PART VI.

CLASSIFICATION OF ANIMALS, AND THEIR DIFFERENT TYPES.

CHAPTER XII.

THE VARIOUS FORMS OF LIVING BEINGS, OR TYPES.

It is well known that animals, like plants, vary very widely in form. They also differ quite as much in respect to simplicity or complication of structure, some having a large number of organs, for the performance of different functions, and others having but few. In all cases, however, whether the animal perform many functions or few, they all serve for three grand purposes, which are identical in all alike.

These three fundamental physiological processes, which all animals must perform, no matter how they are made, are *nutrition*, *reproduction*, and *correlation*, or communication with the external world.

Any animal that could not nourish itself could not develop, but must die; and if it could not reproduce others like itself, the kind must become extinct. It is equally necessary it should be able to establish certain relations with other beings, and with surrounding objects, because all are mutually dependent, in many ways, upon each other, and upon the world in which they live.

The manner in which these three essential functions are performed, however, in different kinds of beings, is remarkably varied. In fact, this is the case with all the organic functions, but, perhaps, more especially so with those concerned in reproduction.

In the lowest kinds of organisms, where there is great simplicity of structure, nutrition, reproduction, and correlation are effected with few organs, and those of a simple type, as we have already shown. But in the more highly organized beings, we find a greater number of separate parts of the body modified, and adapted for different purposes. Commonly they are said to be more *differentiated*, and each part, or organ, so devoted to a special function performs that function alone, and never that of another part or organ. Thus the eye sees, the nose smells, the stomach digests, and so on. The higher the animal is in the scale of being, the greater the number of the separate organs, for special purposes; or, in other words, the being is more highly organized, or *differentiated*.

As we go down in the scale, we find the lower animals with fewer and fewer separate organs, devoted to special functions. In other words, they are less differentiated. In them one organ may perform two or three functions, instead of being devoted to one alone. They must all, of course, perform the three functions of nutrition, reproduction, and correlation, but all three functions may be performed with a small number of differentiated parts, compared with the beings above them in the scale.

In the very lowest beings, in fact, there may be said to be no *differentiation* at all, or no special organs for the special functions. Every part of these beings can effect nutrition, reproduction, and correlation alike, so that every part is stomach, generative apparatus, or organ of correlation, being sometimes the one and sometimes the other, as in the infusoria already described, especially in the *amœba*. This

is the case with both plants and animals, and it is important to be borne in mind, in connection with subsequent explanations.

In the highest animals, especially in man, the number of differentiated parts, or special organs, is very great. Every function is divided into many sub-functions, instead of being simple. Thus, nutrition, which in the lowest beings is only one simple process, that of direct absorption from the surrounding fluid, through every part of its structure, in man is divided into mastication, digestion, assimilation, defecation, respiration, and numerous other processes. It is the same with the other functions—in reproduction for instance, which in man requires a series of different acts, in many of the lower beings is effected simply by the parent throwing off a fragment of its own body, which grows into another being like itself. In many of them this process of simple division may be carried to almost any extent; as in the case of the hydra.

The fundamental organism from which all beings start, as stated before, is the same in all alike. At the beginning man is like every other animal, or even like every plant; he is simply a germ, a speck of organizable protoplasm. What it is that causes some of these primary germs to develop only to a certain extent, and others to develop further, we do not know. Some remain simple infusoria, while others progress to vegetables, or animals, more or less perfectly organized; and others, again, develop into human beings. What this is owing to, we have not yet learned. Whether there be innate differences in the primary germs at the start, which we have not yet detected, which decide what they shall ultimately become, or whether their future is influenced by surrounding circumstances alone, is at present undecided. Probably, in the beginning, when organic germs first originated, they were acted upon in different degrees, and in various ways, by the natural forces then so active, and carried to various degrees of development, some taking one direction, and some another. The several kinds of beings thus originated would afterward continue their kinds, each in its own way, as they do now, by modifying the germs they contain in their own organisms, in the process of reproduction.

Any animal, or plant, when placed in new circumstances will undergo change, and this change may, by gradual stages, proceed so far as to create, in time, an entirely different being. Differentiation of parts will begin, new organs will form, as new functions are needed, and thus gradually, step by step, highly organized animals are gradually originated from the very simplest. This is called *Evolution*; and Darwin has shown, conclusively, that all beings, no matter how perfect or complicated they may be, can be traced back, step by step, to the mere speck of protoplasm from which all alike have sprung, from the highest to the lowest.

Every new animal, or plant, living or fossil, that is discovered, fits into the chain of being at a place where such a link was needed. There is not one that stands alone, but each is connected with one above and one below; and if in any part the chain of life is imperfect, we feel sure it is so only because the links have not yet been discovered. That they exist, or have existed, naturalists feel assured, and every day we are picking up some of the still missing ones.

Life progresses, not in one straight line, but in many different ones, all starting from the same central point, but radiating in different directions, like the spokes of a wheel.

These different lines of development form the different types of animals, or kinds, of which naturalists recognize *six*, and of these it will now be necessary to give a short description.

CHAPTER XIII.

THE DIFFERENT TYPES OF ANIMALS.

1st. *The Protozoa.*—These are minute jelly-like organisms, of no special form, and with no differentiation of parts, except that in some there is an imperfect mouth. There is no special organ for any purpose, and every part can digest or reproduce a new being, if separated. The whole body is stomach or generative apparatus. They live mostly in the water, and are often joined together in large numbers. The Vibriones, Bacteria, Monads, Diatoms, and others, referred to before, belong to this type.

2d. *The Cœlenterata*, formerly called *Radiata.*—These animals have an internal cavity, or pocket, which serves as a stomach. This, however, is not localized in a particular part, but occupies the whole interior, and communicates with every part. The substance of the body is made up of two membranes, or skins, one outside and one inside. Most of them have tentacles, or arms, and some of them have traces of a nervous system. They all have distinct organs of generation. Usually there is a proper mouth, but in no case is there an alimentary canal that traverses the whole length of the body, with a mouth at one end and an anus at the other. They reproduce their kind in different ways, either sexually, or by simple division, as in the Protozoa, on which they are a slight advance. In this type we find corals of all kinds, sea-anemones, polyps, and jelly-fishes.

3d. *Annuloida.*—In this type we have a complete alimentary canal, separate from the rest of the body, and extending from one end of the body to the other, with a mouth at one end and an anus at the other. There is also a distinct nervous system, and, in many, distinct parts, which act as arms, or legs.

Among animals of this type we have sea-urchins, star-fishes, sea-slugs, and some kinds of worms, which are a great advance upon those of the preceding types.

4th. *Annulosa.*—The animals of this type are divided into segments, or parts, arranged like the links of a chain. They have a tolerably perfect nervous system and distinct alimentary organs: most of them have regular limbs.

In this type we find leeches, lobsters, barnacles, wood-lice, crabs, spiders, centipedes, and insects. Among them we see many specialized functions and more complexity of parts. They are far in advance of the previous types.

5th. *Mollusca.*—In this type we find clams, oysters, and other shell-fish, periwinkles, snails, and cuttle-fish. They all have a nervous system, with a distinct alimentary apparatus, and often an imperfect heart. The cuttle-fish even has a rudimentary backbone.

All the above five types, it will be seen, are very imperfectly developed, though each one is a slight advance on the preceding. In regard to reproduction, as will be better shown farther on, they have various modes. Among the simplest the parent simply throws off a part of its body, or divides, and the separated part grows

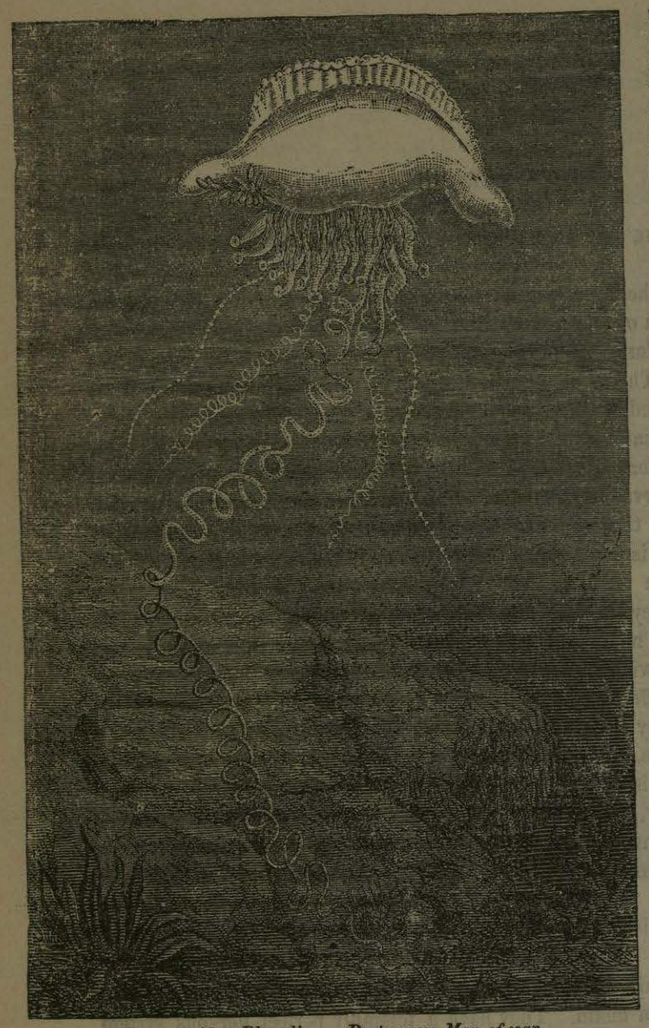


FIGURE 40.—*Physalia, or Portuguese Man-of-war.*

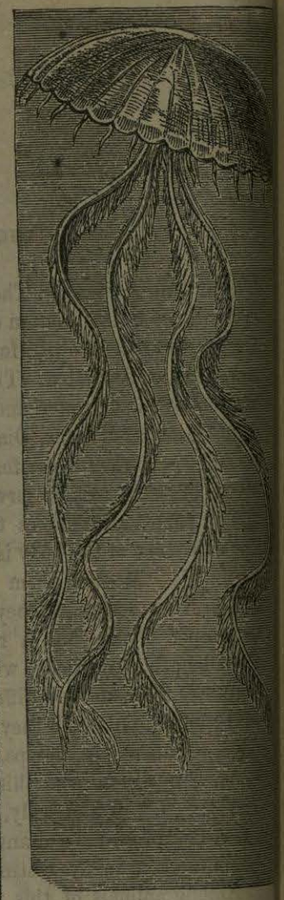
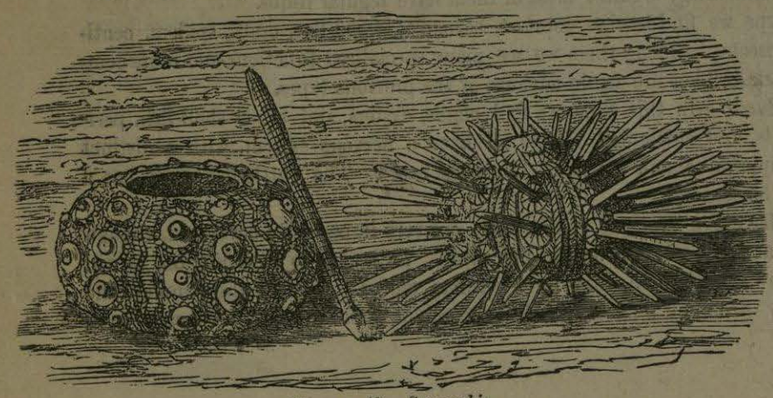


FIGURE 41.—*The Chrysaora*

Different forms of Medusæ, fish, Type 2, *Cœlenterata.*



This shows t
Sea-urchin
spines, and
the spines br
and one spine
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To illustrate
Annuloida.

FIGURE 42.—*Sea-urchin.*

into a similar new being; but there is no special part for the purpose. This mode runs through several types, and after the first we find also that they throw off buds, or germs, which grow into new beings, and some are even truly sexual, or male and female; but often the same being will propagate in all the various modes at once, or one individual will propagate one way, and another differently, or the whole members of a type will propagate in one way at one time, and in another way at another time. They have no fixed mode. All the preceding types are called *invertebrate*, that is, without a *backbone*, though some of them have a faint approach to one, as the cuttle-fish, for instance.

6th. *Vertebrates.*—Animals of this type are well known. Man stands at the head of them. They all have a distinct spine, or backbone, with four limbs, in pairs, and the body may be divided into two similar halves. In animals of this type we find the largest amount of differentiation, with the greatest number of separate organs for special purposes. They propagate strictly sexually, though in many different ways.

This summary of animal classification will enable the reader to understand the references which may be made to the different types when explaining the various modes of reproduction.

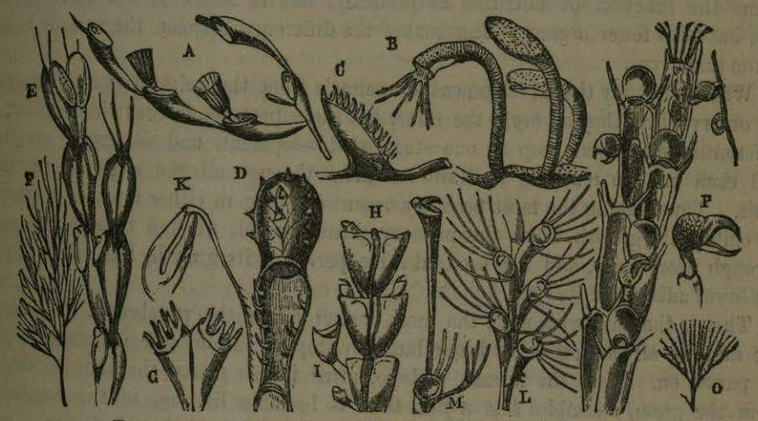

FIGURE 43.—*Various Forms of Polyzoa.* Type 5, *Molluscoida.*

A the Lady's-slipper Coralline. B the Snake-head. C Beania Mirabilis. D the Spiny Farciminaria. E the Coat-of-Mail Coralline, magnified. F the same, natural size. G the Dimetopia Spicata. H the Shepherd's-purse Coralline. K the Caberea Patagonica, or Saw-blade Vibraculum. L the Bicellaria Ciliata—from the thorny cilia around its mouth. M and P different forms of the Bird's-head Coralline.

CHAPTER XIV.

PLAN OF DEVELOPMENT OF ANIMALS.

ALL animals belonging to either of the six types are formed upon the same general plan, but some are more differentiated than the others, or, in other words, have more separate organs for the performance of a greater number of special functions. Thus, one may have a stomach, but no true mouth nor anus, while another may have one or both of these in addition to the stomach, and is then said to be more highly organized. The simplest formed of the two animals performs the function of nutrition as perfectly, for its needs, as the more perfect one, but with fewer organs. This makes the difference between the various beings of the same type.

When we study the development of animals from the primary germs, or eggs, we observe that they all *begin* the same, but some progress farther than others in differentiation. Some stop at one stage of development, and others at another, and each one on reaching its limit has gone through all the stages below that limit. Thus, taking the most perfectly organized being in either type, and tracing its embryonic growth, from the primary germ upward, we find that it has gone through every stage, and has been, at some period of its growth, like every one of the lower animals of its type.

This is the case with man, the most perfect of all the vertebrates. He starts the same as all the rest below him; but they stop at various inferior stages, while he passes on. Thus the human embryo, after it has passed the simpler stages, from the germ, resembles first a *fish*, then it becomes like one of the *amphibia*, and, still progressing, it next becomes a *reptile*, then a *bird*, and finally a true *mammifer*. Thus man may be said to be a true epitome of his type, or to comprise it wholly in himself in the course of his foetal development. We can comprehend from this how different beings have originated from those below them, by the gradual evolution of new organs for special purposes. In one sense all animals are *the same*. They are all, when primary germs, alike in every respect, but some develop farther than others. Fundamentally there is no difference.

In the development of an egg, nothing is needed but a certain degree of heat, continued for a certain time; and for a seed, we need only heat and moisture. It is the same with the germ of an animal, which is merely an egg. In the body of the mother it meets all the conditions required, and develops as the seed does in the ground. If similar conditions of warmth, moisture, and appropriate nutrient fluid could be supplied, it is quite possible that a germ might develop out of the mother's body as well as in it; and it is well known that the human being is often formed in other parts of the body besides the womb.

It is conceivable that in some former stage of the world's history, its condition was such that any germ, or speck of naturally formed protoplasm, might be developed, just as the animal embryo is in the womb. The whole world, *the universal mother*, was perhaps then one grand matrix, in which living beings of various types originated spontaneously. As the conditions varied, so would the degree and direction of the development be effected, and thus the resulting beings would vary. Afterward their descendants would continue to vary more and more, by the influence of surrounding circumstances, or by selection, as shown by Darwin. Such would seem to be a much more probable explanation of the first origin of life, and its diversity, than that of separate creation of each kind, just as we find it.

When once a certain type of animal is produced, the influence of *heredity* probably impresses a character, or constitution, upon the germs it forms, so that they have a tendency to produce the like of their parents, and for this reason each type continues its kind. There is no reason to suppose any fundamental difference in the germs of the different types, although the germ of one type never produces beings of another type, but always those of its own.

Many animals, in the process of development, go through some of the lower stages as independent beings, having no connection with the parent. Thus the egg of the dragon-fly develops, in the water, into a perfect being, utterly unlike its parent, and lives as an aquatic. But, finally, this animal crawls out of the water, throws off its skin, develops wings, and becomes a true dragon-fly. The frog likewise develops as a tadpole, and so does the newt, and breathes by gills, like a fish. In the course of time a change occurs, its tail drops off, legs appear, and it walks out upon the land, and breathes by lungs.

Insects, it is well known, go through several of these stages; from the egg to the larva, from that to the chrysalis, and from that to the perfect insect. Some insects even propagate in their inferior stages, and originate new beings, either like themselves or like the parent, or different from either. We can readily imagine that in this way new forms of beings might originate, from one of the lower forms becoming fixed, and so remaining permanent.

The development of most metamorphic animals, in fact, is often stopped at one of the lower stages, and goes no farther. Thus, the tadpole, with insufficient light and heat, will remain a tadpole, and never develop into a frog. It is the same with many others. A lizard-like animal in Mexico, known as the *Axolotl*, which lives and propagates its kind as a gill or water-breathing animal, will often lose its gills, and breathe by lungs, becoming a totally different being. There is another somewhat similar animal, found in the Western States, called the *Siredon lichenoides*, which has gills and fins like a fish, and is perfectly aquatic. If this animal be confined under new conditions, it changes completely, losing its gills and fins, and breathing by lungs. It, in fact, becomes a *different animal*, and is called a *salamander*.

Until these remarkable changes had been carefully observed, the two animals were always described separately, and were never suspected to have any connection whatever with each other.

Possibly many other animals, which we think distinct, are thus merely different larval forms of the same being; only we have never yet seen the change take place.

The lower types pass gradually into one another, their organization being so indeterminate that they are sometimes referred to one type and sometimes to another.

It is highly probable that they are all only stages of development from the primal germ, by which nature gradually evolves the most perfect of all. Even the highest type, the vertebrate, approximates so closely to the type below, in its most primitive forms, that the two almost merge together. It is possible, also, that other beings exist, or have existed, in which the transition could be still more certainly established. Every day new beings are being discovered, living or fossil, and each new one invariably bridges over some gap that before existed between different kinds.

PART VII.

REPRODUCTION IN PLANTS AND ANIMALS, SEXUAL AND NON-SEXUAL, INCLUDING HERMAPHRODISM.