

## THE PROBLEM OF LIFE.

## PART II.

Judging by first impressions, nothing could be more distinct than animals and plants. Nobody, whether scientific or unscientific, could by any possibility mistake an oak tree for an elephant. To the unscientific observer the tree differs in having no power of free movement, and apparently no sensation, or consciousness; in fact, only a portion of the attributes of life. The scientific observer sees still more fundamental differences, in the fact that the plant feeds on inorganic ingredients, out of which it manufactures living matter or protoplasm; while the animal can only provide itself with protoplasm from that already manufactured by the plant. The ox, which lives on grass, could not live on what the grass thrives on, viz: carbon, oxygen, hydrogen and nitrogen. The contrast is so striking that the vegetable world has been called the producer, and the animal world the consumer, of nature. Again, the plant derives the material framework of its structure from the air, by breathing in through its leaves the carbonic dioxide present in the atmosphere, decomposing it, fixing the carbon in its roots, stem and branches, and exhaling the oxygen. The animal exactly reverses the process, inhaling the oxygen of the air, combining it with the carbon of its food, and exhaling carbonic dioxide. Thus, a complete polarity is established, as we see in the aquarium, where plant and animal life balance each other and the opposites live and thrive, where the existence of either would be impossible without the other.

Sharp, however, as the contrast appears to be in the more specialized and developed specimens of the two worlds, we have here another instance of the un wisdom of trusting to first impressions, and have to modify our conceptions greatly, if we trace animal and vegetable life to their simplest forms and earliest origins. In the first place, each individual animal or vegetable begins its existence from a simple piece of pure protoplasm. This develops in the same way into a nucleated cell, by whose repeated subdivision the raw material is provided for both structures alike. The chief difference at this early stage is that the animal cells remain soft and naked, while those of vegetables secrete a comparatively solid cell-wall, which makes them less mobile and plastic. This gives greater rigidity to the frame and tissues of the plant, and prevents the development of the finer organs of sensation and other vital processes, which characterize the animal. But this is a difference of

development only, and the origination of the future life from the speck of protoplasm is the same in both worlds.

If, instead of looking at the origin of individuals, we trace back the various forms of animal and vegetable life from the more complex to the simpler forms, we find the distinction between the two disappearing, until at last we arrive almost at a vanishing point where it is extremely difficult to say definitely whether the organism is an animal or a plant. For this large family Professor Haeckel suggested the name "Protista," as coming between the lowest animals called "Protozoa," and the lowest plants, or "Protophyta;" but it has not been generally adopted for reasons which are outside the scope of this article.

As development proceeds the distinction between plants and animals becomes more apparent, although even here the simplest and earliest forms often show signs of a common origin by interchanging some of the fundamental attributes of the two kingdoms. Thus, the essential condition of plant existence, is to live on inorganic food, which is manufactured into protoplasm, by working up simple combinations into others more complicated. The diet of plants consists of water, carbonic dioxide, and ammonia; they take in carbonic dioxide and give out oxygen, while animals do, as I have already said, exactly the reverse. But the fungi live, like animals, upon organic food consisting of complicated combinations of carbon, which they assimilate; and, like animals, they inhale oxygen and give out carbonic dioxide.

## Lichens.

Lichens afford a very curious instance of the association of vegetable and animal functions in the same plant. They are really formed of two distinct organisms: a body which is a low form of alga or sea-weed, and a parasitic form of fungus, which lives upon it. The former has a plant life, living on inorganic matter and forming the green cells or chlorophyll, which are the essential property of plants, enabling them under the action of the sun's rays to decompose carbonic dioxide; while the parasite lives like an animal on the formed protoplasm of the parent stem, forming threads of colorless cells which envelop and interlace the original lichen, of which they constitute the principal mass, as in a tree overgrown with ivy.

Even in highly-developed plants we find some curious instances of reversion toward animal life. Certain plants such as the *Dionaea* or Venus' Flytrap, finding it difficult to obtain the requisite supply of nitrogenous food in a fluid state from the arid or

marshy soil in which they grow, have acquired a habit of supplying the deficiency by taking to an animal diet and eating flies. Conjoined with this is a more highly-developed sensitiveness and the power of what appears to be voluntary motion, and a faculty of secreting a sort of gastric juice in which the flies are digested. It is possible, of course, that this power of disintegrating animal tissue may be partially due to micro-organisms in this curious gastric juice. But it must be understood that the fundamental property possessed by vegetable life of decomposing carbonic dioxide and exhaling oxygen depends on light stimulating a peculiar chemical action of the chlorophyll and in the dark, leaves breathe like lungs exhaling not oxygen but carbonic dioxide.

## Interdependence.

The records of geology, imperfect as they are, show a combined progression from the simple and neutral organisms to higher and more differentiated forms, both in the animal and vegetable world. These records are imperfect because the soft bodies of the simpler and for the most part microscopic forms of protoplasm and cell life are not capable of being preserved in petrifications and it is only when they happen to have secreted shells or skeletons, that we have a chance of identifying them. Still, we have a sufficient number of remains in the different geological strata to enable us to trace development; and it is certain that there has been a complete parallelism between the evolution of animal and vegetable life from the simplest to the most complex forms. These facts point very strongly to a process of evolution by which the animal and vegetable worlds, starting from a common origin in protoplasm, the lowest and simplest form of living matter, have gradually advanced step by step, until we have at last arrived at the sharp antithesis of the ox and the oak tree. It is clear, however, that this evolution has gone on under what I must call the generalized law of polarity, by which contrasts are produced of apparently opposite and antagonistic qualities, which, however, are indispensable for each other's existence. Thus, animals could not exist without plants to work up the crude inorganic materials into the complex and mobile molecules of protoplasm, which are alone suited for assimilation by the more delicate and complex organization of animal life. Plants, on the other hand, could not exist without a supply of the carbonic dioxide, which is their principal food, and which animals are continually pouring into the air, from the combustion of their carbonized food in oxygen, which supplies them