

tains, and in that of the almost infinite varieties of the *c. familiaris* or domestic dog, in the bosom of our own country,—in the form of the *c. aureus*, chacal or jackal, we meet with it in the warmest parts of Asia and Barbary, prowling at night in flocks of one or two hundred individuals.

The extensive TURBARIES or PEAT-FIELDS, which are so common to many parts of Europe, are produced by an accumulation of the remains of sphagnum and other aquatic mosses. These surround and cover up the small knolls upon which they are formed; or, in many places, descend along the valleys after the manner of the glaciers of Switzerland; but, while the latter melt away every year at their lower edges, the mosses are not checked by any obstacle in their regular increase; and as such increase takes place in determinate proportions, by sounding their depth to the solid ground we may form some estimate of their antiquity.

The ordinary rise of those extensive ranges of downs which are seen skirting the coasts of many countries, and especially where the shore is not very bold, is a mixed effort of sea and wind. To produce this, however, the soil that the sea washes over must consist of sand. This is first pushed in successive tides towards the shore; it next becomes dry, by being left there at every reflux of the sea; and is then drifted up the beach, and to a considerable distance from the beach, by the winds which are almost always blowing from the sea, and often in whirls or eddies; and are at length fixed by the growth of wild plants, whose seeds are in like manner wafted about on the wings of the breeze, or casually dropped with the excretions of birds or other animals that pass over them. In several parts, observes M. Cuvier, these proceed with a frightful rapidity, overwhelming forests, houses, and cultivated fields in their irresistible progress. Those on the coast of the Bay of Biscay have actually buried a considerable number of villages whose existence is noticed in the records of the middle ages. And even in the present day they are threatening not fewer than ten distinct hamlets with almost inevitable destruction: one of which, named Mimigan, has been in perpetual danger for upwards of twenty years, from a sand-hill of more than sixty feet in perpendicular height, produced by the cause we are now contemplating, and which is very obviously augmenting.*

There are various forelands on the coasts of the North Sea, and particularly on those of the counties of Sleswigh and Holstein, which are formed in the same manner.† But the most extraordinary inroads of sand storms and sand floods are, perhaps, those which have taken place in the Libyan Desert and in Lower Egypt. M. Denon informs us, in his travels over this part of the world, that the summits of the ruins of ancient cities buried under mountains of drifted sands still appear externally; and that but for a ridge of mountains, called the Libyan Chain, which borders the left bank of the Nile, and forms a barrier against the invasion of these sands, the shores of the river, on that side, would long since have ceased to be habitable. "Nothing," says M. Denon, "can be more melancholy, than to walk over villages swallowed by the sand of the desert, to trample under foot the roofs of their houses, to strike against the tops of their minarets, and to reflect, that yonder, in days of yore, were cultivated fields, that hard by were groves of flourishing trees, and the dwellings of men close at hand;—and that all has now vanished."‡

The various ISLANDS that spot the surface of the sea have arisen from different causes. Many of them have been merely separated from the adjoining continent by the inroad of the sea itself upon the mainland; others have been thrown up by volcanoes, which have at times disgorged prodigious blocks of granite among the mixed materials, such as are frequently found in the Danish archipelago, in the midst of the *geest*, or alluvial matter, which has collected around them. Other islands are altogether the masonry of madre-

* Report concerning the downs of the Gulf of Gascony, or Bay of Biscay, by M. Tassin, Mont de Marsan. an. x. Cuvier, Theory of the Earth, § 31. † De Luc, Voyages Géologiques, tom. i.

‡ Jameson's Notes on Cuvier's Theory, &c. p. 217. Compare Dolomieu's Memoir on Egypt, in Journ. de Physique, tom. xlii.

pores, and other coral zoophytes of wonderful industry and perseverance, of which the South Sea furnishes us with the largest and most astonishing specimens. These islands are for the most part flat and low, and surrounded by enormous belts of coral reefs. Most of the calcareous zoophytes are employed in their construction, but the principal worm is the madrepora *lubricata* of Linnæus.

In so large an abundance, and with so much facility, is calcareous matter elaborated by these, as well as by various other animals, and especially the testaceous worms, that M. Cuvier is inclined to ascribe all the calcareous rocks that enter into the solid crust of the earth to an animal origin.* But this is to suppose the earth of a far higher antiquity, and to have been the subject of more numerous general deluges, and inversions of sea and land, than are called for by the Wernerian system, or appear reconcileable with the Mosaic narrative. M. Cuvier apprehends, indeed, that such catastrophes may have occurred five or six times in succession, at a distance of four, five, or six thousand years from each other; and that even the chalk formation found in the basin of Paris originated in a revolution of this kind that occurred antecedently to that which is usually regarded as the flood of Noah. And, following up this idea, he conceives, towards the close of his Introductory Theory of the Earth, that if the science of fossil organic productions could be carried to a much higher degree of perfection, we should be able to obtain far fuller information upon this subject; "and man, to whom only a short space of time is allotted upon the earth, would have the glory of restoring the history of thousands of ages which preceded the existence of the human race, and of thousands of animals that never were contemporaneous with his species."

LECTURE VII.

ON GEOLOGY.

(The subject continued.)

In our last study I attempted a brief sketch of the chief phenomena that occur to the eye of the geologist upon a survey of the solid crust of the earth, as far as he is able to penetrate into it. The conclusion to which such phenomena lead us is the following: that the rudimental materials of the globe, to the utmost depths we are able to trace them, existed at its earliest period, in one confused and liquid mass; that they were afterward separated, and arranged by a progressive series of operations, and a uniform system of laws, the more obvious of which appear to be those of gravity and crystallization; and that they have since been convulsed and dislocated by some dreadful commotion and inundation that have extended to every region, and again thrown a great part of the organic and inorganic creation into a promiscuous jumble.

Now, the only two causes that can enter into the mind of man as being competent to the fluidity that appears at first to have existed throughout the whole crust of the earth are FIRE, or a peculiar SOLVENT. But, if a solvent, that solvent must have been WATER: for there is no other liquid in nature in sufficient abundance to act the part of a solvent upon a scale so extensive.

And hence our inquiries into this subject become in some degree limited, and are chiefly confined to what have been called the PLUTONIC and the NEPTUNIAN hypotheses; the origin of the world in its present state from igneous fusion, and from aqueous solution. Both these theories are of very early

* Some writers have proceeded much farther than this, for they have resolved all the solid materials of the earth's crust into an organic origin. Such was the opinion of Demaillet and Lamarck, who suppose that every thing was originally fluid; that this universal fluid gave rise to plants and animals; that all clay or argillaceous earth is the produce of the former; all calcareous earth of the latter; and that siliceous earth has been the result of the two. Telliamid, p. 169. Philosophie Zoologique, *passim*.

date, and both of them have been agitated in ancient as well as in modern times with a considerable degree of warmth as well as of plausible argument.

Among the ancients, Heraclitus seems to have headed the advocates for the former theory, and Thales, or rather Epicurus, the supporters of the latter. In what may be regarded as modern times, Hooke may, perhaps, be held the reviver of the Plutonic system, which has since, as I have already observed, been supported by the cosmological doctrines of Buffon and Dr. Herschel. Its principal champions, however, in the present day are Dr. Hutton, Professor Playfair,* and Sir James Hall; names, unquestionably, of high literary rank, and entitled to the utmost deference, but most powerfully opposed by the distinguished authorities of Werner, whose system I have just glanced at, Saussure, Kirwan, Cuvier, and Jameson, not to mention that the general voice of geologists is very considerably in favour of the latter class of philosophers, and consequently of the Neptunian or aqueous hypothesis. Let us, then, take a brief view of each of these theories in their order.

According to the former, or the Plutonic conjecture, heat is the great source, not only of the original production, but of the perpetual reproduction of things. This theory supposes a regular alternation of decay and renovation. Of *decay* induced by the action of light, air, and other gases, rain, and other waters, upon the hardest rocks, by which they are worn down and their particles progressively carried towards the ocean, and ultimately deposited in its bed; and of *renovation*, by means of an immense subterranean heat, constantly present at different depths of the mineral regions; which operates in the fusion and recombination of the materials thus carried down and contained there, and afterward in their sublimation and re-exposure to view in new strata of a more compact and perfect character. Hence, the existing strata of every period consist, upon this theory, of the wreck of a former world, more or less completely fused and elevated by the agency of violent heat, and reconsolidated by subsequent cooling: of the general nature of which heat, however, we are still left in a considerable degree of ignorance. "It is not fire, in the usual sense of the word," observes Mr. Playfair, "but heat, which is required for this purpose; and there is nothing chimerical in supposing that nature has the means of producing heat, even in a very great degree, without the assistance of fuel or of vital air. Friction is a source of heat unlimited, for what we know, in its extent; and so, perhaps, are other operations, chemical and mechanical; nor are either combustible substances or vital air concerned in the heat thus produced. So, also, the heat of the sun's rays in the form of a burning-glass, the most intense that is known, is independent of the substance just mentioned; and though the heat would not calcine a metal, nor even burn a piece of wood, without oxygenous gas, it would doubtless produce as high a temperature in the absence as in the presence of that gas."†

This subterranean heat, moreover, is supposed to derive a very considerable accession of power from the vast superincumbent weight that is perpetually pressing upon its materials; in confirmation of which a variety of curious experiments are appealed to, and especially a very ingenious set lately carried into effect and described by Sir James Hall, by which it has been rendered probable, that when the gases of any fusible substance, as the carbonic acid of carbonate of lime, for example, are rendered incapable of flying off, a much less quantity of actual heat is sufficient for the purpose of fusion than when such gases, freed from a heavy compression, can escape with facility. Now, the subterranean heat being supposed to exist at prodigious depths below the surface, the substances on which it operates must be so enormously compressed, as not only to render them easily fused, but in many instances to prevent their volatilization after the fusion has taken place; and from this circumstance it is possible, we are told, to explain a variety of appearances and qualities in minerals, and to answer a variety of objections which would otherwise weigh heavy against the general theory.

* Illustrations of the Huttonian Theory of the Earth. Edinb. 1802.

† Ibid.

To the principle of an alternate decay and renovation, separated from the means by which they are supposed, upon this theory, to be accomplished, there seems to be no very serious objection. It is as readily allowed by the Neptunian as by the Plutonic geologist, that the strata of the earth are liable to waste, and are, indeed, perpetually wasting; and that the waste materials are carried forward to the sea. But the appearance of shells in limestone and marbles, in which the sparry structure is as perfect as in primary limestone, and through which are distributed veins of crystallized carbonate of lime, together with a variety of similar facts, fatally militate against the agency of heat as a universal cause; since, in such case, allowing it to have been sufficient to produce the general effect of crystallization, every vestige of the structure of the shells must have been destroyed, and every atom of the carbonic acid totally evaporated.

It is, secondly, useless to argue, that there are other sources of heat than combustion or deflagration; because, admitting the fact to Mr. Playfair's utmost desire, it can be satisfactorily proved that all these sources are as little capable of acting in the interior parts of the globe, to the extent supposed in the theory before us, as combustion itself, which is relinquished by its defenders as incompetent to their purpose. But even allowing the full operation of all, or of any one of these causes, we have no method pointed out to us by which this subterranean heat is duly preserved and regulated—no controlling power that directs it to the proper place at the proper season, without which it must be as likely to prove a cause of havoc and disorder as of renovation and harmony. It is useless, therefore, to pursue this theory any farther. In spite of the magnificence of its structure, the universality of its application, the plausibility of its appearance, and the talents with which it has been supported, it is built upon assumption alone; it lays down principles which it cannot support, and deals in fancy and conjecture rather than in solid facts and firm evidence.

Let us next, then, take a glance at the theory by which this is chiefly opposed, and which, as I have already observed, is denominated the NEPTUNIAN.

Under this hypothesis, the two substances that were first evolved out of the general chaos on the formation of the earth, and chemically united to each other, were hydrogen and oxygen, in such proportion as to produce water, which is a compound of these substances, and in such quantity as to be able to hold every other material in a state of thin paste or solution. Of the materials thus held in solution granite is supposed to have been produced first, and in by far the greatest abundance. It hence, consolidated first, probably forms the foundation of the superficies of the globe, and perhaps the entire nucleus of the globe itself; and, as has been already seen, while it constitutes the basis of every other kind of rock, rises higher than any of them. It consists, as we have already observed, of felspar, quartz, and mica, all which must therefore have concentered by a crystallization nearly simultaneous; and from its containing no organic remains, it is obvious that it must have been formed prior to the existence of the animal and vegetable kingdoms. All the other rocks, upon this hypothesis, began to crystallize and consolidate after the formation of granite, in the order in which we have already traced them; and some of these before the whole of the granite was rendered perfectly firm, whence we trace beds of several of them in the granite formation itself; and as the same kind of action appears to apply to the whole, we, in like manner, trace beds of the newer rocks successively in formations of those that are older; and, at last, remains of animal and vegetable materials, which are hence proved to have had an existence coetaneous with the newer classes.

The law of gravity appears to have operated through the whole of this process; and hence water, as the least heavy material, must have risen to the surface, and purified itself by a filtration through the other materials, and at length collected in such hollows as were most convenient for its reception: these hollows constitute the bed of the ocean.

Water, thus collected in the cavity of the ocean, is carried by the atmosphere over the tops of the most elevated mountains, on which it is precipi-

tated in rain, and forms torrents by which it returns with various degrees of rapidity into the common reservoir. This restless motion and progress of the water in the form of rain or torrents gradually attenuate and wear away the hardest rocks, and carry their detached parts to distances more or less considerable; whence we meet with limestone, clay, quartz, or flint, sand, and mineral ores, in places to which they do not naturally belong. The influence of the air, and the varying temperature of the atmosphere, facilitate the attenuation and destruction of these rocks. Heat acts upon their surface, and renders it more accessible, and more penetrable to the moisture, as it enters into their texture; the limestone rocks are reduced by efflorescence, and the air itself affords the acid principle by which the efflorescence is continued. Such are a few of the numerous causes that contribute to the disunion of concrete bodies, and powerfully co-operate with that wonderful fluid which alternately forms and unforms; which creates, decomposes, and regenerates all nature.

The immediate effects of water in the shape of rain is to depress the mountains. But the materials which compose them must resist in proportion to their hardness; and hence we ought not to be surprised at meeting occasionally with peaks which have stood firm amid the wreck of ages, and still remain to attest the original level of the mountain-breadths which have disappeared. These primitive rocks, alike inaccessible to the assault of time and to that of the once animated beings which cover the less elevated heights with their relics, may be considered as the origin of streams and rivers. The water which falls on their summits flows down in torrents by their lateral surfaces. In its course it wears away the soil upon which it is incessantly acting. It hollows out channels of a depth proportioned to its rapidity, its quantity, and the hardness of the rock over which it passes, and at the same time carries along with it fragments of such stones as it loosens in its progress.

These stones, rolled by the water, strike together, and mutually break off their projecting angles; and hence we obtain collections of rounded flints which line the beds of rivers, and of smaller pebbles which the sea is perpetually throwing upon the shores, often incrustated with a gravelly or calcareous edging. The powder which is produced by the rounding of the flints, or is washed down from the mountains, frequently stagnates, forms a paste, and agglutinates into fresh masses of the rocky matter of which it consists; often imbedding flints and other materials, and constituting compound substances known by the name of pudding-stones and grit-stones, which chiefly differ from each other in the coarseness or fineness of their grains, or in the cement which connects them. And if the water be loaded, as it often is, with minutely-divided particles of quartz, it will proceed to crystallize whenever it becomes quiescent; and will form stalactites, agates, cornelians, rock-crystals, plain or coloured, according as it is destitute of, or combined with, any colouring material: and if the material with which the water be impregnated be lime instead of quartz, the crystallization will be calcareous alabaster, or marble.

Many of the earths are now known to be metallic oxides, and all of them are suspected to be so: and hence a degree of heat capable of fusing them, and depriving them of the oxygen which gives them their oxide form, will necessarily convert them into their metallic state. That such currents of heat, from electricity and other causes, are occasionally, and perhaps in different places perpetually, existing beneath the surface of the earth, the Neptunian is as ready to admit as the Plutonic geologist; and hence the origin of metallic minerals, of mines, ores, ochres, and pyrites.

The decomposition of animal and vegetable matter contributes largely, moreover, in the view of the system now before us, to the changes which the globe is perpetually sustaining. The exuviae of shell and coral animals is perpetually adding to the mass of its earths, and laying a foundation for new islands and numerous beds of limestone, in which we very often perceive impressions of the shells from which the soil has originated. On the other

hand we observe numerous quantities of vegetables, both submarine and superficial, heaped and deposited together by currents or other causes, constituting distinct strata, which progressively become decomposed, lose their organization, and confound their own principles with those of the earths. Hence the origin of pit-coal, and secondary schists or slates; to which, however, the decomposition of animal substances has also largely contributed. Hence, too, the formation and extrication of a variety of acids and alkalies, which have essentially administered to the actual phenomena of the face of the earth.

The action of volcanoes has contributed much in all ages, and is still contributing in our own, to the present state of the earth's surface. We have daily proofs of the mountains which it has elevated, and have already noticed it as one source of the numerous islands that stud the face of the ocean; and we have just adverted to the subterranean agencies of electricity, heat, water, and other gases and fluids which form its fuel. But the operation of volcanoes is more limited and local than that of the preceding agents. "They accumulate substances," says M. Cuvier, "on the surface that were formerly buried deep in the bowels of the earth, after having changed or modified their nature or appearances, and raise them into mountains; but they have never raised up nor overturned the strata through which their apertures pass, and have in no degree contributed to the elevation of the great mountains, which are not volcanic."

Inundations of seas and rivers have also, from time to time, added their tremendous force; but there is no ground for concluding that any catastrophe of this kind has been universal for the last four thousand years; nor, in fact, that such an event has ever occurred more than once since the earth has been rendered habitable.

In examining, then, the merits of the antagonist systems of geology before us, the Plutonic is perhaps best entitled to the praise of boldness of conception and unlimited extent of view. It aspires, in many of its modifications, not only to account for the present appearances of the earth, but for that of the universe; and traces out a scheme by which every planet, or system of planets, may be continued indefinitely, and perhaps for ever, by a perpetual series of restoration and balance.

With this system the Neptunian forms a perfect contrast. It is limited to the earth, and to the present appearances of the earth. It resolves the genuine origin of things into the operation of water; and while it admits the existence of subterranean fires to a certain extent, and that several of the phenomena that strike us most forcibly may be the result of such an agency, it peremptorily denies that such an agency is the sole or universal cause of the existing state of things, or that it could possibly be rendered competent to such an effect.

More especially should we feel disposed to adhere to this theory, from its general coincidence with the geology of the Scriptures. The Mosaic narrative, indeed, with bold and soaring pinions, takes a comprehensive sweep through the vast range of the solar system, if not through that of the universe; and in its history of the simultaneous origin of this system touches chiefly upon geology, as the part most interesting to ourselves; but so far as it enters upon this doctrine, it is in sufficiently close accordance with the Neptunian scheme,—with the great volume of nature as now cursorily dipped into. The narrative opens, as I had occasion to observe in the lecture on Matter and a Material World, with a statement of three distinct facts, each following the other in a regular series, in the origin of the visible world. First, an absolute creation, as opposed to a mere remodification of the heaven and the earth, which constituted the earliest step in the creative process. Secondly, the condition of the earth when it was thus primarily brought into being, which was that of an amorphous or shapeless waste. And, thirdly, a commencing effort to reduce the unfashioned mass to a condition of order and harmony. "In the beginning," says the sacred historian, "God created the heaven and the earth.—And the earth was WITHOUT FORM AND VOID: and

darkness was upon the face of the deep (or abyss).—And the Spirit of God MOVED UPON THE FACE OF THE WATERS.*

We are hence, therefore, necessarily led to infer that the first change of the formless chaos, after its existence, was into a state of universal aqueous solution; for it was upon the surface of the waters that the Divine Spirit commenced his operative power. We are next informed, that this chaotic mass acquired shape, not instantaneously, but by a series of six distinct days, or GENERATIONS (that is, epochs), as Moses afterward calls them;† and apparently through the agency of the established laws of gravity and crystallization, which regulate it at the present moment.

It tells us, that during the first of these days, or generations, was evolved, what, indeed, agreeably to the laws of gravity, must have been evolved first of all, the matter of light and heat; of all material substances the most subtle and attenuate; those by which alone the sun operates, and has ever operated, upon the earth and the other planets, and which may be the identical substances that constitute his essence.† And it tells us also, that the luminous matter thus evolved produced light without the assistance of the sun or moon, which were not set in the sky or firmament, and had no rule till the fourth day or generation: that the light thus produced flowed by tides, and alternately intermitted, constituting a single day and a single night of each of such epochs or generations, whatever their length might be, of which we have no information communicated to us.

It tells us, that during the second day or generation uprose progressively the fine fluids, or waters, as they are poetically and beautifully denominated, of the firmament, and filled the blue ethereal void with a vital atmosphere. That during the third day or generation the waters more properly so called, or the grosser and compacter fluids of the general mass, were strained off and gathered together into the vast bed of the ocean, and the dry land began to make its appearance, by disclosing the peaks or highest points of the primitive mountains; in consequence of which a progress instantly commenced from inorganic matter to vegetable organization, the surface of the earth, as well above as under the waters, being covered with plants and herbs, bearing seeds after their respective kinds; thus laying a basis for those carbonaceous materials, the remains of vegetable matter, which we have already observed are occasionally to be traced in some of the layers or formations of the class of primitive rocks (the lowest of the whole), without a single particle of animal relics intermixed with them.

It tells us, that during the fourth day, or epoch, the sun and moon, now completed, were set in the firmament, the solar system was finished, its laws were established, and the celestial orrery was put into play; in consequence of which the harmonious revolutions of signs and of seasons, of days and of years, struck up for the first time their mighty symphony. That the fifth period was allotted exclusively to the formation of water-fowl, and the countless tribes of aquatic creatures; and consequently, to that of those lowest ranks of animal life, testaceous worms, corals, and other zoophytes, whose relics, as we have already observed, are alone to be traced in the second class of rocks or transition-formations, and still more freely in the third or horizontal formations; these being the only animals as yet created, since the air and the water, and the utmost peaks of the loftiest mountains, were the only parts as yet inhabitable. It tells us, still continuing the same grand and exquisite climax, that towards the close of this period, the mass of waters having sufficiently retired into the deep bed appointed for them, the sixth and concluding period was devoted to the formation of terrestrial animals; and, last of all, as the masterpiece of the whole, to that of man himself.

Such is the beautiful but literal progression of the creation, according to the Mosaic account, as must be perceived by every one who will carefully peruse it for himself.

Of the extent, however, of the DAYS OR GENERATIONS that preceded the forma-

* Gen. ii. 4.

† Herschel, Phil. Trans. vol. lxxxiv.

tion of the sun and moon, and their display in the sky or firmament, it gives us, as I have just observed, no information whatever. We only know that the flow of luminous matter which measured them advanced or was kindled up by regular tides; so that it alternately appeared and disappeared, commencing with a dawn and terminating with a dusk or darkness; for at the close of each it is said, "and the evening and the morning were the first day;" or, more literally, as indeed suggested in the marginal reading of our national version, "and there was evening and there was morning the first day;" that is, there was dusk and dawn, and by no means such an evening and morning as we have at present. And hence, Origen observes, that "no one of a sound mind can imagine there was an evening and a morning during the first three days without a sun."* So that the passage should, perhaps, be rendered, as most strictly it might be, "and there was dusk as there was dawn, the first day."—וַיְהִי עֶרֶב וַיְהִי בֹקֶר יוֹם אֶחָד.

It has, indeed, been contended, that each of these periods constituted a solar day, or a revolution of the earth round its own axis, and consequently answered to the measure of twenty-four hours, as at present. But to maintain this opinion it is necessary to suppose that the sun and the moon were set in the sky "to rule over the day and over the night,"—"to divide the light from the darkness,"—and to "be for signs, and for seasons, and for days, and for years," on or before the very first day or generation; for otherwise there could be no solar day, or such as we have at present, produced by a revolution of the earth round her own axis. And there have not been wanting cosmologists and critics, as Whiston and Rosenmüller, who have maintained that the sun and the moon were created antecedently to the earth; that they had their stations allotted them in the heavens, and actually produced solar days and diurnal revolutions of the earth from the first. But though their own hypothesis require this, the idea is directly opposed to the spirit and the letter of the Mosaic narrative, and hence can in no respect be acceded to by any one who is anxious to preserve this narrative in its integrity and simplicity.

How much more explanatory and pertinent is the remark of our own excellent Bishop Hall, when speaking of the primeval light, that during the first three days illuminated the face of nature: "Not," says he, "of the sun or stars, WHICH WERE NOT YET CREATED; but a common brightness only, to distinguish THE TIME, and to remedy the former confused darkness." And how admirably to the same effect does Bishop Beveridge thus express himself: "When he said, *let there be light*, by that word the light, WHICH WAS NOT BEFORE, BEGAN TO BE. But when he said (that is, three days or generations afterward), *let there be lights in the firmament, to divide the day from the night*, he thereby GAVE LAWS TO THE LIGHT he had before made, where he would have it BE, and what he would have it DO. This is what we call the law of nature: that law which God hath put into the nature of every thing; whereby it always keeps itself within such bounds, and acts according to such rules, as God hath set it, and by that means shows forth the glory of his wisdom and power."

Nothing, indeed, can be clearer, than that, according to Moses, the sun and the moon were only set in the heavens during the fourth day or generation in the work of creation; and that, whatever may be the relative proportion of the times and the seasons, the light and the darkness, the day and the night, that have occurred subsequently, we have no reason to suppose they occurred in the same proportion antecedently; since we are expressly told by the same inspired writer, that their immediate office, on being set in the sky, was to RULE these divisions of time, as they have ruled them, with a single miraculous exception or two, ever since, and to divide the light from the darkness, as it has since been divided.

We have no knowledge whatever, therefore, of the length of the first three or four DAYS OR GENERATIONS that marked the great work of creation, antecedently to the completion of the sun and moon, and their appointment to their respective posts. And hence, for all that appears to the contrary, they may

* *Περὶ Ἀρχῶν*: in loc.

have been as long as the Wernerian system, and the book of nature, and I may add the term GENERATIONS, employed by Moses himself, seem to indicate.

Nor let it be supposed for a moment, that the term *day* in the Hebrew tongue seems to demand a limitation to the period of four-and-twenty hours, as it ordinarily imports; for there is no term in any language that is used with a wider latitude of construction than the Hebrew יום (*jom*), or its Arabic form, which is the word for day in the original. We are constantly, indeed, employing this very word, as Englishmen, with no small degree of freedom, in our own age; for you will all allow me to drop the phrase "in our own AGE," and to adopt "in our own DAY" in its stead; thus making AGE and DAY terms of similar import. But in Hebrew the same term is employed, if possible, in a still wider range of interpretation: for it not only denotes, as with ourselves, half a diurnal revolution of the earth, or a whole diurnal revolution, but in many instances an entire year, or revolution of the earth round the sun; and this not only in the prophetic writings, which are often appealed to in support of this remark, but in plain historical narrative as well. Thus in Exod. xiii. 10, the verse, "thou shalt keep this ordinance in its season *from year to year*," if literally rendered, would be "through days of days," or, "through days upon days,"—מימים יוממה. And in like manner, Judges, xvii. 16, "I will give thee ten shekels of silver *by the year*," if strictly interpreted, would be "*per dies—for the days*,"—that is, "for the ANNUAL CIRCLE of days,"—לימים.

Sometimes, again, the Hebrew יום, or day, comprises the whole term of life, as in 1 Chron. xxix. 15—

Our DAYS (ימינו) on earth are a shadow,
And there is none abiding.

So again, Job, xiv. 6—

Turn from him that he may rest,
Till he shall accomplish, as an hireling, his DAY (יומו).

But the clearest and most pertinent proof of the latitude with which the term יום, or DAY, is employed in the Hebrew Scriptures, is in the very narrative of the creation before us: for after having stated in the first chapter of Genesis that the work of creation occupied a period of SIX DAYS, the same inspired writer, in recapitulating his statement, chap. ii. 4, proceeds to tell us, "these are"—or rather, "*such were* the GENERATIONS of the heavens and of the earth when they were created; IN THE DAY (ביום) that the Lord God made the earth and the heavens." In which passage Moses distinctly tells us that, in the preceding chapter, he has used the term יום, DAY, in the sense of generation, succession, or epoch; while we find him here extending the same term DAY to the whole hexaemeron, the entire term of time, whatever it may be, that these six days or generations filled up. So that the sense given to the word by Moses, instead of limiting us to the idea of twenty-four hours' duration, naturally leads us to ascribe, not only a different, but a much enlarged extent of time to the divisions he has marked by the word יום, or DAY: or at least to those terms which occurred before the government of the sun and the moon was established, and the heavenly orrery commenced its harmonious action.

Whether, indeed, the days from this last period, constituting the fifth and sixth, were of a different length from any of the preceding, which may also have differed from each other, and were strictly diurnal revolutions of twenty-four hours, it is impossible exactly to determine. But it is a question which by no means affects the actual face of nature or the geological system before us: for as the third or horizontal series of rocks in which petrifications of KNOWN animal and vegetable substances begin to make their appearance must have continued to augment for ages after the completion of the hexaemeron, or six epochs of creation, whatever be the duration assigned to them; and as the two loftiest, the fourth and fifth sets of rocks,

or the alluvial and volcanic, are still forming, and have been, ever since the great work of creation was completed, the precise duration of the last two days of creative labour can have no influence upon this question. But to a plain yet attentive reader of the Mosaic account even these two days must, I think, appear to have been of a far more protracted length than that of twenty-four hours each, and especially the sixth day; for it is difficult to conceive how the first parent of mankind could have got through the vast extent of work assigned to him within the short term of twelve or fourteen hours of daylight, without a miracle, which is by no means intimated to us, and as difficult to suppose that he was employed through the night. On this last day were created, as we learn from Gen. i. 24—28, all the land-animals after their kind, cattle, and wild beasts, and reptiles; then Adam himself, but alone; who was next, as we learn from ch. ii. 15—22, taken and put into the garden of Eden, to dress it and to keep it; where he had explained to him the trees he might eat of, and the tree he might not; after which were brought to him, that he might make himself acquainted with their respective natures, every beast of the field and every fowl of the air; to all of whom he gave names as soon as their respective characters became known to him. Subsequently to which (for at this time, v. 20, there was not found a help-meet for him), he was plunged into a deep sleep, when the woman was formed out of a part of himself, which completed the creative labour of this last day alone.

That the same Almighty Power who created light by a word, saying יר אור ויהי אור "be light! and light was,"* could have ruled the whole of this, or even formed the universe, by a word, as well, is not to be doubted; but as both the book of revelation and the book of nature concur in telling us that such was not the fact, and that the work of creation went on progressively, and under the influence of a code of natural laws, we are called upon to examine into the march of this marvellous progress by the laws of nature referred to, and to understand it by their operations. Nor is it more derogatory to Him with whom a thousand years are as one day, and one day as a thousand years, to suppose that He allotted six hundred or six thousand years to the completion of his design, than that He took six solar days for the purpose; and surely there is something far more magnificent in conceiving the world to have gradually attained form, order, and vitality, by the mere operation of powers communicated to it in a state of chaos, through a single command, which instantly took effect and commenced, and persevered and perfected the design proposed, than in conceiving the Almighty engaged in personal and continuous exertions, though for a more limited period of time.

Thus, in progressive order, arose the stupendous system of the world: the bright host of morning stars shouted together on its birth-day; and the eternal Creator looked down with complacency on the finished fabric, and "saw that it was good."

LECTURE VIII.

ON ORGANIZED BODIES, AND THE STRUCTURE OF PLANTS COMPARED WITH THAT OF ANIMALS.

FROM the unorganized world, which has formed the main subject of our last two lectures, let us now rise a step higher in the scale of creation; and ascend from insentient matter to life, under the various modifications it assumes, and the means by which it is upheld and transmitted.

If I dig up a stone, and remove it from one place to another, the stone will suffer no alteration by the change of place; but if I dig up a plant and remove it, the plant will instantly sicken, and perhaps die. What is the cause of this

* Gen. i. 3.