Competitive Exams: Geological Time Scale: Infancy

The Infancy of Earth

The long Archaean period, into which half the story of the earth is so unsatisfactorily packed, came to a close with a considerable uplift of the land. We have seen that the earth at times reaches critical stages owing to the transfer of millions of tons of matter from the land to the depths of the ocean, and the need to readjust the pressure on the crust. Apparently this stage is reached at the end of the Archaean, and a great rise of the land--probably protracted during hundreds of thousands of years--takes place. The shore-bottoms round the primitive continent are raised above the water, their rocks crumpling like plates of lead under the overpowering pressure. The sea retires with its inhabitants, mingling their various provinces, transforming their settled homes. A larger continent spans the northern ocean of the earth.

In the shore-waters of this early continent are myriads of living things, representing all the great families of the animal world below the level of the fish and the insect. The mud and sand in which their frames are entombed, as they die, will one day be the "Cambrian" rocks of the geologist, and reveal to him their forms and suggest their habits. No great volcanic age will reduce them to streaks of shapeless carbon. The earth now buries its dead, and from their petrified remains we conjure up a picture of the swarming life of the Cambrian ocean.

A strange, sluggish population burrows in the mud, crawls over the sand, adheres to the rocks, and swims among the thickets of sea-weed. The strangest and most formidable, though still too puny a thing to survive in a more strenuous age, is the familiar Trilobite of the geological museum; a flattish animal with broad, round head, like a shovel, its back covered with a three-lobed shell, and a number of fine legs or swimmers below. It burrows in the loose bottom, or lies in it with its large compound eyes peeping out in search of prey. It is the chief representative of the hard-cased group (Crustacea) which will later replace it with the lobster, the shrimp, the crab, and the water-flea. Its remains form from a third to a fourth of all the buried Cambrian skeletons. With it, swimming in the water, are smaller members of the same family, which come nearer to our familiar small Crustacea.

Shell-fish are the next most conspicuous inhabitants. Molluscs are already well represented, but the more numerous are the more elementary Brachiopods (

“lampshells”) , which come next to the Trilobites in number and variety. Worms (or Annelids) wind in and out of the mud, leaving their tracks and tubes for later ages. Strange ball or cup-shaped little animals, with a hard frame, mounted on stony stalks and waving irregular arms to draw in the food-bearing water, are the earliest representatives of the Echinoderms. Some of these Cystids will presently blossom into the wonderful sea-lily population of the next age, some are already quitting their stalks, to become the free-moving star-fish, of which a primitive specimen has been found in the later Cambrian. Large jelly-fishes (of which casts are preserved) swim in the water; coral-animals lay their rocky foundations, but do not as yet form reefs; coarse sponges rise from the floor; and myriads of tiny Radiolaria and Thalamophores, with shells of flint and lime, float at the surface or at various depths.

Cambrian Animals

This slight sketch of the Cambrian population shows us that living things had already reached a high level of development. Their story evidently goes back, for millions of years, deep into those mists of the Archaean age which we were unable to penetrate. We turn therefore to the zoologist to learn what he can tell us of the origin and family-relations of these Cambrian animals, and will afterwards see how they are climbing to higher levels under the eye of the geologist.

At the basis of the living world of to-day is a vast population of minute, generally microscopic, animals and plants, which are popularly known as “microbes.” Each consists, in scientific language, of one cell. It is now well known that the bodies of the larger animals and plants are made up of millions of these units of living matter, or cells--the atoms of the organic world--and I need not enlarge on it. But even a single cell lends itself to infinite variety of shape, and we have to penetrate to the very lowest level of this luxuriant world of one-celled organisms to obtain some idea of the most primitive living things. Properly speaking, there were no “first living things.” It cannot be doubted by any student of nature that the microbe developed so gradually that it is as impossible to fix a precise term for the beginning of life as it is to say when the night ends and the day begins. In the course of time little one-celled living units appeared in the waters of the earth, whether in the shallow shore waters or on the surface of the deep is a matter of conjecture.

We are justified in concluding that they were at least as rudimentary in structure and life as the lowest inhabitants of nature to-day. The distinction of being the lowest known living organisms should, I think, be awarded to certain one-celled vegetal organisms which are very common in nature. Minute simple specks of living matter, sometimes less than the five-thousandth of an inch in diameter, these lowly Algae are so numerous that it is they, in their millions, which cover moist surfaces with the familiar greenish or bluish coat. They have no visible organisation, though, naturally, they must have some kind of structure below the range of the microscope. Their life consists in the absorption of food-particles, at any point of their surface, and in dividing into two living microbes, instead of dying, when their bulk increases. A very lowly branch of the Bacteria

(Nitrobacteria) sometimes dispute their claim to the lowest position in the hierarchy of living nature, but there is reason to suspect that these Bacteria may have degenerated from a higher level.

Here we have a convenient starting-point for the story of life, and may now trace the general lines of upward development. The first great principle to be recognised is the early division of these primitive organisms into two great classes, the moving and the stationary. The clue to this important divergence is found in diet. With exceptions on both sides, we find that the non-moving microbes generally feed on inorganic matter, which they convert into plasm; the moving microbes generally feed on ready-made plasm--on the living non-movers, on each other, or on particles of dead organic matter. Now, inorganic food is generally diffused in the waters, so that the vegetal feeders have no incentive to develop mobility. On the other hand, the power to move in search of their food, which is not equally diffused, becomes a most important advantage to the feeders on other organisms. They therefore develop various means of locomotion. Some flow or roll slowly along like tiny drops of oil on an inclined surface; others develop minute outgrowths of their substance, like fine hairs, which beat the water as oars do. Some of them have one strong oar, like the gondolier (but in front of the boat) ; others have two or more oars; while some have their little flanks bristling with fine lashes, like the flanks of a Roman galley.

Great Division of the Living World

If we imagine this simple principle at work for ages among the primitive microbes, we understand the first great division of the living world, into plants and animals. There must have been a long series of earlier stages below the plant and animal. In fact, some writers insist that the first organisms were animal in nature, feeding on the more elementary stages of living matter. At last one type develops chlorophyll (the green matter in leaves) , and is able to build up plasm out of inorganic matter; another type develops mobility, and becomes a parasite on the plant world. There is no rigid distinction of the two worlds. Many microscopic plants move about just as animals do, and many animals live on fixed stalks; while many plants feed on organic matter. There is so little “difference of nature” between the plant and the animal that the experts differ in classifying some of these minute creatures. In fact, we shall often find plants and animals crossing the line of division. We shall find animals rooting themselves to the floor, like plants, though they will generally develop arms or streamers for bringing the food to them; and we shall find plants becoming insect-catchers. All this merely shows that the difference is a natural tendency, which special circumstances may overrule. It remains true that the great division of the organic world is due to a simple principle of development; difference of diet leads to difference of mobility.

But this simple principle will have further consequences of a most important character. It will lead to the development of mind in one half of living nature and leave it undeveloped in the other. Mind, as we know it in the lower levels of life, is not confined to the animal at all. Many even of the higher plants are very delicately sensitive to stimulation, and at the lowest level many plants behave just like animals. In other words, this sensitiveness to stimuli, which is the first form of mind, is distributed according to mobility. To the motionless organism it is no advantage; to the pursuing and pursued organism it is an immense advantage, and is one of the chief qualities for natural selection to foster.

For the moment, however, we must glance at the operation of this and other natural principles in the evolution of the one-celled animals and plants, which we take to represent the primitive population of the earth. As there are tens of thousands of different species even of "microbes," it is clear that we must deal with them in a very summary way. The evolution of the plant I reserve for a later chapter, and I must be content to suggest the development of one-celled animals on very broad lines. When some of the primitive cells began to feed on each other, and develop mobility, it is probable that at least two distinct types were evolved, corresponding to the two lowest animal organisms in nature to-day. One of these is a very minute and very common (in vases of decaying flowers, for instance) speck of plasm, which moves about by lashing the water with a single oar (flagellum) , or hair-like extension of its substance. This type, however, which is known as the Flagellate, may be derived from the next, which we will take as the primitive and fundamental animal type. It is best seen in the common and familiar Amoeba, a minute sac of liquid or viscid plasm, often not more than a hundredth of an inch in diameter. As its "skin" is merely a finer kind of the viscous plasm, not an impenetrable membrane, it takes in food at any part of its surface, makes little "stomachs," or temporary cavities, round the food at any part of its interior, ejects the useless matter at any point, and thrusts out any part of its body as temporary "arms" or "feet."