COMMENCEMENT OF ORGANIC LIFE—SEA PLANTS, CORALS, ETC.

We can scarcely be said to have passed out of these rocks, when we begin to find new conditions in the earth. It is here to be observed that the subsequent rocks are formed, in a great measure, of matters derived from the substance of those which went before, but contain also beds of limestone, which is to no small extent composed of an ingredient which has not hitherto appeared. Limestone is a carbonate of lime, a secondary compound, of which one of the ingredients, carbonic acid gas, presents the element *carbon,* a perfect novelty in our progress. Whence this substance? The question is the more interesting, from our knowing that carbon is the main ingredient in organic things. There is reason to believe that its primeval condition was that of a gas, confined in the interior of the earth, and diffused in the atmosphere. The atmosphere still contains about a two-thousandth part of carbonic acid gas, forming the grand store from which the substance of each year's crop of herbage and grain is derived, passing from herbage and grain into animal substance, and from animals again rendered back to the atmosphere in their expired breath, so that its amount is never impaired. Knowing this, when we hear of carbon beginning to appear in the ascending series of rocks, we are unavoidably led to consider it as marking a time of some importance in the earth's history, a new era of natural conditions, one in which organic life has probably played a part.

It is not easy to suppose that, at this period, carbon was adopted directly in its gaseous form into rocks; for, if so, why should it not have been taken into earlier ones also? But we know that plants take it in, and transform it into substance; and we also know that there are classes of animals (marine polypes) which are capable of appropriating it, in connexion with lime, (carbonate of lime,) from the waters of the ocean, provided it be there in solution; and this substance do these animals deposit in masses (coral reefs) equal in extent to many strata. It has even been suggested, on strong grounds of probability, that a class of limestone beds are simply these reefs subjected to subsequent heat and pressure.

The appearance, then, of limestone beds in the early part of the stratified series, may be presumed to be connected with the fact of the commencement of organic life upon our planet, and, indeed, a consequent and a symptom of it.

It may not be out of place here to remark, that carbon is presumed to exist largely in the interior of the earth, from the fact of such considerable quantities of it issuing at this day, in the form of carbonic acid gas, from fissures and springs. The primeval and subsequent history of this element is worthy of much attention, and we shall have to revert to it as a matter greatly concerning our subject. Delabeche estimates the quantity of carbonic acid gas locked up in every cubic yard of limestone, at 16,000 cubic feet. The quantity locked up in coal, in which it forms from 64 to 75 per cent., must also be enormous. If all this were disengaged in a gaseous form, the constitution of the atmosphere would undergo a change, of which the first effect would be the extinction of life in all land animals. But a large proportion of it must have at one time been in the atmosphere. The atmosphere would then, of course, be incapable of supporting life in land animals. It is important, however, to observe that such an atmosphere would not be inconsistent with a luxuriant land vegetation; for experiment has proved that plants will flourish in air containing *one-twelfth* of this gas, or 166 times more than the present charge of our atmosphere. The results which we observe are perfectly consistent with, and may be said to presuppose an atmosphere highly charged with this gas, from about the close of the primary non-fossiliferous rocks to the termination of the carboniferous series, for there we see vast deposits (coal) containing carbon as a large ingredient, while at the same time the leaves of the *Stone Book* present no record of the contemporaneous existence of land animals.

The hypothesis of the connexion of the first limestone beds with the commencement of organic life upon our planet is supported by the fact, that in these beds we find the first remains of the bodies of animated creatures. My hypothesis may indeed be unsound; but, whether or not, it is clear, taking organic remains as upon the whole a faithful chronicle, that the deposition of these limestone beds was coeval with the existence of the earliest, or all but the earliest, living creatures upon earth.

And what were those creatures? It might well be with a kind of awe that the uninstructed inquirer would wait for an answer to this question. But nature is simpler than man's wit would make her, and behold, the interrogation only brings before us the unpretending forms of various zoophytes and polypes, together with a few single and double-valved shell-fish (mollusks), all of them creatures of the sea. It is rather surprising to find these before any vegetable forms, considering that vegetables appear to us as forming the necessary first link in the chain of nutrition; but it is probable that there were sea plants, and also some simpler forms of animal life, before this period, although of too slight a substance to leave any fossil trace of their existence.

The exact point in the ascending stratified series at which the first traces of organic life are to be found is not clearly determined. Dr. M'Culloch states that he found fossil orthocerata (a kind of shell-fish) so early as the gneiss tract of Loch Eribol, in Sutherland; but Messrs. Sedgwick and

Murchison, on a subsequent search, could not verify the discovery. It has also been stated, that the gneiss and mica tract of Bohemia contains some seams of grawacke, in which are organic remains; but British geologists have not as yet attached much importance to this statement. We have to look a little higher in the series for indubitable traces of organic life.

Above the gneiss and mica slate system, or group of strata, is the *Clay Slate and Grawacke Slate System*; that is to say, it is higher in the *order of supraposition*, though very often it rests immediately on the primitive granite. The sub-groups of this system are in the following succession upwards:—1, hornblende slate; 2, chiastolite slate; 3, clay slate; 4, Snowdon rocks, (grawacke and conglomerates;) 5, Bala limestone; 6, Plynlymmon rocks, (grawacke and grawacke slates, with beds of conglomerates.) This system is largely developed in the west and north of England, and it has been well examined, partly because some of the slate beds are extensively quarried for domestic purposes. If we overlook the dubious statements respecting Sutherland and Bohemia, we have in this "system" the first appearances of life upon our planet. The animal remains are chiefly confined to the slate beds, those named from Bala, in Wales, being the most prolific. *Zoophyta*, *polyparia*, *crinoidea*, *conchifera*, and *crustacea*,* are the orders of the animal kingdom thus found in the earliest of earth's sepulchres. The *orders* are distinguished without difficulty, from the general characters of the creatures whose remains are found; but it is only in this general character that they bear a general resemblance to any creatures now existing. When we come to consider specific characters, we see that a difference exists—that, in short, the species and even genera are no longer represented upon earth. More than this, it will be found that the earliest species comparatively soon gave place to others, and that they are not represented even in the next higher group of rocks. One important remark has been made, that a comparatively small variety of species is found in the older rocks, although of some particular ones the remains are very abundant; as, for instance, of a

* In the Cumbrian limestone occur "calamoporæ, lithodendra, cyathophylla, and orbicula."—*Philips.* The asaphus and trinucleus (crustacea) have been found respectively in the slate rocks of Wales, and the limestone beds of the grawacke group in Bohemia. That fragments of crinoidea, though of no determinate species, occur in this system, we have the authority of Mr. Murchison.—*Silurian System*, p. 710.

species of asaphus, which is found between the laminæ of some of the slate rocks of Wales, and the corresponding rocks of Normandy and Germany in enormous quantities.

Ascending to the next group of rocks, we find the traces of life become more abundant, the number of species extended, and important additions made in certain vestiges of fuci, or sea-plants, and of fishes. This group of rocks has been called by English geologists, the *Silurian System*, because largely developed at the surface of a district of western England, formerly occupied by a people whom the Roman historians call Silures. It is a series of sandstones, limestones, and beds of shale (hardened mud), which are classed in the following sub-groups, beginning with the undermost:—1, Llandillo rocks, (darkish calcareous flagstones;) 2 and 3, two groups called Caradoc rocks; 4, Wenlock shale; 5, Wenlock limestone; 6, Lower Ludlow rocks, (shales and limestones;) 7, Aymestry limestone; 8, Upper Ludlow rocks, (shales and limestone, chiefly micaceous.) From the lowest beds upwards, there are polypiaria, though most prevalent in the Wenlock limestone; conchifera, a vast number of genera, but all of the order brachiopoda, (including terebratula, pentamerus, spirifer, orthis, leptæna;) mollusca, of several orders and many genera, (including turritella, orthoceras, nautilus, bellerophon;) crustacea, all of them trilobites, (including trinucleus, asaphus, calamene.) A little above the Llandillo rocks, there have been discovered certain convoluted forms, which are now established as annelids, or sea-worms, a tribe of creatures still existing, (nereidina and serpulina,) and which may often be found beneath stones on a sea-beach. One of these, figured by Mr. Murchison, is furnished with feet in vast numbers all along its body, like a centipede. The occurrence of annelids is important, on account of their character and status in the animal kingdom. They are red-blooded and hermaphrodite, and form a link of connexion between the annulosa (white-blooded worms) and a humble class of the vertebrata.* The Wenlock limestone is most remarkable amongst all the rocks of the Silurian system, for organic remains. Many slabs of it are wholly composed of corals, shells, and trilobites, held together by shale. It contains many genera of crinoidea and polypiaria, and it is thought that some beds of it are wholly the production of the latter creatures,

* Such as amphioxus and myxene.

or are, in other words, coral reefs transformed by heat and pressure into rocks. Remains of fishes, of a very minute size, have been detected by Mr. Philips in the Aymestry limestone, being apparently the first examples of vertebrated animals which breathed upon our planet. In the upper Ludlow rocks, remains of six genera of fish have been for a longer period known; they belong to the order of cartilaginous fishes, an order of mean organization and ferocious habits, of which the shark and sturgeon are living specimens. "Some were furnished with long palates, and squat, firmly-based teeth, well adapted for crushing the strong-cased zoophytes and shells of the period, fragments of which occur in the fœcal remains; some with teeth that, like the fossil sharks of the later formations, resemble lines of miniature pyramids, larger and smaller alternating; some with teeth sharp, thin, and so deeply serrated, that every individual tooth resembles a row of poniards set up against the walls of an armory; and these last, says Agassiz, furnished with weapons so murderous, must have been the pirates of the period. Some had their fins guarded with long spines, hooked like the beak of an eagle; some with spines of straighter and more slender form, and ribbed and furrowed longitudinally like *columns*; some were shielded by an armour of bony points, and some thickly covered with glistening scales."*

The traces of fuci in this system are all but sufficient to allow of a distinction of genera. In some parts of North America, extensive though thin beds of them have been found. A distinguished French geologist, M. Brogniart, has shewn that all existing marine plants are classifiable with regard to the zones of climate; some being fitted for the torrid zone, some for the temperate, some for the frigid. And he establishes that the fuci of these early rocks speak of a torrid *climate*, although they may be found in what are now temperate regions; he also states that those of the higher rocks betoken, as we ascend, a gradually diminishing temperature.

We thus early begin to find proofs of the general uniformity of organic life over the surface of the earth, at the time when each particular system of rocks was formed. Species identical with the remains in the Wenlock limestone occur in the corresponding class of rocks in the Eifel, and partially in the Harz, Norway, Russia, and Brittany. The situations of the remains in Russia are fifteen

* Miller's "New Walks in an Old Field."

hundred miles from the Wenlock beds; but at the distance of between six and seven thousand from those,—namely, in the vale of Mississippi, the same species are discovered. Uniformity in animal life over large geographical areas argues uniformity in the conditions of animal life; and hence arise some curious inferences. Species, in the same low class of animals, are now much more limited; for instance, the Red Sea gives different polypiaria, zoophytes, and shell-fish, from the Mediterranean. It is the opinion of M. Brogniart, that the uniformity which existed in the primeval times can only be attributed to the temperature arising from the internal heat, which had yet, as he supposes, been sufficiently great to overpower the ordinary meteorological influences, and spread a tropical clime all over the globe.