with heat and energy. Nature is, therefore, one huge aquarium, in which animal and vegetable life balance each other by their contrasted and supplemental action, and, as in the inorganic world, harmonious existence becomes possible by this due balance of opposing factors.

At first sight the distinction of sex appears as fundamental as that of animal and plant. Mankind and all the higher forms of life with which man has intimate relations, can only propagate their species in one way—viz:—by the co-operation of two individuals, who are essentially like and yet unlike, possessing attributes which are complementary of one another, and whose union is requisite to originate a new living unit—in other words by sexual propagation. So certain does the necessity of two sexes appear that all ancient religions began by assuming a male and female principle for their God, or first guesses at the unknown origin of the phenomena of nature. Thus Ouranos and Gaia, Heaven and Earth; Phoebus and Artemis; the Sun and Moon, are all figured by the primitive imagination as male and female.

### Life Reproduction.

Science, however, has made havoc of the impression of sexual generation being the original and only mode of reproduction, and the microscope and dissecting knife of the investigator have introduced us to new and altogether unsuspected worlds of life. By far the largest proportion of living forms, in number, though not in size, have come into existence without the aid of sexual propagation.

When we begin at the beginning with those monera which are simply specks of homogenous protoplasm, we find them multiplying by self-division, technically called "fission." Amoeba number one, when it outgrows its natural size, contracts in the middle, and splits into two amoebae, two and three, which are exactly like one another, and like the original number one, as far as microscopic power will enable us to ascertain. In fact, number two contains one-half of the parent number one, and the number three the other half. They each grow to the size of the original number one, and then repeat the process of splitting and multiplying themselves.

The next earliest stage in the evolution of living matter, the nucleated cell, does exactly the same thing. The nucleus splits into two, each of the parts becoming a new nucleus for the protoplasmic matter of the original cell, and these two parts either multiply within it, or they burst the old cell-walls and become two new cells resembling the first.

The next stage in advance is that of propagation by germs or buds, in which the organism does not divide into two equal parts, but a small portion of it swells out at its surface, and finally parts company and starts on a separate existence, eventually growing to the size of the parent by the inherent faculty of manufacturing fresh protoplasm from surrounding inorganic materials. This process may be witnessed at any time in an aquarium containing specimens of the sea-anemone, and the minute new anemonies may be seen in every form, both before and after they have departed from the parent body. Propagation by buds remains one of the principal modes of increase in the vegetable world, plants multiplying by this process even after they have developed the higher method of sexual propagation by seeds. In some of the lowest animals, such as worms, the buds are reduced to a small aggregation of cells, which form themselves into distinct individuals inside the body of the parent, and only separate from it when a certain stage of development has been attained.

Advancing still further on the road toward sexual reproduction, we find these germ-buds reduced to spores, or single cells, which are emitted from the parent, and afterwards mutiply by division until they form a many-celled organism, which possesses the hereditary qualities of the original one. This is the general form of propagation of the lower plants, such as algae, mosses, and ferns. Many micro-organisms, also, propagate by spores, which float in the air in enormous quantities, and multiplying, when they find a suitable soil with astonishing rapidity, in a few days devastate the potato crop of a whole district, or bring about something approaching an epidemic of diphtheria. They have their use, however, in the world, and their action is beneficent as well as the reverse, for they are the cause of putrefaction, the process by which the dead organic matter which, if not removed, would choke up the world, is resolved into the inorganic elements from which it sprang, and rendered available for fresh combinations.

### Sexual Generation.

We now come to the system of sexual propagation which is the rule in all the higher animals as well as among many plants. The following conception of the origin of sexual generation is, I believe, new; it is put forward, not as a dogma, but merely as an hypothesis. The germ cell, of a spore, may have amalgamated with the original cell which was about to develop into a germ-bud in the body of some individual, and, by the union of the two, a new and more vigorous originating cell may have been produced, which modified the course of development of the germ-bud and of its resulting organism. This organism, having advantages in the struggle for life, established itself permanently with ever new variations in the same direction, special organs being gradually evolved—and retained by the process of natural selection—to meet the altered conditions. At length, therefore, the distinction would be firmly fixed of a female organ, or ovary, containing the egg, or primitive cell from which the new being was to be developed, and a male organ supplying the fertilizing spore, or cell, which was necessary to start the egg in the evolutionary process by which it would grow into the germ of an offspring combining qualities of the two parents. This hypothesis is, to some extent, confirmed by a study of embryology, which shows that in all mamals the distinction of sex is not developed until a considerable progress has been made in the growth of the embryo. Moreover, it is only in the more specialized families that we find this mode of propagation by two distinct individuals of different sexes firmly established. In the great majority of plants, in some of the lower families of animals —snails and earthworms, for example —the male and female organs are developed within the same being, and they are what is called "hermaphrodites." In most of the flowering plants, the same blossom contains both the male organs—the stamens and anther—and the female organs—the style and germ.

Another transition form is parthenogenesis, or virginal reproduction. In this case, germ-cells, similar to egg-cells, develop themselves into new individuals without any fuctifying element. This method of propagation is found in many species of insects, with this curious result, viz:—that the same germ-cells which develop parthenogenetically, are often capable of being fertilized, and when they are, very different individuals are produced, among the common bees, for example, male bees, or drones, arise from the non-fertilized eggs of the workers, when they lay any, which is very seldom. But when the queen has been fertilized—this occurs once in her life time only—workers and drones are hatched, the sex being determined by the cell in which the egg is laid. The worker-cell made, of course, by the worker bees, is small and narrow, and the queen's abdomen has to be contracted when laying eggs in it. It thus happens that the egg comes in contact with the seminal fluid which the drone left when he fertilized the queen. This egg invariably produces a worker. The drone-cell is broader and longer than the worker-cell and no abdominal con-