ſea-ſalt: but alſo manifeſt, that, whereas it is the opinion of ſome ſeamen, and of a perſon, for whom I have a profound reſpect, that water ought to have a little ſaltiſhneſs to preſerve it; if this be really a deſirable quality in our artificial water, it may in a trice be ſupplied with as much ſaltneſs, whether corporeal or ſpirituous, as ſhall be required, and conſequently as will bring it to be equal in that quality to the common water of rivers, or of ſprings. And perhaps it will not be impertinent to add on this occaſion, that in ſome places, eſpecially lying in hot climates, it may ſometimes be of good uſe to know, whether on the account of the ſun's heat, or that of the ſubterraneal regions of the earth, the rain water is impregnated with volatile (not acid) ſpirits, like thoſe, that are diſtilled from urine, and which I have, for curioſity's ſake, obtained from a mineral body, native ſal-armoniac; upon which account I made a trial, that informed me, that if five or ſix drops of ſtrong ſpirit of urine (whoſe drops I obſerved to be but ſmall) were ſhaken into a thouſand grains at leaſt of diſtilled or rain water, impregnated with but one of ſalt, our precipitant would make a diſcovery of ſome ſaltiſhneſs in the liquor. And it were neither to be admired nor cenſured, if the patentees water ſhould ſometimes ſhow a change, when our precipitant is plentifully put or long kept in it, eſpecially that change being a more light one, than that I came from ſpeaking of; ſince, for ought I have yet obſerved, not only ſuch undiſtilled waters as are generally allowed to be freely potable, but even thoſe, that nature herſelf diſtils, are not always quite devoid of ſaltneſs. For I have found rain water, that I cauſed to be carefully ſaved, after the houſetops had newly been well waſhed with former rain, to grow a little troubled, if any ſtore of our precipitant were kept for ſome competent time in it. And being gently diſtilled off, it left a reſidence, which with a little of our ſolution afforded a far more ſuddenly made and copious precipitate, than had been produced with the like quality even of pump-water itſelf. And, though I have met with rain water, that was more free from ſalt than any ſpring or river-water, that I remember I have examined; yet having, for curioſity's ſake, made a trial of ſnow-water, (which if the weather had been ſomewhat milder, would have been rain) this liquor, I ſay, which is thought to afford the lighteſt water of all natural ones, I manifeſtly found, by our way of examining it, not to be devoid of ſaltneſs.

XV. But to return to the trial we made with the ſpirit of ſalt, theſe experiments may not a little confirm the patentees water. And whereas ſome have either really ſuſpected or invidiouſly pretended, that even a moderate action of the fire upon water, will make it brackiſh and putrify; as I ſee no ſubſtantial grounds of this ſurmiſe, ſo it appears by the foregoing trials, that really the patentees water is not brackiſh, but is more free from ſaltneſs, than moſt of the waters men do without ſcruple drink. And if it

were true that this water ſhould not keep quite ſo long as others, yet that were no more than is objected (how truly I now enquire not) to the generality of diſtilled waters: and that this we ſpeak of may keep ſweet longer than is neceſſary in a ſhip, that can from time to time, within a few days, ſupply itſelf with freſh out of the ſea, may be gathered from theſe two things. The firſt is, that to ſatisfy myſelf, whether cloſeneſs would make the prepared water ſoon putrefy, (as ſeemed obvious to be ſurmiſed) or at leaſt afford dregs, I cauſed a pint, or a pound of it, to be hermetically ſealed in a vial, whereof I left by gueſs about a third part empty; and having above ſix weeks after held this veſſel againſt the light, I found the water to be clear and limped; though I did not judge it had depoſited ſo much as the tenth part of a grain of feculency. And having opened the ſeal, and taken out a little of the liquor, I did not find it altered, either as to ſmell or taſte. The ſecond of the two things, that were to be mentioned, is, that I have kept the bottle of prepared water mentioned in my letter to Dr. *Beal*, in the ſame unſtopped veſſel ever ſince *March*, that is ſo long, that it is near eight months old, and yet it continues ſweet and well conditioned. And if that, which is called crudity in water, does conſiſt (as probably it oftentimes does) in certain groſs particles, that are mingled with the purely aqueous ones, it is likely, that the action of the fire may divide and diſſipate theſe into minuter particles, and thereby deſtroy the texture, that makes them hurtful; and by cauſing innumerable tumblings and rovings among the more earthy particles, give them opportunity to make little coalitions, whoſe weight precipitating them to the bottom frees the pure water from them.

XVI. And becauſe it is but too probable, that the unwholeſomneſs of divers waters proceed, not only, or perhaps not ſo much, from bare crudity, as from a great quantity of groſſer particles, that are not eaſy to be raiſed, becauſe of their being combined with fixed and earthy ones, that ſwim up and down in the water they impregnate, as ſilver or mercury does in a ſolution made with aqua fortis, or rather as the particles of ſalt do in pump-water, and many other common waters; on this account, I ſay, the patentees invention may very much correct ſuch waters, ſince by their way of ſweetning thoſe liquors, the truly aqueous parts are not only freed from the ſaline ones, but from the mineral, and other groſs and hurtful corpuſcles, that may have lain concealed in the liquor. As may be argued from hence, that having purpoſely in the gentle fire of a digeſtive furnace ſlowly diſtilled off a pound of the patentees water, it left us in the cucurbit ſo light and thin a feculency, that the bottom of the glaſs ſeemed to be rather ſullied than covered by it; and I did not judge, that the whole feculency, if we could have got it out, would have amounted to ſo much as two grains.

XVII. But to return, after this ſhort, and I hope not impertinent digreſſion, to what I was lately ſaying of the virtue of the fire, to correct the crudity of waters, I ſhall proceed and ſay, that perhaps it was upon ſome ſuch reaſons, (to which others might be added, if I could in few words confirm paradoxical ones) that the laſt great duke of *Tuſcany*, when he drank water, (for it was not, as I perceive ſome have miſunderſtood, his only drink) preferred, for wholeſomneſs, that, which was diſtilled, to that which was not; and if herein that learned prince, and thoſe of the ſame opinion, were not miſtaken, it will highly recommend the uſefulneſs of the patentees invention to mankind: for I ſhall on this occaſion obſerve, that there are multitudes of waters, that are not conſiderably brackiſh to the taſte, that yet, by reaſon of ſome unheeded ſaltneſs, as in moſt pump-waters, are more frequently, by reaſon of crudity, not only unfit, or (at beſt) leſs fit, for divers œconomical uſes, as waſhing, boiling of ſome meats, &c. but are very unwholeſom; ſometimes to a degree, that makes them miſchievous to whole communities, and perhaps nations. Of this it were to be wiſhed, that it

were

were harder to give inſtances. I remember I have ſeen a notable one, in thoſe high and unſightly tumours about the throat, which are obſerved by travellers to be exceeding common among thoſe, that inhabit the lower tracts of ground, that lye between the Rhætian, Helvetian, and ſome other neighbouring mountains; which monſtrous ſwellings are generally imputed to the ſnow-waters, that flow from the mountains, and make the uſual drink of the meaner ſort of people; whence it is obſerved that perſons of better condition, who drink wine more than water, are either not at all or far leſs troubled with theſe diſfiguring *goitres*, (as they call them.) But much more notable inſtances to our preſent purpoſe are afforded me by that great (and yet living) traveller, monſieur *Tavernier*, baron of *Aubonne*, who ſpeaking of a nation of Cafres or negroes, that comes ſometimes to trade with the Portugueſe from a remote part of *Africk*, informs us, that the water of their country is very bad, which is (ſays he) the reaſon that their thighs do ſwell, and it is a wonder to ſee any one of them free. Nay, which is far more, where he ſpeaks of the African kingdom (or empire) of *Monomotapa*, he has this memorable paſſage, "the natives never live long, by reaſon of the badneſs of the waters in the country. For at the age of twenty-five they begin to be dropſical, ſo that it is a great wonder, if any among them live above forty years."

Tavernier's travels, part II. book II. chap. 21. page 156.

XVIII. WHAT monſieur *Tavernier* delivers being taken for granted, it ſeems very probable, that theſe people may be much relieved, and be brought to live as long as other nations, if they had ſo compendious a way as that of the patentees, to provide themſelves plentifully with water, whoſe crudity is corrected, its groſſer and heavier parts ſeparated, and its brackiſhneſs deſtroyed by the fire, as its action is regulated and helped by their invention.

[THE experiment mentioned in this paper was tried at a meeting of the Royal Society, *February* 17, 1691-2, by Dr. *Sloane*, with a ſucceſs anſwerable to the aſſertions of the honourable author, and that a drop or two of ſpirit of ſalt mixed with common water would be by the ſame method diſcovered.]

END *of the* FIFTH VOLUME.

MVSEVM BRITAN NICVM