SCRIPTURAL GEOLOGY;

OR

AN ESSAY

ON THE

HIGH ANTIQUITY ASCRIBED TO THE ORGANIC REMAINS IMBEDDED IN STRATIFIED ROCKS:

Communicated, in Abstract, to the Geological Section of the British Association, at the Annual Meeting held in Newcastle.

IN TWO PARTS.

Part I.—Proving that the Strata, instead of requiring myriads of ages for their formation, may have been deposited nearly about one period.

Part II.—Shewing that the Deluge was the period, when all the Secondary and Tertiary Rocks were formed.

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PREFACE.

The substance of the following Essay was communicated to the Geological Section of the British Association, at their recent Meeting in Newcastle; but owing to the number and length of other communications made to that Section, the First Part alone was admitted, and was read only in abstract. As the subject is one of no small importance, both to religion and to science, the author, following the advice of some respected friends, has enlarged his Essay, and now presents it to the public.

While the Essay was in progress, "The Doctrine of the Deluge," by the Rev. L. Vernon Harcourt, was announced; and the author at first supposed, that the publication of that respected Divine might have superseded his own; yet upon seeing that valuable work, he found it to be chiefly occupied with the historical evidences of the question, whereas the present work takes up its geological evidences. From notices in some periodical publications, it appears that others are engaged in the same task; but not having seen their productions, the author cannot say how far their views may coincide with his own.

It is common to raise a cry against theories, and to urge the necessity of collecting more facts; and the principle might be just, if all would adopt it; but what geologist is there, even among those who are most diligent in collecting facts, that has not his favourite theory, in support of which, his descriptions and statements are selected and arranged? No collector has been more indefatigable than Mr. Lyell; and yet none is more given to theorizing. Now, if theories wild and dangerous be

advanced by one party; another may be allowed to bring forward a hypothesis more sober and rational.

In opposing the extravagant speculations of some popular geologists, the author has drawn his chief arguments from the phenomena of nature, partly as witnessed by himself, partly as described by others; and he has not scrupled to avail himself of useful statements and principles, laid down and illustrated by those authors with whom he is at variance on the main subject of his Essay. The advocates of the pre-adamite theory often speak as if all the facts and evidences were on their side, and nothing but the testimony of scripture on the other side. The gross injustice of such reflections, the reader, it is hoped, will not fail to perceive. These geologists complain, and have a right to complain, of those who stigmatize them as atheists, infidels, and enemies to revelation: yet they ought to remember, that they have no right, on their part, to denounce their opponents as bigots, fanatics, ignorant, and illiberal. It is not by hard names, but by strong arguments, that the cause of truth is to be established.

The author does not pretend to have brought forward a complete theory. He is aware that the subject is beset with difficulties: yet if these difficulties are more easily surmounted by his hypothesis, than by any other, his labour has not been in vain. He has at least exposed some of the absurdities of the pre-adamite scheme; and although he has little hope of making converts of those who have wholly given themselves up to that fascinating delusion, his Essay may be of use to guard others against running into those wild imaginations, which are alike dangerous to science and to religion.

Whitby, November 5th, 1838.

SCRIPTURAL GEOLOGY,

&c.

PART I.

Extravagant notions entertained respecting the antiquity of organic remains.—Not supported by any valid arguments.—Reasons for believing that fossil vegetables and animals did not live where they are found, but were drifted thither.—Appearances in the strata indicating that they might all be deposited about one period.—Objections answered.

From the nature of the materials with which Geology has to do, it might be thought to discourage the flights of imagination; and yet there is scarcely a science in which imagination has had more scope. The extravagant theories of ancient cosmogonists are well known, and have often been held up to ridicule; but many speculations of modern geologists are almost equally extravagant. Valuable collections of facts, illustrating the subjects of geological study, are indeed rapidly accumulating, and must eventually turn to good account; yet even some of the most diligent and zealous collectors of such facts, indulge in the wildest fancies, instead of making a legitimate use of the phenomena before them.

Such is the case with those authors who ascribe an almost immeasurable antiquity to the organic remains occurring in the crust of the earth. Assuming that the animals and vege-

tables imbedded in stratified rocks, have lived and flourished on the spots where we find them, and calculating on a number of ages as required for the gradual deposition of the strata, and for the production, increase, decay, and destruction of these organic bodies; each group or division of which, they assign to a distinct period in the annals of our globe;—such geologists would thus carry back its antiquity to a time inconceivably remote; the older groups being supposed to have existed millions of years, if not ages, prior to the creation of man. According to them, there have been on the face of this planet, a long succession of creations and destructions, corresponding with the successive formations of stratified rocks; the lowest fossiliferous bed being the first, and the present living world, the last in the series. In this process of extension, they eagerly lay hold on the most trivial circumstance that seems to favour their theory, as if resolved to spin out the duration of the globe to as great a length as possible. They picture to themselves a multitude of primeval worlds, each garnished with its peculiar race of animals and vegetables, each subsisting for thousands of years, but at length overwhelmed, to make way for a new race, destined in its turn to grow, to flourish, and to be destroyed.

In these sports of fancy, there is doubtless something fascinating, as well as novel. The imagination delights to fly back into such remote ages, and to enjoy itself in roving amidst the

beauties and singularities of such distant and diversified worlds. But if we would follow the maxims of sound philosophy, we must not suffer our imagination to mislead our judgment. However gratifying to the fancy these pre-adamite creations may appear, we must regard them as utterly fabulous, unless we can discover some clear proofs of their existence. Is there, then, any thing in the strata, or their imbedded relics, to indicate such high antiquity? We see the crust of the earth composed of a vast series of beds, which must have been deposited one over another by water; with a number of irregular masses, which appear to be of igneous origin, and may be supposed to have been ejected from below, by some volcanic expansive force: but, as we discern nothing in the latter class of rocks to shew how long they were in being heaved up, so we perceive not any thing in the former, to shew what time was occupied in their deposition.

The regularity with which the depositions have been made, and the remarkable thinness of some of the seams, are, indeed, urged as proofs, that the process has been very slow, and that an immense period of time must have been required to form the whole series. The ripple-marks on many of the beds, and the laminated texture of others, are particularly appealed to, as decisive evidences of a leisurely and long protracted deposition. But do we not witness on our sandy shores, where ripple-marks abound, the formation of strata in miniature, often accumulating

to a considerable thickness in a few days? When a storm, or high tide, has broken down, and swept away, any large sand bank; its materials, in less than a week, are redeposited on another part of the beach, where they form a new bank, perhaps some yards in thickness, composed of regular layers of sand, clay, gravel, sea-weed, and comminuted coal. The orderly appearance and laminated texture of stratified rocks, therefore, cannot prove, that a vast period was employed in producing them. Suppose that the *laminæ*, or seams, of the strata, are so thin that twenty are required to make an inch; if each successive wave deposits such a seam, and five waves occur in a minute, it will require only four minutes to deposit an inch: and as the ocean takes no rest at night, and keeps no sabbath, it is easy to see that, with every minute so employed, thirty feet of strata may be formed in a day, and no less than nine hundred feet in a month; provided there are currents to supply the materials. At this rate, the whole series of stratified rocks, instead of requiring ages, might be formed within a very limited period. In some instances, the process of deposition might be considerably slower; but in others it might be much more rapid, without causing any confusion or derangement in the beds produced.

Nor do we find in the imbedded relics any decisive evidence of extreme antiquity: for although each bed, or series of beds, may generally be distinguished by some peculiar fossils, it

does not follow, that they are of different creations. There is nothing to demonstrate, that long periods intervened between the successive depositions; nor are we warranted to affirm, that these diversified groups of animals and vegetables could not have been coexistent.

Some have alleged, in proof of the pre-adamite theory, that in tracing the beds upwards, we discern among the inclosed bodies, a gradual progress from the more rude and simple creatures, to the more perfect and completely organized; as if the Creator's skill had improved by practice. But, for this strange idea there is no foundation: creatures of the most perfect organization occur in the lower beds, as well as in the higher. Nor is there much more to support the assertion, that in ascending from the lower formations, we can trace a gradual approximation to the present living races. In some of the tertiary strata, or the beds above the chalk, the fossil genera and species are, indeed, nearly identical with those now existing; but what approximation can be seen in the secondary strata? Fishes, zoophytes, ammonites, belemnites, terebratulæ, &c., occur in almost every portion of them; but those in the inferior strata have as much similarity to the living races as those in the superior. The fishes and reptiles of the lias have fully more resemblance to existing species, than those of the chalk; and there are no shells in the cretaceous or oolitic beds, more closely allied to those of living mollusca,

than the shells of the cardium, nucula, mya, unio, and ostræa families, found in the lias. The alleged approximation, therefore, is in a great measure imaginary, and cannot be admitted as an argument on the point in question.

But the grand source of error, as to the antiquity of the strata and their contents, is the assumption, that the imbedded animals and vegetables lived, flourished, and died, on the spots which they now occupy, instead of being drifted thither. This is a subject which requires close investigation. Let us begin with the vegetable remains. It is now almost universally allowed, that coal is of vegetable origin, produced from the trees and plants of a former world; and of course, that vast forests must have perished, to compose the immense beds of coal, occurring in Britain, and other countries. Did each of these beds, then, originate in a submerged peat bog, or a forest overwhelmed *in situ*, as some allege? There are coal beds twenty or thirty feet thick: was there ever a forest or peat bog in the world, that when overwhelmed, and consequently compressed, could yield a bed of coal of such thickness? To produce such a stratum, the vegetable matter of a forest, or bog, must have been set afloat, and drifted together, one part being heaped up over another.

But, should we suppose it possible, that a submerged forest or bog could produce such a bed, without drifting or accumulation, a much stronger objection to the submerging system still remains.

There are numerous beds, or seams, of coal, in each coal field; in some instances, thirty, forty, or even fifty seams; alternating with strata of sandstone, shale, limestone, or ironstone; which strata have been all deposited by the waters of the ocean. Was each of these coal seams once a forest, growing on the spot? Did the land sink down, to become the bed of the sea; and then rise again, to become the site of a forest, fifty times in succession; without destroying the conformity of the strata, or leaving the slightest vestige of such mighty agitation? An idea so monstrous can never be maintained. It is clear, that the carboniferous series of rocks, both in the greater and smaller coal fields, have all been formed by ocean currents, drifting and depositing the materials, whether vegetable, animal, or mineral, in successive layers. Accordingly, Professor Phillips, in his valuable Treatise on Geology, p. 180, inquires from what land the materials of the carboniferous strata of England were drifted; and remarks on the subject; "The Lammermuir mountains, to the north, seem not to be of such composition as would yield the coarse quartzose sandstones; we must therefore appeal to the Grampian or Scandinavian ranges; or finally close all further discussion, by admitting that tracts of land which supplied part of the sediments, mixed with the limestone of the carboniferous period, have disappeared from the Northern and Western Oceans."

While the most judicious geologists allow

that the materials forming the coal strata, have been drifted into their present positions; some authors take a very different view of the vegetable remains occurring in certain portions of the oolitic series. In the Isle of Portland many silicified stumps of trees occur, and as several of these are in an upright position, and the bed containing them is of a dark colour, called the dirt-bed, it is presumed that they grew on the spot, and that this bed was the soil. Professor Buckland and Mr. Lyell are decidedly of this opinion; yet Professor Phillips speaks doubtfully on the subject: and there is good reason for questioning their judgment on this point, especially as they grant, that the conformity of this bed with the strata above and below, has not been at all affected by the convulsions which, according to their theory, must have here taken place. That such alternate elevations and submersions of the strata as Professor Buckland enumerates in his Notes on this subject (Bridgewater Treatise, pp. 495, 496), could take place without disturbing the parallelism of the beds, is highly improbable, or rather, utterly incredible. A much better solution of the phenomena is furnished elsewhere by Mr. Lyell himself. He states in his Principles of Geology, I. p. 216, (second edit.), on the authority of Capt. Hall, that several trunks of trees, drifted down the Mississippi, cast anchor in the mud of the channel, where their broken stumps, known by the name *snags*, standing up in the water, occasion no small danger to

boats navigating the river. This fact Mr. Lyell employs, to account for the upright position of many trees and plants in the coal strata (Elements of Geology, p. 449); and it explains as readily the phenomena of the Portland and Lulworth beds. The trees and stumps imbedded there, are only a lot of snags, accidentally planted by the weight of their roots, and of the soil adhering to them when transported thither; which soil may account for the dark colour of the bed, if its colour was not occasioned by the decayed leaves and twigs.

On the same principles, appearances of a similar description may be satisfactorily accounted for. Thus, at High Whitby, on the Yorkshire coast, there is a bed of sandstone, belonging to what some call the coal measures of the oolite series, where we find numerous specimens of a kind of reed, or large equisetum, in an erect position, as if they had grown on the spot; while in some instances, their roots, or lower joints, descend into a bed of shale that is below. "These appearances," says Professor Phillips, (Illustrations, I. p. 95), "have led some persons to conjecture, that the plants are preserved in the place of their growth; that the shale served them for soil, and that they were buried by an influx of sand and water." But he very judiciously adds, "A more probable hypothesis, perhaps, will suggest itself, to those who have seen plants transported by great floods, floating down the streams in a perpendicular position, in con-

sequence of the superior specific gravity of their roots."

The occurrence of fossil wood bored by the Teredina, has been appealed to, as an evidence of the long period occupied in the deposition of the strata; but, on the contrary, it may well be adduced as a proof, that the fossil wood of our strata, has not grown where we find it, but has been drifted. It is not in a forest, or a bog, but in the sea, that the Teredo and other borers perform their excavations. The wood has been floating about in the ocean, when attacked by its devourers, and after suffering much from the attack, it has been deposited, and fossilized. But when or where it grew, what set it afloat, or how long it endured the process of excavation, are questions which we have no means of solving. A beautiful specimen of silicious wood, from the London clay, thus excavated, is in the Whitby Museum; where there is also a piece of recent wood which was found floating at sea, curiously perforated in all directions by the Teredo.

On the whole, there is no ground for believing, that any of the fossil vegetables grew where they are found: all of them appear to have been drifted by currents, and deposited in strata.

Let us now inquire, if the fossil animals have lived and died on the spots which they occupy. As those occurring in the carboniferous strata are associated with vegetables which are known to have been drifted by currents, it is reasonable to think, that they have been brought hither by

the same means. The beds containing shells are every way conformable to those containing coal, and we have a right to conclude, that they have been deposited in the same way. This remark may be extended to the oolitic series, for there also we find seams of coal, interstratified with sandstone, shale, limestone, and ironstone; and as the limestone, which abounds with shells, is parallel to the other beds containing drifted vegetables, we are not warranted to assign a different mode of formation to each.

When we examine the aluminous or lias strata, and their contents, the fact of their having been brought by currents, forces itself on our notice. Here we see crocodiles, and other large saurians; fishes, both great and small; nautilites, ammonites, belemnites, and myriads of other shells; associated with trees, and fragments of wood: and all, with very few exceptions, lying parallel to the plane of the strata. Such an assemblage, and so arranged, could have been formed only by ocean currents, collecting these substances together, and depositing them in their places. Even the beds of sea shells give indications of the fact. In the marlstone bands, occurring in the lias of Yorkshire, there is a seam composed chiefly of oyster shells, about four or five inches thick, extending for many miles along the coast, being found wherever the marlstone beds appear, and reaching far into the interior, where it is seen in the front of the Cleveland hills. The shells of this seam are chiefly single valves,

many of them are water-worn, and all of them appear to have been floated into their present positions, their flat sides being laid in the plane of the bed. No unprejudiced observer can affirm, that this is an ancient oyster bed, in its original place and form: its contents must have been drifted together, to produce this extensive and singular stratum.

The same observations will apply to the higher rocks. The upper oolite beds, which abound with corals and shells, owe their origin to depositions from what Professor Phillips calls "the oolitiferous sea," into which sea these corals and shells have been borne by currents. Some assert, that the beds of coralline oolite have been coral rocks, and that the fossil zoophytes found there have grown on the spot. But it requires the creative power of fancy, to discover in these strata any thing like groves or beds of coral, such as exist in recent coral reefs. The corals of the oolite are generally laid flat, like the shells with which they are mixed; and those which are found in an upright position, might acquire that position in the same way as the vertical plants and trees in the carboniferous strata: their roots, or points of attachment, might be heavier than their tops; especially if portions of the rocks from which they have been detached, adhered to the roots, and were drifted along with them. That they grew on the shelly rocks usually occurring under them, and partly mixed with them, is a notion for which there is no proof

whatever. Respecting the quarter from whence some of the materials of these and other strata might be drifted, Professor Phillips asks, "May we venture to suppose, that the primary tracts of the Scandinavian peninsula and Scotland, with other land now sunk beneath the German Ocean, has been the source of most of the arenaceous and argillaceous deposits of the carboniferous, oolitic, and Wealden formations of England?" (Treatise, p. 217.)

From whence the materials of the cretaceous strata have been derived, this judicious writer does not venture to conjecture. Mr. Lyell, in his Elements, p. 55, supposes that white chalk may have had its origin in microscopic organic bodies; as Professor Ehrenberg has discovered myriads of infusoria in the white coating of flints, as well as in tripoli, and mountain meal. In a subsequent part of his interesting work, p. 320, Mr Lyell considers white chalk as resulting from the decomposition of corals. But whether we adopt one, or both, or neither of these hypotheses, the time required for depositing the cretaceous rocks is not thereby determined. If they originated in corals, or in animalcules, it does not follow, that either the one or the other lived on the spot. The microscopic discoveries of Professor Ehrenberg are indeed wonderful. That substances, hitherto considered as minerals, or portions of rocks, should be found to be composed of creatures so minute that above 40,000 millions exist in a cubic inch, may well fill us

with astonishment, and excite us to admire and adore that infinite Being, who is glorified in the formation of the smallest as well as the greatest of his creatures. If but an hundredth part of our chalk rocks has been made of such animalcules, what countless multitudes must have been required for even that proportion! Yet, if we admit this hypothesis, we have no means of ascertaining, from what extent of surface these animalcules have been swept; or what time was required for their growth, or for their accumulation. The ancient world appears to have been much more prolific than the present; and yet even now, immense myriads of insects, of various descriptions, are produced in a single season. Prodigious swarms of gnats, flies, locusts, &c., are often seen, especially in hot climates: and even in Britain, those beautiful insects called *cow-ladies* frequently alight in such vast numbers, as to seem like a shower of hail falling. The sea is as prolific as the land. In many instances, the ocean appears illuminated by night far and wide, to the extent of many leagues; and when, in such cases, a portion of the water has been taken up and examined, the light was found to proceed from myriads of animalcules, with which every part of the water was densely crowded. Shoals of herrings, of great breadth and depth, are, in some instances, found to extend for several miles, on our own coasts, forming almost one continuous living mass. If we grant, therefore, that some rocks are formed of countless

accumulations of animalcules, this is no proof that ages were required for their deposition.

And here it may be proper to remark, that the discovery of fossil shells, encrinites, or corals, pierced by pholades, or covered with serpulæ, anomiæ, acorn-shells, or coralline substances, can furnish no evidence as to the length of time occupied in the deposition of the chalk, oolite, or other rocks containing them; unless it could be proved, which it has not been, that these accidental changes took place on the spot, or during the time of deposition. Mr. Lyell, in his Elements, pp. 46, 374, &c., appeals to some instances of this description, as triumphant proofs of his theory. But what proof do they afford? Might not shells, encrinites, and corals, which had met with such accidents in places where they formerly grew, be drifted into their present positions, as easily as those which are found entire and unencumbered?

The tertiary strata, which are above the chalk, are remarkable for containing a multitude of shells coinciding with existing species. These strata occupy but a small space in the crust of the earth; yet three or four ages have been assigned to them; which ages are distinguished by the greater or less approximation of the fossil shells to those of the living world. The beds that have very few living species among the extinct, are termed *eocene;* those which have somewhat more, *meiocene;* those with about one half of each kind, *elder pleiocene;* and those in

which nearly the whole correspond with existing shells, *newer pleiocene*. In addition to these, there is a post-tertiary period, comprising some more ages; particularly, the age of diluvial detritus and of erratic blocks, and the age of ossiferous caverns: and these supplementary ages, with perhaps one or two more, are all supposed to have preceded the creation of man. These divisions, and subdivisions, of pre-adamite worlds, display more of imagination than of sound judgment. The whole tertiary strata cover but a small portion of the face of our globe, and each of the four sections can claim but a few patches; yet to these patches a whole age is assigned! What became of the rest of the earth, when one of these sections, say the meiocene, had its reign? Did the process of life stand still elsewhere, while a few meiocene spots monopolized the concerns of the living world? Or, was there a general meiocene creation, the whole of which was lost, except these favoured spots, before the pleiocene era began? To give the dignity of a world to such insignificant patches, is like attempting to erect a pyramid on a single point.

The tertiary strata abound with shells, and contain also, in no small quantity, the remains of quadrupeds, and other animals of various classes. Many of these relics, particularly the shells, are in a high state of preservation; and this is advanced as an argument, that the animals imbedded here, must have lived and died in their

present localities. But, under favourable circumstances, the most delicate shells might be drifted unharmed, from vast distances. Glass bottles, containing letters or papers, have in not a few instances, been floated across the Atlantic, from the banks of Newfoundland, and landed unbroken on the coasts of Ireland, or of the Hebrides. We can, therefore, have no difficulty in conceiving, how shells, and other fragile substances, might be floated from afar by ocean currents, and deposited among fine sand, or soft mud, which may also have been transported along with them, without their sustaining the slightest injury.

On the whole, it appears, that no valid proof has yet been given, to demonstrate that the animals and vegetables imbedded in the strata, have lived and flourished where they are found; but that, on the contrary, there is every reason to believe, that they have all been drifted or floated thither. What evidence, then remains, to establish the enormous longevity ascribed to the world by some popular geologists? What is there to shew, that the stratified rocks might not all be deposited within a very limited period?

Mr. Lyell and others would maintain, that the strata have been formed in the same gradual way in which sediment is now being deposited in the bed of the ocean, furnished by the waste of sea cliffs, and the mud of rivers; that no extraordinary convulsion has changed the crust of the globe, but that all the phenomena appearing in our rocks may be accounted for by existing

causes, still in operation. But there are facts presenting themselves to our view almost every where, which cannot be reconciled with any such opinions. It is clear to an unprejudiced observer, as some of the best geologists have acknowledged, that the stratified beds have been formed on a grander scale, and deposited at a rate much more rapid. And, although we distinguish a succession of beds, and speak of different formations, rising one above another, we must not suppose that there is any such line of demarcation between them, as to favour the idea, that a long interval might occur between the deposition of any one bed and that which immediately succeeds it. On the contrary, the strata are found to run into one another, so that it is often very difficult to say, where one ends and another begins. Hence, every geologist takes the liberty of grouping the strata in his own way; there being no fixed boundaries, to indicate how many, or how few, must be assigned to any particular series. In fact, although in describing them we may distinguish a succession of deposits, they are so connected together as to form one whole,—one grand deposit; leading us to conceive, that one age might give birth to the entire series. Accordingly, Mr. Phillips, in noticing how the secondary strata gradually pass into one another, or are, as he terms it, intercalated with each other, aptly observes; "These transitions are merely examples of the general harmony, which connects together the whole system of stratified deposits,

into one varied and locally disturbed series of phenomena." (Treatise, p. 218.)—Yes, however numerous the beds, and however we may attempt to sub-divide them, they are but parts of the same whole; and, instead of being very slowly formed during a long succession of ages, they bear the marks of having been deposited about one period. To some of these marks let us now attend.

1. The general conformity of the strata, and their undisturbed succession, indicate that they must have been deposited about the same era.—Had an age intervened between the formation of the several beds, the hand of time, with numerous accidental causes, must have produced inequalities on the surface of each, before it was covered by its successor; and thus marred their conformity. When, therefore, we see each member of the series succeeding another, without interruption or irregularity, must we not conclude, that they followed each other so closely, as not to allow time for such disturbance or derangement?

In several instances, however, notwithstanding this general conformity, derangements have occurred, and the strata are unconformable; examples of which may be seen at some spots where the tertiary strata succeed the secondary. To these and other irregularities, I will hereafter advert; but may remark, in the mean time, that as such disturbances have doubtless been caused by volcanic agency, the operation of which is usually sudden, there is no necessity for admitting that, in such cases, the interval between the

deposition of the two sets of strata has been of long duration.

2. The breaks, or faults, in the strata, affect the whole mass of rocks, in almost every instance where they occur, instead of being limited by the boundaries of particular formations. Had there been a series of creations, belonging to different ages, we ought to have found dislocations peculiar to each, and leaving off at their several boundaries. Now when, instead of this, we see such dislocations, or faults, traversing the whole series of beds, without any regard to such divisions, have we not a right to presume, that the whole should rather be assigned unto one age? That remarkable fault, usually termed at Newcastle *the ninety-fathom dyke*, which commencing at Cullercoats, runs up the vale of the Tyne to Brampton, and from thence bends southward and eastward, pursuing a course of 110 miles, pays no respect to formations, ages, or creations, but is one continuous fracture of the earth's crust, as far as it reaches; the whole beds, of every description, on the north and west of this enormous fault, being sunk below those on the south and east, to the depth of from 1000 to more than 2000 feet! (Phillips's Treatise, p. 182.) In like manner, the great *whinstone dyke* of the eastern part of Yorkshire, has been traced from Maybecks, near Robin Hood's Bay, to Cockfield Fell, in the County of Durham, a distance of 60 or 70 miles; traversing indiscriminately all the beds that occur in its course, though it does not

always rise to the surface. Do not such facts indicate, that the division of the strata into a long series of formations is wholly imaginary?

3. Several of the smaller faults, or slips, have taken place when the strata were but half consolidated, so hard as to break, yet so soft as also to bend. Instances of such bent strata occur in the Newcastle coal-field, as exhibited in Mr. Buddle's sections; and the same phenomena are not uncommon on the coast of Yorkshire. The undulations in the ironstone and hard sandstone, on both sides of Scarborough; those in the sandstone, at Haiburn wyke; those in the hard bands of the aluminous strata, at Peak and Robin Hood's Bay; and those in the dogger near Saltwick, on the east side of Whitby harbour, and in the sandstone on the west side, may be quoted as examples. In such undulations, indeed, the curvature of a bed is generally owing, in some degree, to small rents or cracks; but, there is also a real bending of the mass of the stratum, shewing that it was somewhat flexible when the break took place. Now, as these breaks and bendings, wherever they occur, affect the lowest beds as much as the highest, the one cannot be much older than the other; the whole having been in a semi-indurated state at the same time.

4. The denudations of the strata speak the same language. When the dry land was beginning to appear, the tides and currents of the retiring ocean, sweeping over the surface, have borne away immense masses of the strata, scooping out

valleys, and forming river-courses, bays, creeks, and other irregularities. Such denudations, as they are called, are every where seen; and, in many instances, they have not only swept away the uppermost bed, but demolished a large portion of the series; and as vast masses of what are now the hardest beds have been carried off, along with a much greater quantity of the softest, there is reason to believe, that the denudations, like the faults, have taken place before the strata were quite consolidated. The materials thus abraded by currents, have been partly carried into the sea, and partly deposited on the land, to form the alluvial covering; filling up many of the inequalities produced by faults or dislocations, smoothing the general outline, and furnishing a soil for the growth of vegetables. Now, if each formation in the strata has belonged to a world like the present, the dry land of every such world must also have been raised up out of the ocean, and, in emerging, must have suffered great denudations, obtaining likewise its alluvial covering and its soil. The monuments, therefore, of each world, should present some traces of its denudations, and some relics of its alluvial beds. But where, in the whole series of formations hitherto explored, are there any vestiges of such denudations and such alluvial covering? Were the hollows and gaps which the retiring ocean made in the strata of each pre-adamite world, neatly filled up and mended, and its alluvium carefully removed, before the next world appeared?

Where are the soils of these primeval worlds,—those fertile soils that produced such stately pines, and palms, and tree-ferns? Is there nothing left of those rich soils, save only the dirt-bed of Portland,—a bed which, being regularly stratified, and conformable to the strata above and below, can claim no kindred with the irregular alluvial beds of the present world? Were the existing world submerged, and a new formation deposited over it, is it possible to conceive, that a section of the strata in the next age, would shew no vestige of the present extensive denudations, and dense alluvial beds? And, if the laws of nature have been the same from the beginning, how can we believe, that the formations of the strata are the monuments of a series of worlds like our own, when in each of these monuments the distinguishing features of a habitable world are wholly obliterated!

5. The marks of violence and severe pressure, in many of the organic remains, prove that the strata containing them have not been deposited in a slow and gradual way; while the same thing appears from the high state of preservation in which fossil fishes are frequently found. It may seem inconsistent, to draw the same inference from phenomena so opposite; and yet, in both cases, the inference is just. With regard to the last, it is well known, that scarcely any substance decomposes more speedily than dead fishes; so that, when we find fossil fishes in a high state of preservation, we may be sure that the strata containing

them were deposited so rapidly, as not to allow them time to become putrid, till they were safely incased in their present matrix. Now, the fossil fishes in the carboniferous strata, in the magnesian limestone, in the lias, in the oolite, in the chalk, and in some of the tertiary deposits, are often found in the finest condition, with no part of their structure injured; while we know that fishes left dead on the beach, or on the banks of rivers, begin to decay in a few hours. The inference to be drawn from these facts, is well expressed in the words of Professor Phillips, Treatise, p. 87: "Struck with the contrast offered by these layers of fishes in ancient marine sediments, with the few and scattered fragments which occur in modern deposits, M. Agassiz has conjectured, that the rate of deposition of these ancient strata must have been almost inconceivably rapid." Mr. P. accounts for the sudden death of the fishes, by supposing some remarkable change in the water; but the proper cause of their fine preservation was their being so suddenly entombed in the strata. See Dr. Buckland's Bridgewater Treatise, p. 123.

The marks of violent pressure in other petrifactions furnish also a proof of the rapid deposition of the stratified rocks, different in kind, but equally strong. Had the beds been formed in the slow and still way, imagined by the abettors of the pre-adamite theory, the bodies, or rather the skeletons, of imbedded animals, if not dissolved, would have had their cavities filled up

with the substance of the matrix, and have retained their natural shape; and being fixed in their places before the new depositions over them could accumulate to any thickness, the pressure of those beds could have had little or no effect in altering their shape or form. Now, when we see fossil animals, such as the large saurians in the lias, crushed and broken, as under an enormous weight, it is plain that the strata containing them must have been formed so quickly, that the lower beds had not time to harden, before the weight of the new strata over them was sufficient to crush them. Illustrations of this occur in great numbers, both at Lyme Regis, and at Whitby. Thus, the great crocodile in the Whitby Museum has evidently been crushed by the super-incumbent strata; the effects of pressure being visible, both on the head and the body; particularly on the hind legs, the bones of the one leg being partially sunk into those of the other. A fine specimen of ichthyosaurus, in the same Museum, gives similar indications of violent pressure, the whole being crushed into a flat mass, and the ribs of the one side pressed across the spine, so as to form an angle with the ribs of the other side. But there is another peculiarity in this specimen. The elegant curvature of the spine shews that it was not the dead carcase of the animal that was imbedded in the strata; it was not in the flaccid state of a dead and stranded fish, but must have been suddenly entombed alive; and, writhing in the agonies of death, it has twisted its body into

its present handsome shape; as if, like a Roman gladiator, it would die gracefully. Similar instances have been noticed among the fossil fishes of Germany. (Dr. Buckland's Bridgewater Treatise, p. 125.)—In like manner, numerous beds of shells, and many fossil trees or pieces of wood, in various strata, are found to be crushed flat; which is particularly the case with the reeds in the coal strata, and the trees converted into jet in the lias.—These marks of violence and pressure clearly prove, that, in very many instances, the strata have been formed by rapid accumulation.

6. Throughout the whole of the strata, with scarcely any exception, there are indications of only one climate, at the time when the organic remains were imbedded. It is a remarkable fact, generally acknowledged among geologists, that the animals and vegetables discovered in our strata are analogous to the living species of the tropical regions. This is the case, not with one or two formations only, but with all; except, perhaps, a few of the tertiary beds. The corals, and nautilites, of the mountain limestone; the canes, palms, pines, and tree-ferns, of the coal measures; the crocodiles, and other saurians, of the lias; the enormous bats, and lizards, of the chalk; the tortoises, tapirs, and opossums, of the Paris basin; with all the subordinate varieties of animal and vegetable life, throughout the secondary strata, and even the tertiary, bespeak a warm climate. Nay, a tropical heat still prevailed in the post-tertiary period, the era of the ossiferous

caverns, when the elephant, the rhinoceros, the hippopotamus, the hyæna, and the tiger, inhabited these regions: so that the last of the formations was as hot as the first. Now, does not this uniformity of temperature, as indicated by the organic remains throughout the whole series of stratified rocks, shew that they have all belonged to one period? Had there been a long succession of ages, an oft reiterated change of worlds, we might surely have looked for some tokens of a change of climate, some productions of the frigid and temperate zones, intercalated with those of the torrid zone; or at least, we might have expected to find the world growing colder, as some have alleged it does. But when, on the contrary, we see the deposits of all the strata, however diversified, giving indications of a hot climate; and those of the caverns, as much as those of the mountain limestone;—have we not a right to affirm, that the whole have belonged to one and the same period?

To obviate objections, and throw further light on the subject, let us attend to a most important idea, advanced and ably maintained by Mr. Lyell, in his Principles of Geology, I. pp. 140, 141, &c. He shews that, by a different arrangement of land and sea, a temperature nearly equal might exist all over the globe, without any change of its axis, or of its relative position in the planetary system. Were the highest mountains transferred to the equatorial regions, the most extensive oceans removed towards the poles, and fringed with a

border of archipelagos, or clusters of islands, while lands of moderate height occupied most of the intermediate spaces, between these archipelagos and the equatorial mountains; then, a temperature almost uniform would prevail throughout the world. The heat of the torrid zone would be moderated by the height of its mountains, the warmth of the temperate zones would so increase that they might be said to possess a tropical climate, and even the northern and southern archipelagos would enjoy a perpetual summer, like the isles of the Pacific; while "all signs of frost would disappear from the earth."

Now, there is good reason to believe, that something like this was the actual state of the primeval world, and that those geologists cannot be far wrong, who think that the place of the British isles was once occupied by part of a great northern archipelago, enjoying a climate like that of the West Indies, or of the South Sea Islands. By adopting this hypothesis, we at once account for the remarkable fact, that the animals and vegetables imbedded in our rocks, are those of the tropical countries.

But this hypothesis helps us to get over a difficulty still greater; for it enables us to account also for the prodigious quantities of animal and vegetable remains existing in our strata. If the primeval world enjoyed universal summer, it must have been in the highest degree prolific; every region teeming with life. There would be no sandy deserts, no barren moors, no bleak and

sterile hills; but the whole of the dry land,—the extent of which might bear a much greater proportion than now, to that of the sea,—would be clothed with rich vegetation, adapted for the support and accommodation of an equal abundance of animal life. Stately forests and smiling groves would wave on the tropical mountains, as well as on the verdant isles of the northern and southern archipelagos, and the fertile plains of the intermediate regions; and the whole would be peopled with every variety of living creatures. Hills and dales, woods and plains, rivers and lakes, would each be densely tenanted by their appropriate inhabitants. The seas would swarm with fishes, the shores with mollusca; crocodiles and lizards, in great numbers, would frequent the beach, while other large saurians would sport in the waters, or browse among the rank sea-weed. Myriads of insects also, visible and invisible, would people the earth, the air, and the sea; filling every region with life and motion. There is no need, then, to inquire from what inexhaustible stores, our vast beds of shells, corals, fishes, crustacea, and other varieties of imbedded animals, have been derived: nor need we be at a loss to conceive, how the immense supplies of vegetable matter, required for the formation of the coal strata, could be procured. Even the present American forests, if uprooted and floated into stratified masses, would suffice to form coal seams of great extent; and can we then doubt, that the primeval forests, which were perhaps an hundred times

larger, would be more than sufficient to furnish materials for all the coal beds in existence?

But it may be asked, "If the fossil animals and vegetables all belonged to one period, why do those of one formation differ so widely from those of another? And why are there so many beds, in which there is not a single species identical with any existing species?"—To obviate this difficulty, let us attend to another important statement, laid down and fully established by Mr. Lyell, in his Principles of Geology, II. pp. 66, 67, &c.; viz. that the animals and vegetables of our globe, are not equally distributed over the whole, but exist in groups, occupying peculiar districts. The productions of the New World are totally different from those of the Old; those of Europe are not the same with those of Africa, nor do the latter correspond with those of Asia. The indigenous species of animals and plants in New Holland are, almost without exception, distinct from those of other countries. In the Flora of St. Helena, out of 61 native species, only two or three occur any where else. With the exception of some eels, none of the fishes in the river Nile correspond with those of Europe. (See Geological Survey of the Yorkshire Coast, p. 335.) In the Galapagos archipelago, as described by Mr. Darwin, "The birds, reptiles, plants, and insects are, with very few exceptions, of species found no where else in the world;" and these islands abound with saurians, not unlike those of the lias. (Lyell's Elements, p. 394.) In short, as Mr. Lyell observes, "Each separate region of the globe, both of land and water, is occupied by distinct groups of species; and most of the exceptions to this general rule, may be referred to disseminating causes now in operation." (Principles, II. p. 67.) Not only in each quarter of the globe, but in each considerable division of that quarter, especially if it be somewhat insulated, we find quadrupeds, birds, reptiles, insects, plants, fishes, mollusca, and sea-weed, peculiar to that locality.

If, then, a similar distribution existed in the primeval world, and if we suppose, with Professor Phillips, that the currents which brought the materials of our strata, flowed from remote regions, and from various directions; the organic bodies, as well as the mineral substances, drifted by any one current, must needs have been different from those deposited by any other current. And if we grant, what is extremely probable, that the animals and vegetables of the ancient world, were distributed over a much greater extent of surface, at least of productive surface, than there is in the present world; we need not be at all surprised at the variety of genera and species, discovered in stratified rocks. Looking upon the whole case, it would be more strange to find uniformity than variety, in the relics of a world replete with life, in all its diversified forms, beyond what can now be witnessed.

When we see so much diversity and beauty among the productions of the present world, can we doubt that the primitive world was no less

richly furnished and adorned by the infinite Creator? His stores of wisdom and goodness, of power and skill, can never be exhausted. Rich as our planet is with the blessings of his bounty, and the tokens of his grandeur, there may be other orbs that are richer still: and could we visit and explore those distant realms of the Almighty King, we might find them peopled with beings, both rational and irrational, animate and inanimate, of an endless variety of natures and forms; and garnished with beauties and glories, surpassing all that we have seen or conceived: while, in every part of his vast dominions, we might observe the development of the same all-wise plans, the workings of the same infinite supreme Intelligence.

Other objections will be answered with more advantage in the Second Part of this Essay. I would here only notice further, the assertions, or insinuations, of some modern geologists, that to restrict the age of our planet to five or six thousand years, is to limit the displays of the Creator's glory; that to assign millions of ages to our globe, must afford a much better exhibition of his riches; and that it is improper to think, that he would delay making our earth the theatre of his mighty works till so late a period. To this I reply, that it would be presumptuous in us to attempt to decide, what was the most fit period for creating the world; or what length of time was most proper for displaying the wonders of his power, wisdom, and goodness, in constructing

our globe, and replenishing it with diversified races of creatures. "It is not for us to know the times or the seasons, which the Father hath put in his own power." His time must always be the best; and we have no right to find fault with the world's duration, any more than with our own. Doubtless he created our globe at the best time; and, in framing and furnishing it, he took the best method for promoting his glory, and the good of his creatures. To allege that a longer period was necessary to manifest his greatness, savours of ignorance, as much as of presumption. He created the world in six days; shall we affirm that the work would have been more magnificent, if performed in six years? Nay, rather, the facility and speed with which it was completed, demonstrate more strikingly the wonders of his power and skill. "He spake, and it was done; he commanded, and it stood fast." The amount of his glory, as exhibited in his creatures, is not a question of time; and the wonders of his wisdom, power, and goodness, apparent in the construction of animals and vegetables, now found fossil, are the very same, whether their age be five thousand years, or five millions. The admirable remarks of Professor Buckland on this point, in his Bridgewater Treatise, are just as appropriate in the one case as in the other. At whatever time these curious fossil animals lived, we see an exhibition of infinite wisdom, in the mechanism of their bodies, and their adaptation to the purposes of life and enjoyment. On all the

monuments of a former world, as on every part of the present, we see inscribed, in legible characters, the praises of the great Jehovah, "who is wonderful in counsel, and excellent in working."

PART II.

The pre-adamite theory not consistent with Scripture.—An attempt to shew that most of the stratified rocks might be formed at the period of the Deluge.—Illustrations of the subject, and answers to objections.—Conclusion.

Having endeavoured to shew, that the stratified rocks, instead of requiring ages for their deposition, might all, or almost all, be formed about one period, let us proceed to inquire if we can ascertain the era of their formation. In conducting this inquiry, we can receive no aid from history, unless it be from the most ancient of all histories,—the narrative of primeval transactions in the sacred volume.

An appeal to scripture on geological questions, is regarded by many as altogether inappropriate; because, from the superior nature of its objects, we cannot expect it to be occupied with matters of science. And it is true, that the Bible is not intended to teach us geology, any more than astronomy: its statements relating to nature, are not expressed in scientific language, but are set forth in the simplest form; being in accordance with the appearances of things, and the views most generally received among men. Yet we are sure, that the facts of science may be reconciled with the sacred page; and we may be permitted to doubt the truth of any theory, which makes that reconciliation impossible. The volume of creation, the volume of providence, and the volume of inspiration, have all one Author; and

whatever apparent discrepances there may be between them, there can be no real opposition. It is an interesting fact, that the progress of science has, in more than one case, illustrated the truth of the sacred records. The story of the famous Zodiac of Dendera, is well known. Some French philosophers asserted, that it was at least 15,000 years old; nay, some carried back its antiquity to 40,000; making it as old, perhaps, as the *eocene period* of geologists: but when Dr. Young and M. Champollion discovered the method of reading proper names in the hieroglyphic character, this formidable stone, which was supposed to have battered down the chronology of Moses, was ascertained to belong only to the era of the Cæsars.

The attempts made by some geologists, to reconcile the system of pre-adamite formations, with the Mosaic account of the creation and the deluge, have signally failed. The notion, that the six days of creation, may correspond with six successive formations, each extending through an indefinite period, seems now to be abandoned as utterly untenable. Yet many are of opinion, that as, without contradicting scripture, we may believe in the existence of numerous planetary worlds, all furnished with their respective inhabitants; so also we may be allowed to think, that numerous creations might exist on our globe, long before the creation recorded by Moses; the sacred pages making no mention of the one, any more than of the other. To a certain extent, this may

be conceded. I agree with my learned friend Dr. Buckland, that the narrative of Moses does not necessarily preclude the supposition, that the materials of our globe might pre-exist under another form, and that this world may have been constructed out of the wreck and ruins of a former creation. But this hypothesis falls far short of the pre-adamite theory, now maintained; for, according to it, there was properly no wreck or ruin at the Mosaic creation,—no chaos, requiring to be separated into land and sea; but a goodly world, already disposed into continents, islands, oceans, lakes, and rivers: all that it wanted was, to be garnished with a new coating of vegetables, peopled with some new inhabitants, and furnished with a governor in the person of man. How this view of the matter can be reconciled with the scripture narrative, it is very difficult to conceive.

Besides, it seems scarcely consistent with the wisdom of the Divine Being, any more than with the declarations of his word, that a succession of creations, all beautiful and interesting, should occupy our globe throughout long ages, without any intelligent creatures, to enjoy the scene, and praise the Creator. All his works, indeed, praise him, independently of man; but there is a rational praise, which man alone can render on earth; and it is unreasonable to suppose that, during so long a period, no provision should be made for an object so important.

It may likewise be observed, that, according to scripture, it was man's disobedience that brought

death into the world, with all our woe; but, according to this geological system, death had reigned and triumphed on the globe, in the destruction of numerous races of creatures, thousands of years before man existed.

But the strongest scriptural objection to this system is, that it leaves no room for the deluge, that great catastrophe so distinctly recorded in sacred history. Some of the supporters of the pre-adamite theory, speak of the flood as a quiet effusion of waters over the earth; but others of its advocates would reduce it to a mere local inundation, caused by the bursting of some large lake, or inland sea. (Lyell's Principles, III. pp. 270—274.) Such ideas it is utterly impossible to reconcile with the sacred volume.

The scriptures inform us, that before the deluge, men were greatly multiplied, and instead of being located in a single province or region, were dispersed, as now, over the whole world; so that, when they degenerated and became grossly depraved, "the earth was filled with violence." If we consider the great longevity of the antediluvians, and recollect that 1656 years intervened between the creation and the flood, we may reasonably suppose, that the population of the ancient world would be little, if any thing, short of the present population. No local inundation, then, could have sufficed to destroy that ungodly race; and the Bible plainly and repeatedly describes the deluge as universal: "All the high hills, that were under the whole heaven, were

covered." "The world that then was, being overflowed with water, perished."

From the words of the sacred historian, we also learn, that the deluge was much more than "a quiet effusion of waters:" it was the destruction of the earth, as well as of its inhabitants; for so the threatening ran, "I will destroy them *with the earth*." This great event was designed to accomplish mighty changes in the very constitution of the earth itself, changes that would operate on the constitution of man, so as materially to shorten the term of human life. The time occupied by this awful dispensation decidedly intimates, that much more was contemplated by it, than merely the drowning of the earth's inhabitants. To effect that object, a few days would have sufficed; but the deluge lasted a number of months. About six weeks elapsed ere the flood attained its greatest height, covering the highest mountains; half a year expired before the ark took the ground, on mount Ararat; during the next half year, the waters were retiring, the land was drying, and recovering its vegetable coat; so that more than a year had passed by, when Noah, with his charge, quitted the vessel in which they had been preserved; and many years might revolve before the ocean subsided to its present level.

An effusion of waters over the whole earth, so still as not to destroy the vegetation, is the kind of deluge fancied by some geologists: but such a deluge could not take place, without the most

extraordinary miracles;—miracles uncalled for, and of which Moses gives not the slightest hint. In that case, the Almighty must have created an immense quantity of waters, to produce the flood; and afterwards annihilated those waters, to remove it. On that supposition too, the laws of nature must have been suspended, so as to prevent the alluvial soil and vegetable covering from being demolished and washed away, by the torrents, tides, and ocean currents, then acting; the force of which, during forty days of tremendous rain, and while the swelling billows were dashing over mountains, woods, and plains, must otherwise have been irresistible.

But there was no occasion for such miracles: existing causes, directed and controlled by the great First Cause, were sufficient to produce the deluge, without any new creation, or any violation of the laws of nature. The sacred historian mentions two agents as combining their energies, to effect the total submersion of the world. There was a tremendous rain, of forty days' continuance, so heavy and incessant, that it seemed as if "the windows of heaven were opened," to pour down torrents on the earth. In the mean time, "all the fountains of the great deep were broken up;" the waters of the vast ocean being heaved up, to overwhelm the land. This last agent is mentioned first, in the narrative, as having the principal share in accomplishing the great catastrophe.

Now, that the waters of the great deep might be raised up to cover the whole earth, the bed of

the ocean must have been elevated, and the dry land at the same time depressed; for it was only by the elevation of the one, and the depression of the other, that the object could be gained. To produce these changes, another agent, not expressly mentioned, must have been employed, viz. an expansive force acting from below, to heave up the ocean's bed. All geologists seem now agreed, in ascribing the elevation of the stratified rocks, from their original place of deposition in the bed of the ocean, to the agency of some such expansive force, similar to that which produces earthquakes and volcanoes, if not identically the same. To this agency also, are attributed the vast masses of granite, gneiss, basalt, and other rocks of igneous origin, which seem to have been forced upwards, in a state of fusion, into their present lofty stations. Some authors are of opinion, that the crust of the globe is the only solid part of it, and that the interior consists of a liquid mass, like melted metal, on which the outer portion rests, or floats. Whether this hypothesis be adopted, or not, it is clear, from the extensive distribution of volcanoes, several of which are constantly in operation, that there is even now an expansive force, acting under the earth's crust, in various quarters; heaving up, or ejecting, ignited matter in great abundance, frequently shaking whole continents, and working mighty changes on the face of the globe. Whatever explanation may be given of the phenomena of these subterranean furnaces, and whether they

are considered as all connected with one grand central furnace, or not, we are sure that their movements and operations are all, and ever have been, under the guidance and controul of Him who governs the winds and waves, the clouds and meteors, and who directs all for the purposes of his glory.

Is it, then, unreasonable, or unphilosophical, to suppose, that when the Almighty resolved to destroy an ungodly world, he might employ the energies of this great expansive force, to heave up the bottom of the sea, and to shake, dissolve, and depress the land? We cannot easily conceive how the fountains of the great deep could be broken up, in any other way, so as to co-operate with the rains in overflowing the world. In this way, the object could be accomplished by the supreme Ruler, without forming any new matter; and as, at the creation, one day only was occupied in raising up the dry land from the sea, even so at the deluge, a single day might have sufficed for submerging the dry land beneath the waters. But, instead of being the work of a day, this mighty revolution was in progress during several weeks; the earth sinking, and the sea rising, in a gradual and comparatively tranquil manner; so that the safety of the ark and its inmates was not endangered, and time was allowed for effecting, in a more orderly way, the changes now made in the crust of the earth. There was not one great terrific convulsion, to complete the work at once; but a series of smaller convulsions, carrying it

forward by successive stages. Now, may we not trace, in the different formations of the stratified rocks, a correspondence with these successive convulsions; and, on this principle, explain the diversified phenomena of the present strata? Let us inquire, then, into the effects, which volcanic agency thus operating, would naturally produce.

The ancient bed of the ocean may be supposed to have consisted of numerous layers of sand, clay, lime, and other substances, including corals and marine shells; and these layers having been accumulating from the earliest ages, might have acquired a vast thickness at the era of the deluge, and might to a certain degree be consolidated into rocks. At any rate, when volcanic agency began to heave up these primeval strata, the powerful heat and pressure from beneath, aided perhaps by chemical causes, and by voltaic or electric action, would speedily indurate them, and when continued for some time, would reduce many of them to a crystalline form. In this way, we may account for the formation of the primary stratified rocks, including the transition rocks, with the rocks of the Silurian system. Many of these rocks are slaty, and finely laminated, as might be expected from their being slowly deposited throughout a long series of years. Several of them also contain, as might be expected, the remains of shells, corals, and other organized substances, such as might be found in the primeval ocean, or might be accidentally conveyed into it. While these rocks were thus hardened, and

gradually raised, the inequality of the pressure from below, would throw them into various irregular positions, and occasion numerous contortions and fractures. Hence, fragments of the slate rocks might be expected to occur in the strata that succeed; and the one could not be supposed to be conformable to the other.

During these operations at the bottom of the sea, others of great importance were taking place on the shore; for, when the bed of the ocean began to rise, the dry land would necessarily begin to sink; and, in sinking, would be violently shattered, and partially dissolved. In consequence of this, the mountain torrents, swoln with the rains, and the waters of the sea, now spreading along the open country, would sweep away immense quantities of matter, organized and unorganized, to be deposited in the deepest parts of the ocean. First, the alluvial soil, yielding to the united attacks of the torrents and the waves, would be extensively carried off from the plains and low islands; and, mingling with the sand and gravel, brought down by the mountain streams, or lying on the shore, would be conveyed into the deep sea, and deposited there, to form the red sandstone, or conglomerate, which rests unconformably on the slate rocks, and is often of immense thickness.

While the waters were demolishing the alluvial soil, the trees would be uprooted, and the whole vegetation set afloat; so that the rich forests of the plains, and low islands, would, each in succession, become a floating mass of vegetable matter; and this dense mass, partially loaded with mud, being conveyed into the ocean, would, in a short time, sink to the bottom, to become eventually a bed of coal. In the mean time, currents running from various quarters, bringing arenaceous, calcareous, or argillaceous matter, would form beds of sandstone, limestone, or shale, alternating with the vegetable strata and with one another. Thus, the materials of the carboniferous series of rocks, would be gradually deposited; the contents of many a rich forest being lodged in the new formed beds, while each stratum would contain the organic bodies brought by the current to which it owed its formation.

At each succeeding stage of convulsive movement, the sea rising higher, and spreading farther over the land, new currents would be produced, and fresh materials conveyed by them to the depths of the ocean; so that the magnesian limestone, the saliferous beds, the lias, and other members of the strata, would thus be deposited in succession, together with their peculiar organic remains. The direction of the currents might be changed through various causes; such as, the shape of the hills, against which the waves now dashed; the form and bearing of the valleys, or openings between the hills, through which the sea made a passage; the change of the winds; and the ebullition occasioned by volcanic movements, or perhaps occasional eruptions. The currents, therefore, which would become more

extensive in their range, in proportion as the sea was elevated and the land depressed, might frequently change their direction, and consequently the nature of their deposits. And here it may be proper to remark, that the observations formerly made, respecting the distribution of animals and vegetables over the globe, (see pp. 34, 35.), are equally applicable to rocks. They also exist in groups, each considerable district or province having rocks of its own. We can scarcely doubt, that it was so also in the antediluvian world: and if every district then, as now, had its peculiar rocks and minerals, as well as its peculiar animals and vegetables, every considerable change in the direction of the ocean currents, would be followed by a corresponding change in the beds deposited. If we suppose, as is not improbable, that the rocks of that period were softer than the present strata, and consequently more liable to be dissolved, or decomposed, the facilities for procuring and conveying the materials of the new strata, would be so much the greater.

Here, also, it is necessary to observe, that the stratified rocks are not of a uniform and continuous thickness, but assume the form of extensive lenticular masses, thickest in the middle parts, and thinning out on their sides, or exterior edges. It has been correctly observed, that the earth's crust is not tunicate, with concentric coatings, like an onion; but squamose, like an artichoke, or the root of a lily. Each stratum is a flat mass, resembling a lens, terminating in a thin edge in

every direction: and the edges of the different strata often wedge into one another, the thin edge of one extending over, or under, the thick part of another. Now, this is just what would take place, through the operation of different currents, at the general deluge. Each current would convey its mineral, animal, or vegetable substances, into some deep ocean, or large marine basin; spreading them out on the bottom, so as to form a lenticular stratum, thickest in the middle, and wearing out into a thin edge all round. Numbers of such marine basins might be filling up simultaneously, in various parts of the globe; each differing from another in form and extent, as well as in the nature and number of the beds deposited; yet all arranged on the same general plan, subject to those irregularities, which the different convulsive movements, going on in various quarters, would necessarily occasion.

Yet, while the deep hollows of the ocean were thus filling up with strata, the more shallow seas, with the islands on their bosom, might, in many places, be heaved up, and elevated for a time above the general level of the waters. In this way, innumerable beds of corals, shells, and crustacea, would be thrown up; and these being swept away, in successive groups, according as the currents reached them, would be carried into the different marine basins, to take their places in the new strata. Materials for the latter might also be derived from the mineral substances that had formed the bottom of such shallow seas; and

these soft substances, being drifted along with the shells, would contribute to their good preservation.

The gravel belonging to the shores of these seas, with that in the channels of large primeval rivers, would furnish a supply of pebbles for the conglomerate beds of the oolite, and other strata. The mud and clay of the rivers might contribute largely to the formation of the lias; especially as many of the huge saurians imbedded in it, must have been drifted thence. In like manner, the mountain forests of the old world, when uprooted by the rising flood, would form the coal seams of the oolitic series. Yet we may presume, that much of the vegetation of the mountainous regions, being the last attacked, might float about till the waters subsided; and then, taking root in the alluvial soil, might serve, with numerous springing seeds, that had also floated, to restore the verdant mantle of the earth.

If the white chalk has originated in decomposed coral, supplies of that might be obtained from primeval coral reefs and lagoons, of which many might exist in the great northern archipelago. It is not pretended, that the coral was decomposed on the spots occupied by the cretaceous strata. Yet there is more reason to believe, that chalk, like marl, sand, and clay, is a mineral substance, which had its place in the rocks of the ancient world.

As the flood, in its progress, would arrive at inland lakes, as well as large rivers, and as the

contents of these would be drifted, and deposited in strata, it is not surprising that there should be found some fresh-water or lacustrine formations. These, as might be anticipated, are all in the upper, or newer, strata. They are comparatively of small extent; and in almost all of them, there is a mixture of marine shells, among fresh-water and land shells. Beds containing the former are found also, as it is natural to suppose, alternating with beds containing the latter. Many geologists allege, that in such instances, the sea has given place to a fresh-water lake; that this lake has been afterwards supplanted by the sea; that the sea has been again expelled in its turn, and the lacustrine dynasty restored; and yet that, during this severe and protracted warfare, between salt water and fresh, the conformity of the rival beds has remained undisturbed! Such notions are really unworthy of a place in philosophic minds. It is surely much more rational, to account for these phenomena, by referring them to the agency of the deluge, which affords the most natural solution of the difficulties presented.

Allusions have been made to irregularities that would take place in the stratification, through the unequal pressure of the expansive force upraising the beds. In this way, some of the lower strata might be bent, and partially fractured, before the next deposits were laid down; in consequence of which, unconformable strata would be produced. It would seem that, in a few instances, the coal strata were thus bent, and slightly broken, pre-

vious to the deposition of the magnesian limestone. In like manner, the position of some portions of the secondary strata has been shifted, before the tertiary deposits were laid over them. Such alterations, however, were not likely to be so extensive, as those which had occurred in the primary beds, antecedent to the deluge. Mr. Lyell, in his Elements, pp. 115, 116, describes a case, in which cretaceous strata have been deposited horizontally on transition limestone, which had been previously bent, highly inclined, and bored in many places, by perforating mollusca.

The volcanic agency employed in producing the deluge, might not only heave up the bottom of the ancient ocean, with the new strata forming there, but might, in various instances, throw up basalt, and other igneous rocks, through openings, or fissures, in the crust of the earth. There are granite rocks, as well as basalt, apparently more recent than some of the stratified rocks; and such granitic masses might be raised up during the progress of the deluge, or towards the close of that great event. These unstratified masses, protruded from beneath, would occasion numerous bends, fractures, and other irregularities, in the strata through which they forced their way upwards. If they burst up in a fluid state, they would naturally spread over the surface of the beds that were uppermost; and if new strata were subsequently deposited over them, there would then be produced the remarkable phenomenon, occasionally witnessed, of igneous rocks

apparently interstratified with rocks of aqueous origin. Such anomalous cases, however, generally occur among the primary strata; and may be regarded as a proof, that volcanic action prevailed in the ancient world, as well as at the deluge.

We might have noticed before, that the homogeneous nature of the stratified deposits, would be greatly promoted by the affinity, or elective attraction, of the particles held in solution by the waters. We see this exemplified, in the deposition of substances that have been set afloat on the sea beach. They are not confusedly dispersed along the shore, but regularly arranged in a sort of strata; substances of the same kind having been attracted to each other while afloat. The same thing would naturally take place, but on a far grander scale, in the stratification at the deluge; and hence the order and uniformity of the beds, notwithstanding the comparatively brief space employed in their deposition.

By the agency of a chemical affinity, or attraction, the principal beds have also undergone various modifications, after being deposited. Secretions have been formed in each considerable stratum; where they are found as subordinate seams, or inclosed masses. Mr. Lyell well observes, (Elements, p. 76), "After deposition, similar particles seem to exert a mutual attraction on each other, and congregate together in particular spots, forming lumps, nodules, and concretions." These concretions are often spherical, but more frequently lenticular, or flat; in which case, they

are usually arranged in rows, or imperfect seams, parallel to the line of stratification. In this form, the flint occurs in the chalk; where also there are sometimes perpendicular concretions, as if the silicious matter had been trickling down from above, and stopped in its descent. In the same manner, masses of chert have been formed by secretion, in the oolite; ironstone nodules, or seams, in the sandstone; septaria, and other calcareous or pyritous masses, in the various beds of shale. The shape of each nodule is often modified by that of some shell, or other organic substance, round which as a nucleus, the matter has been accumulated by molecular attraction. The spheroidal concretions in magnesian limestone, having both a concentric and radiated structure, appear to have been formed in a similar way. The process of secretion, must have commenced in the different beds, soon after their deposition, while they were as yet imperfectly indurated; and might go on for a considerable period. We may likewise remark that, as the same process runs through the whole series, and seems to have been going on in all the principal beds simultaneously, this is an additional token, that they were formed about one era.

The time required for completing the consolidation of the strata, might not be so great as many would imagine. They might acquire a considerable degree of hardness immediately after their deposition; partly by the chemical combination of their materials, partly by the pressure of the

volcanic force from below, partly by the heat attending it, and partly by the action of electricity. That this last agent has been employed in hardening the strata, accelerating concretionary formations, producing metallic veins, and aiding the crystallization of minerals, is an opinion which is now pretty generally received. The experiments of Mr. Crosse, as detailed at the Bristol Meeting of the British Association, strikingly illustrate the effect of voltaic or electrical action, in accelerating the formation of quartz, and other crystals. And if, by artificial means, such minerals can be produced in ten or twelve days, they might surely be formed with equal expedition, and on a much larger scale, in the great laboratory of nature. A few weeks, therefore, might suffice to consolidate and mineralize a great proportion of the new deposits. In fact, the process of induration is not an affair of time only; it depends more on the chemical properties of the substances deposited. Some of the lower and older beds are still soft; while many of the higher and newer strata are remarkably hard.

There is, then, no room for alleging, that when the new strata were raised up to become the dry land, they would be likely to run together into one confused mass: nor can it be urged, that the surface of the strata so raised, would be too soft to afford a firm footing, and a comfortable residence, for man and beast. The heat excited by volcanic agency, would be felt, in some degree, even in the highest beds, and would accelerate

the drying of the surface, and the growth of vegetables, as well as the hardening of the strata below.

The chemical changes to which I have alluded, might be going on, not only while the waters prevailed upon the earth, but during the period in which they were gradually subsiding, and the new strata gradually rising. As these strata were formed in the bottom of the ancient ocean, by materials derived from the dissolution of former continents and islands, the sea and the land would now, for the most part, exchange places; the ancient dry land having sunk down, and become the bed of the new ocean, while the place of the former ocean was occupied with the new dry land. In several places, however, the volcanic agency might alter its direction, so that parts which were covered with the sea before the flood, might sink down and be again the bed of the sea; while some portions of the dry land might, to a certain extent, escape the general dissolution, and become dry land as before. Such might be the case with some of the primitive mountains; particularly, the mountains of Armenia, where the ark took the ground, and where the rivers Euphrates and Tigris, mentioned in the description of paradise, have their sources. Some of these primeval mountains were the last parts covered by the flood, and might be the first parts left dry, when the waters retired. Yet all of them must have undergone extensive changes; their beds being disordered, rent, and often raised up at a high

angle, like masses of broken ice set on edge; as is the case with the peaks of the Himalay mountains, the most lofty in the world. In this way, some mountains would acquire an elevation greatly surpassing what had been hitherto witnessed.

The heights of Ararat, now so cold and bleak, might seem an unlikely place to furnish Noah's dove with an olive leaf, so soon after the retiring of the waters; but we are to recollect, that the altitude of that mountain above the level of the sea was, for the time being, comparatively small; and that, owing to the volcanic action, then prevailing, a genial heat was every where felt. The plucking of the olive leaf, is appealed to, as a decisive proof, that the vegetation was not destroyed by the flood: but it is only a proof, that the vegetation was soon restored. There is no need for supposing, though it is not impossible, that in some sheltered spot in this mountainous tract, the soil had not been wholly dissolved; for, if we consider, that the retiring waters must have left on the ground a rich loam, abounding with seeds, roots, shrubs, and even trees, which would quickly spring up, and flourish, it is not at all surprising that, after a lapse of four months, there should be green leaves to pluck; nor that, in three months more, the ground should be fit to accommodate both man and beast.

The new formed strata would also, in many places, rise to a great height; especially where the expansive force, pressing them upwards, produced volcanoes, rearing their lofty craters among

the clouds. While the elevating process was going on, numerous breaks and dislocations, as noticed above, would necessarily occur; particularly when the pressure upwards was unequal, increased in one place, and suddenly withdrawn in another. In consequence of such irregularities, and the occasional heaving up of basalt, or other igneous masses, some of the strata would rise into lofty mountains, others of the same age would form plains, while others, also contemporaneous, would continue at the bottom of the sea; or, if raised up for a time, would sink down again. Thus, precipitous cliffs would be formed, both on the coast and in the interior, presenting natural sections of the strata. Hence also, the beds would lose, for the most part, their horizontal position, and be found to dip, some in one direction, and some in another. Numerous fissures also would be opened, and caverns formed; especially when the rising strata came near the surface.

At a stage somewhat later, just before the waters finally retired, those extensive denudations of the strata, already described, pp. 25, 26, would take place, and the alluvial covering would be spread over the surface. These operations appear, in some instances, to have been conducted slowly; the waters lingering on the surface, and producing gravel by their flux and reflux. Yet there have been movements of no small violence, detaching masses even of the primary and igneous rocks, and hurling them along the surface

to immense distances. Some of the tertiary beds might be formed, or modified, at this period. Professor Phillips remarks, (Treatise, p. 247), "The London tertiaries are supposed by Mr. Lyell to have been derived from the waste of the previously raised or then rising Weald: oceanic currents would plough the sloping parts of the submarine land; and thus we have a clear explanation of the mixture of marine and fluviatile sediments, as well as the local diversity of their nature, which so remarkably characterizes the tertiary strata." In most countries, the general direction of the current that has deposited the alluvium, may be traced with considerable accuracy. In our own country, it has flowed, generally speaking, from north-west to south-east; and hence numerous boulders from Shap fell, and other Cumbrian mountains, are found in the alluvium of the Yorkshire coast. These blocks of granite, porphyry, &c. must have been transported across the country, at the commencement of the denudation, before the intervening valleys were scooped out.

Mr. Lyell seems to be sadly puzzled with the transporting of these erratic blocks. He attempts to ferry them across the valleys on rafts of ice; alleging, that "there is no real difficulty in supposing them to have been carried by ice, when the lands over which they lie scattered were submerged beneath the sea." (Elements, p. 136.) Some of the smaller pebbles he would float over by means of trees and sea-weed, especially the pebbles

of the chalk, as he cannot assign ice to the cretaceous period. (Ibid. p. 322.) But he forgets to tell us, at which of his eras, the eocene, meiocene, or pleiocene, Britain, France, and Germany were so far within the frozen zone, that their seas could furnish icebergs for this service. If we should grant him the use of both agents, his hypothesis could scarcely account for the hundredth part of the phenomena, unless an enormous period of time be also allowed for the supposed transportation: and were even this conceded, it would not explain the fact, that these erratic blocks are not strewed on the surface only, but often buried in the alluvium, to the depth of fifty or a hundred feet. Professor Phillips, in summing up his discussions on transported blocks, candidly owns, that, "It is impossible to comprehend the phenomenon as one capable of being produced by the watery agencies now at work in nature, except under different dynámical conditions:" and, looking at the nature and condition of the deposits of boulders and gravel, he justly observes, with respect to the movements that produced them, "We cannot hesitate to pronounce in favour of sudden and violent movements, of incomparably greater energy, than those by which most of the old conglomerate rocks were formed." Treatise, pp. 277, 272.

Having dwelt so long on the mineral and vegetable branches of this great question, let us now return to the living world, particularly to the case of men and quadrupeds, as connected with the deluge and its effects.

The absence of the remains of men and terrestrial quadrupeds from all the lower strata, and their rare occurrence even in some of the higher, have been urged as insuperable objections against the hypothesis, that the secondary and tertiary rocks might be deposited at the deluge. But as men and beasts would naturally flee for refuge to the higher grounds, on perceiving the rise of the waters, their relics ought not to be expected in the first formed strata; particularly those of men, who being most capable of shifting for themselves, would be the last destroyed.

It is a curious fact, recently ascertained, that the footsteps of some quadrupeds have been found impressed on beds of red sandstone, and other rocks, while the animals themselves have no where been discovered. It would appear that, during the formation of the new strata, tortoises, or other animals tenacious of life, walked about on the margin of the sea, and left the prints of their feet on the soft beds last deposited; which prints, the matter of the next succeeding stratum filled up, without defacing them. The circumstance, that no relics of the animals themselves can be seen,—although, if they were tortoises, their shells ought to be found;— shews how necessary it is to be cautious in concluding against the existence of any particular animal, at the time of the deposition of this or that stratum, merely from the negative evidence of its not being hitherto found there. The *cheirotherium*, as this animal is named, has left in these foot-marks indelible proofs of its

existing when the red sandstone was being deposited; yet its remains are not found imbedded in that, or any other rock. Impressions of the feet of birds also, have been discovered on several beds; although their remains are not only absent from these lower beds, but are rarely seen even in the highest.

The lowest strata in which any mammalia have yet been detected, belong to the oolitic series. The discovery of the remains of an animal of the opossum family, at Stonesfield, near Oxford, a few years ago, exploded some fond speculations of geologists; who had previously maintained, that no mammalia were created before the tertiary period. Future discoveries may soon put an end also to the no less irrational idea, that no quadrupeds belonged to the secondary period, but those of the Marsupial order, such as the kangaroo, or the opossum. There may yet be seen in these strata, mammalia of all orders.

It is, however, in the tertiary beds, as might be expected, that the remains of mammalia chiefly abound. A list of 110 species, many of them belonging to extinct genera, is given by Professor Phillips, in his Treatise, p. 256, &c. They occur principally in the Paris basin at Montmartre, and at Eppelsheim, Œningen, and Georges Gmünd, in Germany. Among the quadrupeds in this list, we find the elephant, rhinoceros, hippopotamus, horse, ox, deer, sow, hare, antelope, dog, fox, squirrel, hyæna, and many others belonging to genera still existing. It is worthy of remark, that, as the

remains of birds, are extremely rare, so also are those of monkeys, creatures noted for their agility; and it is natural to suppose, that those animals which had the best means of escaping, would perish the last, and consequently be the least likely to be intombed in the strata. Some of the cheirotherium marks resemble impressions made by the feet of monkeys.

But the animals which at first escaped, would at length be overtaken by destruction, when the flood rose to the higher grounds, where they had enjoyed a temporary refuge. Here immense numbers would be carried off together by the swelling waters, and would become floating masses of animal matter, in which the huge pachydermata, the hippopotamus, the rhinoceros, and the elephant, would hold an important place. It is a common, and very probable opinion, that Noah's raven found subsistence by feeding on the floating carrion. The carcases of the beasts thus swept away, which were perhaps far more numerous than those previously imbedded in the strata, would at last sink down, and be drifted in immense quantities along the surface of the new formed strata. Many of them would ultimately find a resting place in the alluvial soil, which their decomposition would serve to enrich; and in which the most durable portions of the mass are still frequently found, especially the bones and teeth of elephants. But many of them, also, would be drifted into those fissures and caves, recently formed by fractures or dislocations of the strata. Hence the

numerous bone caverns of Germany, France, England, and other parts of the world; containing a mixt assemblage of relics, generally broken, and oftentimes water-worn; belonging to creatures great and small, carnivorous and herbivorous; with a few bones of fowls, and more rarely, some human bones.

The only ossiferous cavern which the author has had an opportunity of exploring, is the celebrated Kirkdale cave, discovered in 1821, and supposed by Professor Buckland to have been a den of hyænas. Having examined the cave within about a week after its discovery, when it was but partially opened; being well informed, both by personal inspection, and by inquiries at the workmen, as to the original state of the entrance, and of the alluvium that covered it; and having repeatedly searched the cave, and carefully examined great quantities of the relics procured from it; I am perfectly certain, that it never was the residence of any living creature. The notion so generally received among geologists, that this was a den of hyænas, while there is such powerful evidence to the contrary, is an illustration of the well known fact, that the love of theory will sometimes strangely warp the understanding; and that there are cases in which the statements of even the most experienced geologists must be received with caution. My views on the subject being already before the public, in the Geological Survey of the Yorkshire Coast, pp. 294—310; and in two Papers in the Memoirs of the Wer-

nerian Society, Vol. IV. Art. 22, Vol. VI. Art. 7; it is unnecessary to revive the controversy on this occasion. I may just remark, that the strongest argument for the den theory, was the discovery of *album græcum*, the fæcal remains of the hyænas, in the cavern. In reply to the argument drawn from this discovery, it was observed, that these substances would exist in the intestines of dead hyænas, and would, therefore, be drifted in along with their carcases. The force of this reply is strongly corroborated by the observations of Dr. Buckland himself, relating to the coprolites of Lyme Regis. He informs us, (Treatise, p. 190), that quantities of coprolites are found within the fossil skeletons of ichthyosauri, in the abdominal regions; a clear proof that these substances existed in the intestines of these animals when deposited. On inspecting his Figures, Plates 13, 14, we see what a mass of coprolites must have existed in each specimen; and as few of the specimens are so entire as to shew the coprolites within them, it is no wonder that quantities are found strewed about in the lias, apart from any skeleton; for those which came out of the carcases that were broken, must have been scattered abroad in all directions. The discovery of the coprolites is no proof that Lyme Regis was the abode of living ichthyosauri; and the discovery of *album græcum* at Kirkdale, is no evidence that it was a hyænas' den. In both cases, the carcases of the animals, containing fæcal remains, have been drifted to the spots where they are now found.

It has been urged, that if the relics in such a cave as that of Kirkdale were drifted in by the waters of the flood, we cannot also ascribe to the flood, the formation of the strata, and of the cave itself. And certainly, these different effects could not have been produced simultaneously: but there is no impropriety in attributing diverse effects to the same cause, acting under varied circumstances, and in various stages of its progress. After the strata had been deposited by the waters, and become partially indurated, there is no inconsistency in supposing that, when the strata were raised up by an expansive force from below, and fissures were made here and there, on their approaching the surface of the waters, the flux and reflux of these waters might, by washing away part of the softer substances, convert some of these fissures into caves; nor is it unreasonable to suppose, that the waters might subsequently drift into these caves, a quantity of animal matter, then floating about in all directions; nor that, at a future stage, even at the final retiring of the waters, the entrance into any such cave should be completely closed up by the alluvium then deposited.

In the cave at Kirkdale, there were bones of the bear, the tiger, and the wolf, as well as of the hyæna; but the latter, having the greatest number, has attained the honour of being tenant of the cavern. In the cave of Gailenreuth, in Germany, where a much larger and more varied assemblage of relics was discovered, those of the

bear preponderate; and to it, therefore, that den has been allotted. It is not alleged, that wolves, bears, and hyænas, were joint tenants of the domicile; nor is it satisfactorily explained, how the minority came there at all, as it does not seem very probable, that these voracious creatures made a prey of one another. The best way of accounting for these remarkable deposits, is to consider the whole as portions of those animal masses, which were drifted about by the waters of the deluge, and found a lodgement in such cavities, before the waters finally retired.

It has been laid down as an axiom in geology, that no remains of man can be found in any of the strata; or in any deposits coeval with those of the ossiferous caves. Human remains, it must be acknowledged, are extremely rare in deposits so ancient; and the causes of this rarity have been already glanced at. Perhaps the principal cause is, that as land and sea, for the most part, exchanged places at the deluge, by far the greater part of the inhabitants of the land, must have been buried in the depths of the ocean. But human relics have been discovered in ancient deposits. In the cave of Gailenreuth they are found intermixed with the bones of extinct species of bears, hyænas, elephants, &c.; and the same discovery has been made in the caverns of Bize, Pondres, and Souvignargues, in the south of France; and more recently, in some caverns near Liege. In some of these localities, fragments of pottery, and rude flint knives, are said to have been

found. Of course, the abettors of the pre-adamite theory, will not allow these human relics to be of the same age with the bones of the extinct animals; and have made several lame attempts to get over the difficulty thus lying in their way. M. Schmerling, and other men of learning, residing near these caverns, and having much better opportunities of knowing the facts, than any transient visitor, however skilful, have decidedly expressed their opinion, that the human bones in these deposits are coeval with those of the quadrupeds. It is not pretended, that the bones of men were merely lying on the surface, or found only in the entrance, where they might be accidentally dropt: they were found in the inmost recesses of the caves, buried in the mud with the bones of the bear, the hyæna, and the rhinoceros; and to deny them the same antiquity, is to attempt to uphold theory at the expense of unquestionable fact.

But it is not in cave deposits only that human relics have been detected: they occur also in solid rocks. The discovery of human skeletons imbedded in grey limestone, in the island of Guadaloupe, marks an important era in the progress of geology. It is to be regretted that further researches have not been made into that interesting deposit; especially as most geologists roundly assert, that the stone is a mere modern concretion. This notion, now so generally adopted, is quite at variance with the plain facts of the case, as detailed by Mr. Konig, in the Philosophical Transactions

for 1814; and the valuable specimen in the British Museum gives it no countenance whatever. The stone, which I carefully examined, greatly resembles some varieties of oolite limestone; like which, it contains fragments of shells, and of corals; the latter, as in the oolite, sometimes retaining their original red colour. The bones are entirely fossilized, and have no appearance of recent bones accidentally incrusted with stalactite or travertine. Nothing but a fixed determination to set up theory against fact, can resist the evidence arising from this discovery. The strange idea, that these imbedded human remains are the result of a battle and massacre, of so late a date as 1710, may be believed, when once another petrified field of battle can be pointed out; but it is far more likely, that we shall first discover other fossil specimens of the human race in secondary rocks, affording such irresistible evidence, as will at once annihilate the whole system of pre-adamite creations.

The reader will have perceived that, in the foregoing illustrations and reasonings, I have studied to meet the principal difficulties attending what may be called the diluvian theory. A few more, however, remain to be noticed.

It will very naturally be asked, If so many antediluvian species, and even genera, be extinct, how can it be true, that Noah, by Divine command, preserved couples "of every living thing of all flesh," to replenish the new world? To this I reply, that general terms are often employed in a

limited sense, both in scripture and in common conversation. *All, every one, the whole,* and such like expressions, are very often used to denote *a great many,* or *a large proportion;* of which our common phrases, "all the world knows," "every body says," &c., are examples. Numerous instances of the same kind occur in the sacred volume. Thus, in the narrative of the plagues inflicted on the Egyptians, we are told, that "all the cattle of Egypt died," by the grievous murrain; and yet, presently after, we read, that the hail also killed all the cattle left in the field, while others that were taken into the houses still survived; and the last of the plagues smote "all the firstborn of cattle." Thus also, in the account of John Baptist's ministry, it is said, "Then went out to him Jerusalem, and all Judea, and all the region round about Jordan." In both these instances, the term *all* obviously denotes *very many.* There is, therefore, nothing inconsistent with the scriptural or common use of general terms, in regarding the orders given to Noah, and strictly fulfilled by him, as restricted to all those animals that were within his reach, all that were in that part of the world where he lived, or, all that God thought necessary for supplying the new world. Such orders might be given, and punctually executed, although many species, and even genera, were suffered to perish.

Again, the great thickness of the entire mass of the strata, may seem to militate against the idea, that the whole might be formed about one

period. Geologists have sometimes estimated the thickness of the earth's crust, so far as it can be examined, at no less than ten miles. But this estimate, which seems far too high, includes the amount of the primary and unstratified rocks, as well as the stratified; and, with regard to the latter, the calculation is made on an erroneous principle, by taking the extreme thickness of each stratum, and then adding the whole together. Now, we must recollect what was stated above (p. 50), that the stratified rocks are not of a uniform and continuous thickness; each stratum is a flat mass, like a lens, thickest in the middle, and wearing out on each side to a thin edge: and as they wedge into one another, where one bed is thick, another may be proportionally thin. If, therefore, we would measure fairly, we must take, not the extreme, but the mean thickness of each bed. Calculating by this rule, the amount will be greatly reduced. At any rate, if we should estimate the secondary and tertiary strata at two miles, or upwards, there is no serious difficulty in the way; for we have only to suppose, that the depth of the primeval ocean, and the extent of the ancient continents, were in the same proportion. On this supposition, there would be sufficient room for depositing the strata, and sufficient materials to form them.

It may likewise be difficult to conceive, how, in the course of deposition, the different strata should be kept distinct and homogeneous; so that the magnesian limestone does not interfere with the

coal measures below, nor the sandstone above it; the lias does not interfere with the oolite, nor the oolite with the chalk, nor the chalk with the tertiary beds. But this difficulty, if it be one, militates much more strongly against the pre-adamite scheme, than against the diluvian theory. It is much easier to conceive, that each current might, in succession lay down its homogeneous deposits, in the course of a few weeks or months; than to imagine, that an oolitiferous current reigned supreme for a thousand years, that a cretaceous current held an undisturbed sway for another thousand, and that the rest of the formations had each its peculiar current, prevailing exclusively throughout an extensive age. The supporters of such an hypothesis seem strangely blind to the actual state of the world, and the tokens of its former state, when they affirm, that the very same process which gave birth to the existing rocks, is now going on with the same energy, in the deposition of sediment at the bottom of the sea; that there has been no period when the work of stratification has advanced more rapidly than it does at present; that no convulsion has changed the earth's crust, different from those now in operation; in short, that "all things continue as they were from the beginning of the creation." We shall shew a disposition to be "willingly ignorant," if we shut our eyes against evidences every where visible, indicating that the earth has experienced convulsions inconceivably greater than any now felt, and that the stratified

rocks have been deposited at a rate incomparably more rapid than the present depositions of mud in the ocean. Professor Buckland himself, though he attempts to neutralize the effect of his own testimony, shews in his Treatise (p. 307), by indubitable tokens, that the lias at Lyme Regis must have been deposited with a rapidity a thousand times greater than the sediment now accumulating in the sea; for the fossil cuttle-fish found there, must have been killed and imbedded in the strata almost in a moment of time, being prevented from discharging the contents of their ink-bags. "I might register the proofs of instantaneous death, detected in these ink-bags, for they contain the fluid which the living sepia emits in the moment of alarm; and might detail further evidence of their immediate burial, in the retention of the forms of these distended membranes; since they would speedily have decayed, and have spilt their ink, had they been exposed but a few hours to decomposition in the water. The animals must therefore have died *suddenly*, and been *quickly* buried in the sediment that formed the strata, in which their petrified ink and ink-bags are thus preserved." It is strange, that the learned author of these valuable remarks, should ever advocate the system of gradual deposition, during countless ages. The difficulties attending that system are vastly greater, than any that can be started against the diluvian theory.

The followers of the pre-adamite scheme give us no clear ideas of what they mean by their series

of formations. They speak of a succession of creations and destructions; but do not explain, in what way these destructions can have taken place, or in what form the new creations followed them. It would seem that, according to them, the ruin of each successive world was never complete, but that a portion of its inhabitants escaped, to mingle with those of the next. We might almost suppose, from some of their expressions, that whenever the earth was brought into a certain state, creatures adapted to that state, must have been produced as a matter of course; just as crops of mice were imagined by the ancients to be generated by the fertilizing mud of the Nile. Mr. Lyell, in his zeal for extending the duration of the world, seems disposed to lay aside the notion of periodical creations and destructions, and to adopt the idea, that a very gradual and almost imperceptible mode of destruction and renovation may be in continual progress; corresponding with his system of gradual and continuous deposition of strata. He supposes that, at distant intervals, a single species may become extinct, and a new species may be created to make up the loss; the one going out, and the other coming in, almost by stealth: and puts the case, that the process may be so gradual that only one species of mammiferous quadrupeds may disappear from Europe in eight thousand years! At this rate, countless myriads of years would indeed be required, to complete the entire cycle of destruction and renovation, or, as he terms it, "to bring about a

complete revolution in organic life." (Principles, II. Chap. XI.) Although Mr. Lyell does not expressly adopt this theory, he is obviously inclined to favour it; and the idea, that the earth has existed throughout such incalculable ages, comes so near to the opinion that it had no beginning, that the transition from the one to the other seems easy and natural. Indeed, the Huttonian theory, which Mr. Lyell has embraced in a modified form, favours the dangerous sentiment, that the world is eternal; the author of that theory having distinctly maintained, that there is nothing to indicate that the world had a beginning, or that it will have an end.

Upon the whole, let us learn, in the pursuits of geology, to guard against launching into wild imaginations, alike unfavourable to science and to religion. Let every phenomenon be attentively surveyed, let every fact be duly investigated, let facts be accumulated, and diligently compared; and, instead of indulging in flights of fancy, let sober reason, and sound judgment, determine the results.

In the present Essay, the author has endeavoured to exhibit, not only a scriptural, but a rational and common sense view of the subject, according to the evidence furnished by acknowledged facts. He has exposed the absurdities of the pre-adamite scheme, as well as set forth the proofs of the diluvian theory. In proposing the latter, he has endeavoured to explain every

difficulty that occurred to him, and answer all the objections to it which he has seen, or heard of;—all at least, that seemed to deserve the slightest attention. How far he has succeeded, must be left to the determination of the judicious reader. Much additional illustration might be adduced, and many collateral arguments might be urged: but it was the author's plan, to give a brief sketch of the subject in its principal bearings, leaving it to others who may be better qualified, to enter into a more ample exposition and detail. Fresh discoveries may, ere long, throw much additional light on the subject; and the statements, reasonings, and suppositions, here advanced, may assist future inquirers, in making use of such discoveries, so as to arrive at a more perfect knowledge of the history and structure of the globe.

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APPENDIX

TO

SCRIPTURAL GEOLOGY,

OR

AN ESSAY

ON THE

High antiquity ascribed to the Organic Remains imbedded in Stratified Rocks;

Communicated, in Abstract, to the Geological Section of the British Association, at the Annual Meeting held in Newcastle:

Containing strictures on some passages in Dr. J. Pye Smith's Lectures, entitled

SCRIPTURE AND GEOLOGY;

Particularly his theory of a local Creation, and local Deluge.

BY THE

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APPENDIX, &c.

Since the appearance of my Scriptural Geology, the Lectures of Dr. J. Pye Smith, entitled Scripture and Geology, have been published; and as about ten pages of that work, Notes included, are occupied with animadversions on my Essay, it will not be unreasonable to say something in reply; especially as I feel it a duty to raise my voice, however feeble, against the dangerous notions which that respected author has advanced. A geological work from the pen of a gentleman so distinguished, as a divine, a scholar, and a man of science, could not fail to excite an uncommon interest, in the religious world, and among scientific inquirers; attracting the attention of many who have hitherto paid little regard to geological pursuits: and as, notwithstanding the general excellence of the work, and the devout spirit in which it is written, it advocates theories tending to undermine the very foundations of our faith, though nothing could be farther from the pious author's design, I am bound to remonstrate against such perilous speculations, and to plead for what may be called the common sense view, both of the statements of scripture, and of the phenomena of geology.

It is well known, from the writings of Dr. Smith, that, along with great learning, he possesses a

lively imagination; and in the study of geology, as in some other studies, he appears to have allowed his imagination to get the better of his judgment; running into the wildest extravagances of popular geologists, and adding others of his own still more wild. Not content with making the deluge of scripture a local flood, he has localized the creation too; limiting the Adamic creation, the abodes of the antediluvians, and the phenomena of the deluge, to a portion of central Asia, "lying between the Caucasian ridge, the Caspian Sea, and Tartary, on the north; the Persian and Indian Seas, on the south; and the high mountain ridges which run, at considerable distances, on the eastern and the western flank." In marking out this locality, as comprising the whole region to which the early part of scripture history belongs, he adds, "I venture to think that man, as first created, and for many ages afterwards, did not extend his race beyond these limits; and therefore had no connexion with the extreme east, the Indian and Pacific clusters of islands, Africa, Europe, and America; in which regions we have ocular demonstration, that animal and vegetable creatures had existed, to a vast amount, uninterruptedly, through periods past, of indescribable duration." P. 286.

So then, we must not suppose that the living world, whether animal or vegetable, of our own country and the rest of Europe, or of Africa, America, or eastern India, had any thing to do with the Adamic creation. The animals and

vegetables living beyond the bounds of this central Asian world, may belong to a great variety of different ages and formations; so that a new and wide field of inquiry will be opened, to ascertain the relative antiquity of each region. "There must have been separate original creations, perhaps at different and respectively distant epochs." P. 74. Those geologists, therefore, who consider the present living world as of one period, or one formation, are much mistaken. Some portions of it may belong to the pleiocene era, some to the meiocene, some to the eocene, and some to earlier formations. Perhaps the opossum tribes of Australia are coeval with their fossil brethren of the Stonesfield slate, as that land may have escaped the frequent submersions to which this part of the earth's surface has been doomed: and it may be, that the ornithorhincus of the former, may rank, in point of antiquity, with the huge saurians, pterodactyles, and other fossil monsters of the latter. The term *recent*, as applied to living animals and vegetables, must be restricted to the productions of the little Adamic world; for the groups beyond its pale may belong to periods incalculably distant!

But, leaving such curious inquiries to persons possessed of a livelier fancy, I proceed to notice the method by which Dr. Smith contrives to find this local creation, and local deluge, in the scriptures; where almost all other commentators have hitherto found a creation replenishing the whole earth, and a deluge overwhelming the whole. He

occupies many pages in proving what is generally taught and acknowledged, that the Divine Being, in communicating with man, adapts his communications to the weakness of our understandings, and the imperfections of our knowledge. It is certain that men, and even angels, are incapable of fully comprehending the nature and operations of the infinite Jehovah; and that the figurative descriptions of him in the sacred volume convey but a faint idea of his glory. Nor can it be denied that, not only in these descriptions, but in notices relating to the kingdom of nature, and to what may be called matters of science, the language of the scriptures is "such as comported with the knowledge of the age in which they were delivered." P. 276. This principle has been adopted, not by "two distinguished authors" only, but by almost all biblical critics worthy of the name.

Connecting this principle with another well known truth, that universal terms are often used in a limited sense, Dr. Smith is of opinion, that we may very well believe the creation and the deluge to have been local, although the scriptures appear to describe them as universal. But, however true the principle which he lays down, its application in this case is by no means legitimate. The question, whether the scripture narratives of the creation and the deluge refer to the whole world, or only to a portion of it, cannot be numbered among the deep things of God, nor even among the mysteries of science. The distinction between a part and the whole, between what is

local and what is universal, may be understood by a peasant as well as by a philosopher, by a savage as well as by a sage. In setting forth the ignorance of the ancient Israelites, Dr. Smith scarcely does them justice. When they spake of the "windows of heaven," and "the binding up of waters in the clouds," we have no right to suppose, that they considered the heavens as a solid concave expanse, with openings in it like windows; or that they regarded the clouds as strong bags, containing masses of water. They used the expressions, "wings of the wind," and "wings of the sun;" yet who would say, that they thought them birds? Their knowledge of the system of nature, and of the form and extent of the globe, was doubtless very defective; yet it was not therefore necessary that the sacred historian should represent a part of the earth's surface as the whole. When the books of Moses were written, they were acquainted with large portions of the globe, lying far to the west and south of Dr. Smith's Adamic world; and could very well understand the difference between a creation and a flood belonging only to that little world, and such as might include Egypt, Nubia, and other regions, that were better known to them. There was no need, then, on their account, to employ universal terms in describing subjects that were merely local; and it is not doing honour to the sacred volume, to allege that the whole of the antediluvian history, with the account of the deluge, may be understood to apply only to

central Asia; while the record itself, in its plain and obvious meaning, professes to be the early history of the whole world.

The theory of a local deluge is not new, but Dr. Smith has given it a more definite shape than it has hitherto assumed. He supposes that the human population, prior to the deluge, was comparatively scanty, and had not spread itself far from its original seat, the country of Eden; and that, owing to the prevailing depravity, instead of being then on the increase, it was in a course of rapid progress towards an extreme reduction, or even extinction. On this supposition, a local deluge, confined to his Adamic world, was sufficient to answer the ends of Divine justice. P. 308—310. To prove the small amount of the antediluvian population, he notices the paucity of births recorded for that period: but he might as well argue, that the men of that age were extremely indolent and inactive, because so few of their deeds are named; or that they had scarcely any cities, because one city only is mentioned. The genealogical table (Gen. V.) referred to as indicating the paucity of births, is merely a list of the progenitors of Noah in the direct line; and while it states, that each of the patriarchs in that line had other children, both sons and daughters, not named, it gives no countenance to the idea that these were but few. From the incidental notice of the marriage of Cain, it is clear that the first pair had other children besides Cain and Abel, long before the birth of Seth; and how many more they had

after that event, is not known. As Seth was not an eldest son, we are not sure that each of the other patriarchs in the line, or indeed any one of them, was an eldest son; so that each of them might have many children before, as well as after, the son from whom Noah sprang. The families of the antediluvians, instead of being small, were in all probability extremely large. The blessing pronounced on the first pair, "Be fruitful, and multiply, and replenish the earth," was not retracted at their fall; although the woman was then assured that sorrow would attend the increase: and there is good ground for believing, that mankind did increase, and replenish the earth; not the microcosm of Dr. Smith only, but the world at large.

It would be unreasonable to allege, that the rate of increase was greater after the deluge than before it; for although, in consequence of the shortening of human life, the number of successive generations within a given period would be more, a greater number of generations, in the former world, would be living at one time; and allowing, as is most natural, the period during which each pair might continue to have children, to be in proportion to their longevity, the families of the old world would be much more numerous than those of the postdiluvian age: so that its population must have rapidly increased.

Now, let us recollect that the antediluvian period was 1656 years, and mark the vast increase of Noah's posterity during the same number of years

after the flood. Before the expiration of the latter period, the large and populous empire of Assyria was in all its glory, while many and great nations were occupying various regions of the globe, far and wide. At an early date, Egypt was a populous country; and while Jacob's posterity were there, in a state of servitude, they increased so rapidly, in little more than two centuries, that at the time of their deliverance they numbered above 600,000 fighting men, implying a population of nearly two millions, men, women, and children. In the days of David, and in some following reigns, when their men of war were about a million and a half, their whole population could scarcely be less than eight or ten millions. The neighbouring kingdoms were also populous. The Syrians, in Ahab's reign, lost above 100,000 men in one battle; and yet, in a short time, could muster another army, sufficient to face the Israelites, and overcome them. In king Asa's time, Zerah, the Ethiopian, invaded Judah with an army of above a million; so that his subjects must have consisted of many millions. In short, the population of the world, 1656 years after the flood, cannot be reckoned less than a hundred millions, and perhaps might be double that amount.

The population of the old world could not well be less, and was probably much greater; especially as the earth was, in all likelihood, more fertile, and the climate more mild and genial. That such a population should remain cooped up in central

Asia, while there was nothing to prevent them from dispersing over the world, is altogether incredible.

The notion, that their numbers were rapidly diminishing through the effect of their crimes, receives no countenance from scripture. It is true, that their vices increased "when they began to multiply," and that "the earth was filled with violence;" but from other expressions in the sacred volume, it rather appears, that they were still increasing and multiplying up to the year of the deluge. "They were eating and drinking, marrying and giving in marriage, until the day that Noah entered into the ark."

Whether their numbers were so great as I have estimated them, or not, it is utterly improbable, on other accounts, that Adam's posterity should keep within the bounds of central Asia, during the space of sixteen centuries. They were not savages, but were acquainted with the arts and conveniences of civilized life. They had musical instruments; and weapons or ornaments, of iron and brass; together with implements of husbandry, and (as the building of the ark implies) tools for carpentry. Some of them were enterprising men, "men of renown;" who would naturally seek to extend the sphere of their influence, and their enjoyments. Such as engaged in mining operations, would not rest content with the supplies of metal afforded by the hills of central Asia; but would explore the mountains of other regions, in quest of the precious ores. The principle of

curiosity also, if not the love of science, would induce numbers of them to set out on journeys of discovery; undertakings which their extraordinary longevity, and their vigorous constitutions, would enable them to prosecute with great success. Long before the deluge, they must have spread themselves abroad throughout the whole world; so that a local flood could not sweep them all away.

In noticing the agents employed in producing the deluge, Dr. Smith correctly remarks, that in addition to the tremendous rain, there must have been an elevation of the bed of the seas, and a subsidence of the inhabited land: and it is more than probable, that volcanic agency occasioned the raising of the one, and the sinking of the other. He is right also in protesting "against the practice of bringing in miraculous interpositions, to help out the exigencies of arbitrary and fanciful theories." P. 91. Now, on this very principle, I protest against his local deluge; for such a deluge, bearing any resemblance to that described by Moses, could not take place without a series of miracles of the most extraordinary nature. In the first place, if the general level of the ocean remained undisturbed, how could the sea, without a miracle, swell up so as to cover the whole of the Adamic world in central Asia? Or if we suppose that, by means of an earthquake, the waters of the ocean were suddenly heaved up, and overwhelmed the land; nothing but a miracle could prevent their immediate reflux, while another miracle was required to raise them so high as to reach the hills, the high hills, the mountains; for all these were covered by the deluge. It was necessary that the waters should be elevated, not indeed to the height of "five miles," but to that of about one mile; and that they should retain this elevation about 150 days, or five months. Now, if the seas over the rest of the globe did not change their level, how could this be, without a signal interposition of Divine power, making the waters to stand up like a wall, as at the passage of the Red Sea? If we could imagine, that the earthquake which injected the flood from the ocean, threw up a sea-ward barrier, to prevent its regress in that direction, another miracle would be required, to keep the waters from escaping through the numerous passes in the Caucasian ridge and other chains of mountains, considered as the land-ward boundaries of this Adamic world: for these passes behoved to be stopped up for 150 days. Again, supposing this elevated mass of waters secured in its position for that period, would not this huge protuberance, like a mighty wart, on the face of the globe, affect its equilibrium; and another miracle be demanded, to prevent any disastrous influence on its diurnal and annual motions?

Besides, had the creation and the deluge been limited to this district, we must have found here some obvious traces of this localization; some peculiarities of soil, of rocks, of animals, and of vegetables; enabling us to discern, with tolerable

accuracy, the extent of this newest part of the earth's surface, at once the cradle and the grave of its primeval inhabitants. But where are the landmarks of this Adamic world? Where are the traces of its existence, or its distinguishing features? The face of the country shews not a vestige of evidence for this localizing theory; which we are therefore warranted to dismiss, as "the baseless fabric of a vision."

It is proper to add, that, according to the words of Peter (2 Peter III), the heaven and the earth that are reserved unto fire against the day of judgment, are the same that were overwhelmed by water; and we might as well plead for a local conflagration, as for a local flood. The argument drawn from this text, is not to be set aside by alleging, that the world may mean only the inhabitants of the world; for at the day of judgment, "the earth and all the works that are therein shall be burnt up;" not the inhabitants, who shall then be otherwise disposed of.

Against the doctrine of a universal deluge, the doctrine taught in scripture according to its most plain and obvious sense, no such objections can be urged. Those which Dr. Smith has produced as insurmountable, are chiefly conjured up by himself, or by those whom his lively imagination has induced him to follow.

He alleges, that to effect a universal deluge, a zone of water five miles in thickness must have encircled the whole globe; that this mass of waters must have been created on purpose, and

subsequently annihilated; and that this vast increase of the earth's bulk, though only temporary, would greatly augment its power of attraction, and tend to derange the whole solar system.

But this difficulty is altogether imaginary. To produce a general deluge, there was no need to create a single particle of water: for there is enough of water in the ocean even now to repeat such a deluge, if required. All that is wanted for this purpose is, to elevate the bed of the sea, and consequently to sink the dry land; for when the former rises, the latter must subside, to fill up the space which would otherwise be a *vacuum*. Nor was it at all necessary that the waters should attain an elevation of five miles above their present level, or even a third part of that height: for we have no right to suppose, that the antediluvian mountains were as lofty as the present. The highest existing mountains are either the cones of volcanoes, such as Chimborazo, Hecla, and the Peak of Teneriffe;—which very probably had no place in the ancient world;—or, like the lofty peaks of the Himalayan range, they consist of masses of primary rocks, thrown up on their edges, like projecting fragments of broken ice; and these might be elevated in the breaking up of the earth's crust at the deluge. (See above, p. 59.)

The supposed inadequacy of the ark to accommodate the terrestrial animals, is an objection scarcely more substantial. If some authors have made their estimate of the number of species much below the truth, there is a disposition among naturalists

of the present day to raise the estimate as much above the truth, by creating new species out of mere varieties. A large proportion of the insects and reptiles would not require to be preserved in the ark; for numbers of them, or quantities of their eggs, might be floated about on trees or shrubs, and left safe on the surface at the subsidence of the waters. The difficulty about climates, proceeds on the gratuitous assumption, that the atmosphere before and at the deluge, was the same as at present. The animals preserved in the ark might have sufficient time to disperse themselves throughout the various regions of the globe, before the climates of the postdiluvian world assumed their present character.—The preservation of the fishes, whether marine or lacustrine, presents no real difficulty: for in an ocean consisting of salt water and fresh blended together, fishes peculiar to each might easily subsist for a time; or, in some cases, their spawn might be preserved, for the continuance of the species.

It is highly probable, that a genial heat, resulting from the volcanic agency employed in raising the strata, or from chemical processes consequent on the new combinations of their materials, prevailed extensively at the close of the deluge, and contributed in no small degree to the speedy developement of animal and vegetable life, on the retiring of the waters. There is, therefore, no occasion to resort to miracles, for the replenishing of the new world, the consolidation of its crust, and the restoration of its vegetable covering.

Hence, Dr. Smith's remarks (p. 162, 163) about the perils of descending mount Ararat, on the wet and slippery faces of naked rocks, and the necessity of a miracle, to save Noah and his family and cattle from breaking their necks in attempting to get down, are rather puerile. There is no need to suppose, that the ark rested on the highest pinnacle, and during the seven months that elapsed, from the day when it took the ground to that on which Noah and his family quitted it, the sloping sides of the mountain would be clothed with rich verdure. If the news lately received be correct, that the lofty peak of Ararat has sunk down, it would seem to be the cone of a volcano, which may have been thrown up long after the time when a part of that mountain afforded a resting place for the ark.

On another account, Dr. Smith is unwilling to concede this honour to mount Ararat: for he asserts (p. 159), that, "by the action of the sun upon the atmosphere, currents would be produced, by which the ark would be borne away, in a southerly and then a western direction;" and hence he argues, that it could not ground in Armenia, without circumnavigating the globe, which it had not time to do. But, does it not savour of presumption, to decide what was the course of winds or currents, at a period when the frame of nature was so extensively shaken? Besides, how does he know that the ark was built to the west and south of mount Ararat? For any thing we can tell, it might be built to the north-east of that

mountain; in which case, according to his own assumption, the currents would float it to the very spot.

The hypothesis of a local deluge presents a much greater difficulty with regard to the ark; and that is, the question why there was an ark at all. If the flood was local, the ark was unnecessary: Noah and his family, and their cattle, had only to travel over one of the mountainous ridges forming the border of the Adamic world, and thus gain a place of safety. God displays the riches of his wisdom, in accomplishing his ends by the simplest means: he never has recourse to any thing like a clumsy expedient. The building of the ark was, indeed, a practical warning to a guilty world; but as warning might have been given in various other ways equally impressive and appropriate, it is very unlikely that a wise and gracious God, would have subjected Noah and his family to the immense toil and trouble of constructing such a vessel, and to the tedium and hardship of more than a year's confinement in it, if they could have been saved by mere emigration.

It is scarcely necessary to notice the alleged existence of antediluvian trees, said to be five or six thousand years old: especially as Dr. Smith, in his Second Edition, seems disposed to give up this point, finding the high authority of Dr. Lindley against him. The modes of estimating the age of trees are so vague and uncertain, that we may very well question the accuracy of those calculations, which would make some existing trees to

have been growing in the times of Methuselah and Enoch. One common source of error in such calculations, arises from the fact, that some of the largest and oldest trees in the world have compound trunks, two or more having coalesced into one. See Murray's Physiology of Plants, p. 284.

Another of Dr. Smith's arguments against the universality of the deluge, drawn from the number and appearance of extinct volcanoes in the south of France, is equally feeble. He alleges that the period of these volcanoes, above 200 in number, "runs back, not to the age of Noah merely, but immeasurably beyond the date of the creation of man and his contemporary plants and animals!" p. 150. Upon this assumption, he argues, that the deluge cannot have reached the south of France; as, in that case, it would have demolished the greater part of the cones of these volcanoes, consisting of "pumice-stone and other loose and light substances." But how can it be proved, that these volcanoes are antediluvian? There is quite as much uncertainty in computing the age of lava, as the age of trees. The fact that Cæsar, in narrating his Gallic wars, makes no mention of these volcanoes, does not prove that in his time they were all extinct; for, an author so observant and inquisitive might as well have been expected to notice such a numerous group of exhausted volcanoes, as one or two active ones. But, granting that they were then extinct, was not the space of twenty-three centuries, that had elapsed between the deluge and the Julian æra, more than

sufficient for them to have not only shot up their cones, but expended their fires? It appears that in the island of Lancerota, one of the Canaries, no less than thirty such cones, some of them of great magnitude and height, were thrown up in the short space of six years, from 1730 to 1736, and soon spent their force; on what principle, then, can we assign immeasurable ages to the volcanic eruptions of Auvergne and Languedoc? See Murray's Portrait of Geology.

As another proof of the extreme antiquity of these volcanoes, it is asserted that, since their lavas ceased to flow, rivers have worn themselves new channels, to the depth of 150 or 160 feet, through solid beds of basalt, and have even eaten into the granite rocks beneath, to a considerable depth. P. 150, &c. That there are rivers flowing through openings in basalt and granite, in these districts, need not be doubted; but that such rivers have cut their way, either through the one or the other, is quite a different thing. Many extravagant calculations have been made, on the groundless notion, that rivers have excavated their own channels. Rivers and streams modify their channels, but cannot have made them; for how could a stream commence, if there was no pre-existing hollow or opening for the waters to flow in? Waters descending from heights, will naturally proceed by the nearest and lowest opening; and when any rock or other barrier obstructs their downward course, they will accumulate till their weight force it away, or till they overflow it.

Now it is possible, that the water, where it flows over this barrier, may by continual abrasion wear it lower and lower, at the rate of an inch or two in a century; but that there is any stream in the world, great or small, that has cut a channel for itself through solid rock, to the depth of a number of yards, I have a right to question. For many years I have paid particular attention to the courses of rivers, and have invariably found, that these courses are connected with breaks, faults, denudations, or other irregularities in the strata through which they pass. Where streams have apparently made their way through hard rocks, it will be found, upon attentive observation, that the way has been opened for them by some dislocation or fissure of the strata. See Geological Survey of the Yorkshire Coast, Sec. Edit., p. 314, &c.

No less unavailing is Dr. Smith's supposed chronometer (p. 152), furnished by a finely laminated rock in the same region, "consisting of sixty feet of siliceous and calcareous deposits, each as thin as pasteboard, and bearing upon their separating surfaces the stems and seed-vessels of small water plants in infinite numbers, and countless multitudes of minute shells." "These layers," he adds, "have been formed with evident regularity, and to each of them we may reasonably assign the term of one season, that is a year:" and reckoning 25 to an inch, he thus gains, for the sixty feet, a period of 18,000 years! But what proof is there, that each layer would require a year, or even a month, or a week, or a day?

For any thing that appears in this statement, the plants might be all of one year's growth, and the whole sixty feet might be deposited in sixty weeks, or even sixty days.

That such finely laminated rocks have, in many instances, been deposited with great rapidity, is matter of fact, rather than of conjecture; for it is in such rocks that we find many of our best preserved fossil fishes. The beautiful fishes of Monte Bolca and of Solenhofen are discovered in finely laminated rocks; and the fish-beds of the lias, the Stromness slate, the carboniferous strata, and the magnesian limestone, are, for the most part, finely laminated. In the present year, I obtained a well preserved fish, in that very finely laminated portion of the strata, the flexible limestone (or dolomite) of the Marsden rocks, near S. Shields. Like most fossil fishes, it has obviously been crushed flat, by the pressure of successive layers rapidly accumulating over it; confirming the opinion of M. Agassiz, which I have quoted above (p. 28), that the rate of deposition in such strata, instead of the tardy progress of a year for each lamina, must have been almost inconceivably rapid.

Now, if so many portions of the finely laminated strata, which might be thought to have been formed the most slowly, give evidence, by the state of their contents, that they have been deposited with inconceivable rapidity, on what ground can we affirm, that any of the coarser strata have been deposited leisurely? And what are we to think of the notion, which seems to pervade Dr. Smith's Lectures, and other geological works, that the stratified rocks have been formed in the same gradual way as beds of mud are now depositing in the sea? It is acknowledged, in a quotation from Dr. Macculloch (p. 397), "that the accumulation of materials at the bottom of the ocean, is a work *infinitely slow*." Can this infinitely slow deposition account for the phenomena presented by our present rocks? The materials washed down by the rivers, or abraded from the coasts by the sea itself, are deposited, partly along the shores of the ocean, and partly in hollows in its bed. In this manner, banks of mud, sand, and gravel, are formed in various spots; and a few organic substances, chiefly shells, may be found mixed up with such materials. But what ground have we to believe, that these banks are future rocks in embryo? Is there any portion of them that can be called an incipient bed of red sandstone, or of magnesian limestone, or of oolite, or of lias, or of chalk? At the mouth of one or two great rivers are found masses of drifted trees, covered with mud, illustrating in some degree, the origin of coal beds; but where do we find any carboniferous strata now forming; any incipient beds of sandstone, shale, ironstone, and coal? It is plain, that the existing rocks, composed in so many instances of homogeneous materials, have been deposited under very different circumstances, and with far more rapidity, than any of those accumulations of sand, gravel, or mud, now going on.

The doctrine of the gradual formation of future

rocks in the bottom of the ocean, or along its shores, is connected with the more extravagant fancy, that these incipient rocks are gradually rising up to become dry land; and with the strangely whimsical notion, that masses of strata, or portions of the earth's crust, are alternately rising and subsiding, like the two ends of "a long board balanced on a fulcrum!" P. 60. To this alternating process, all the stratified parts of the globe are supposed to have been repeatedly subjected; so that "there is scarcely a spot on the earth's surface which has not been many times in succession the bottom of a sea and a portion of dry land." P. 77. "In the majority of cases," adds Dr. Smith, "it is shown by physical evidences of the most decisive kind, that each of those successive conditions was of extremely long duration; a duration which it would be presumptuous to put into any estimate of years or centuries, &c." But where are these decisive evidences;—where is there any evidence at all, that such successive conditions, such seesaw motions, such dippings and redippings of the earth's crust, have ever taken place? The *evidences* exist only in the wild imaginations of some modern geologists. It is true, that in countries where earthquakes and volcanoes prevail, coasts have been elevated, or have subsided; and in a few instances, the same spots that have sunk at one time, may have risen at another: but can the occurrence of one or two isolated facts of this kind, authorize us to set up a system of alternate elevation and subsidence as

a general law of nature, prevailing throughout the globe during countless ages? Dr. S. objects to my ascribing the phenomena of unconformable strata "to the elevating force of volcanic agency" (p. 390); but surely it is more rational to suppose, that in such cases, volcanic agency has thrown one set of strata out of their natural position before the next set began to be deposited over them, than to attempt an explanation of such phenomena on the principle of alternate elevation and subsidence.

There are other instances in which mere fancies are set forth by Dr. S. as positive facts, or demonstrated truths: for, as he can tell with certainty the direction of the winds and currents at the deluge, so he can assure us, on physiological and chemical evidence, that at the time of the carboniferous deposits, the atmosphere was so loaded with carbonic acid, that neither men nor quadrupeds could then exist. P. 79. He has forgotten, it seems, that the footsteps of the *cheirotherium* (see above p. 63) have left indelible proofs, that quadrupeds did exist prior to the formation of a part, at least, of the carboniferous rocks.

Another of his *facts* is, that death entered our world before sin; and in connexion with this, that the carnivorous creatures lived on animal food before the fall of man, as well as after. He must therefore believe, that the ravages of fierce lions and prowling wolves could not diminish the happiness of the first pair; that the sight of a cruel tiger destroying a lamb, and the cries of the innocent

victim piercing their ears, might be quite compatible with their state of perfect bliss! He argues (p. 296), that the threatening of death implies that they had witnessed death; but he might as well reason, that the mention of good and evil to them implies that they had witnessed evil as well as good. He allows that, during the state of innocence, the constitution of man was exempted from the law of mortality; and he might as well have granted, that the ravenous propensities of carnivorous animals were then dormant. The case of animalcules is not easily explained; but if any were eaten by the first pair, with their earliest food, they were not themselves conscious of the fact.

There is one favourite object never lost sight of in these Lectures, the ascription of inconceivable antiquity to the globe. The fabulous ages claimed by the annalists of Egypt and Hindostan, for their respective nations, sink into utter insignificance beside the exorbitant demands of Dr. S. He claims many thousands of centuries for the production of gneiss alone (p. 396); as if that, and other primary rocks, could not have been formed in a day, or in an hour, by the almighty *fiat*, at the first creation. He claims countless ages for the formation of the secondary and tertiary strata, according to his slow rate of deposition already noticed. He demands, as we have seen, an immeasurable period, for the eruption and action of the volcanoes of Auvergne; and he requires 500,000 years, on the authority

of Mr. Mc.Laren, for a single period of volcanic quiescence at Arthur's Seat! P. 81. This last he pronounces "no random guess, but founded upon knowledge and consideration." Yet he owns, p. 229, that Mr. Rhind takes a very different view of the matter: and well he might. I have had frequent opportunities of examining the same rocks, and can assure the reader, that there is nothing to indicate, whether the said period was 500,000 years, or 500 years, or less than 500 days. The assertion is a matter of pure fancy.

But his extravagant claims for time, rest principally on his views of the organic remains imbedded in the strata. His "successive conditions" are coupled with successive creations, or "changes in organic life;" concerning which he makes this remarkable assertion; "it is an inevitable inference, unless we are disposed to abandon the principles of fair reasoning, that each one of such changes in organic life, did not take place, till after the next preceding condition of the earth had continued through a duration, compared with which six thousand years appear an inconsiderable fraction of time." P. 78. The principles of fair reasoning require, that we should argue from real facts, not from wild fancies; and what can be more fanciful than the notions, that the different sets of animals, or vegetables, in successive beds, are so many distinct creations; and that they occupied, when living, the spots where we find them? Having already discussed these topics at some length (pp. 10—21), and endeavoured, on very

different principles, to explain the phenomena of the varied groups of organic remains (pp. 35, 49, 50), it is not necessary to say much in addition. The discovery of a few fossil shells clustered together, as in the instance of the *gryphæa incurva*, noticed by Dr. S. (p. 383), does not prove that such shells have not been drifted: for, among the myriads of shells which the sea has washed together, in forming the fossil oyster beds, it would be strange if we did not find several adhering. Under favourable circumstances, clusters might be drifted without parting; nay, clusters might be formed even in the act of drifting. In acknowledging that Professor Phillips supposes that the materials of the carboniferous strata have been drifted, Dr. S. observes, that it must have been from *neighbouring* land, whereas my reasoning (he thinks) implies the transport from considerable distances. But Professor P. speaks of their being drifted from Scandinavia, or from lands once existing in the northern or western oceans (Treatise, I. p. 180, 217): and such are the distances which I had in view. Large portions of the materials of our strata, with their imbedded organic remains, may have been derived from countries occupying the site of the great Atlantic. The long array of distinct sets or groups of fossil bodies, produced against me (p. 389), does not militate against my views: there were lands enough in the ancient world to furnish the whole.

Not content with demanding enormous periods for this supposed succession of creations, Dr. S.

adopts, like Mr. Lyell, another method of extending the duration of the world;—the theory of the gradual extinction of species and of genera, one at a time; and the gradual creation of new species or genera in their stead, at the same slow rate. Counting 6000 years a very moderate allowance for one species, he discovers another "chronometer" for measuring the age of the world, in multiplying the number of known species by 6000! Pp. 66, 67, 408. This is another of those strange vagaries, for which there is not a shadow of proof, either in the fossil or living world. It is not easy to see, how this theory of a successive creation of species, can be made to agree with the theory of the successive creation of the groups or sets, belonging to the series of strata. Certain it is, that instead of a continuous line, gradually changing, we find one set of animals or vegetables disappearing at once, and giving place to another set entirely different. There is no such gradual transition as that supposed. Species or genera disappear, not because they have grown old and decayed, or because they have completed the term of their probation; but simply because other materials, with a different kind of remains, have been drifted over them from another quarter. Do we find, either in the living or dead world, species that can be called young, species in their full vigour, and species in the decrepitude of old age? The disappearance of the Dodo, a foreign bird, and of some quadrupeds that inhabited Britain, a few centuries ago, can furnish no illustration of this

wild theory; unless it could be shewn, that they dwindled away through the old age and frailty of the expiring species, and that new animals have been created to supply their place.

After all the claims of countless ages, for the strata and their contents, ages more are demanded for making and depositing the diluvial beds of sand and gravel. Pp. 125—136,400. But this demand must also be disallowed. I have seen, and seen with surprise, square blocks of silicious sandstone, each weighing three or four tons, detached by the sea from masses of masonry, and in little more than twenty-four hours, reduced by the dashing of the waves to a form almost round: and surely the flux and reflux of the waters along the face of the strata, when just rising from the ocean, would produce immense quantities of gravel in the course of a few weeks, or even a few days.

Of all Dr. Smith's demands, perhaps the most unreasonable is his claiming "a vastness of time," for producing the jointed structure, and lines of cleavage, in slate and other rocks. P. 404, &c. If these operations were the work of chemical agents, they might be effected in a few days; and if they originated in electric or voltaic agency, they might be produced in a moment.

Several other portions of Dr. Smith's Lectures call for animadversion, but the limits of this Appendix will not suffer me to notice them. In some instances, it is difficult to grapple with his theories, because they are not presented in a tangible shape.—To some of his criticisms on my

Essay, I have not thought it necessary to reply. In a few things, he has misunderstood and misrepresented me; which, I am persuaded, was not his design. It is possible, that I also may have misunderstood him, on some points; but I am not conscious of having done him injustice, or of having said any thing in the spirit of hostility. While our geological views are, on various topics, diametrically opposed; we are both, I trust, devoutly inquiring after truth, and love the truth as far as we discern it. I have read with much delight and admiration, his closing address to men of science, on the value of true religion; and deeply regret to think, that its excellent tendency is too likely to be neutralized, by the wild and dangerous notions advanced in other parts of the volume.

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