SINGLE AND MULTIPLE ANIMALS.

BY J. CARTER BEARD.

It is quite natural for persons who have given no special thought to the subject to believe that it is impossible to breathe without lungs, feel without nerves, move without muscles, distinguish light from darkness without eyes, manifest any intelligence without a brain, eat without a mouth, and digest food without a stomach, and yet by far the greatest number of animals do all these things, besides producing young, quite as unfailingly as we ourselves do.

These unicellular organisms exist as separate and independent units of life in water, in blood, and in the intestines of animals.

Their number is indeed so enormously great, and their increase so rapid in sea water, that modern scientific writers upon the subject say that the basis of all life in the modern ocean is the micro-organisms of the surface. Modern microscopical research has shown that the one-celled plants and the one-celled organisms that feed upon them are so abundant and prolific, that they meet all demands and supply the food of all creatures that are used for food by all the larger forms of marine animals. The most completely representative form of the unicellular type is Amœba, a sort of a Diogenes among animals, that dispenses with every means possessed by other living creatures for performing the processes necessary for the life of an animal. Not only is this minute drop of that infinitely complex substance called protoplasm without parts or organs, but it has not even any proper shape, being continually changing its contour, and in the simplest varieties lacks what every other living product of nature possesses, some kind of a firmer external surface, crust, hide, or shell, as a protection from external injuries, so that it eats by pushing its semi-liquid substance against its food and immersing it in its body, and moves forward by protruding part or parts of itself and flowing into them.

It avoids obstacles and shuns strong lights in its progress, as if it had the use of eyes; it responds unmistakably to chemical or to mechanical stimulation, by means of which its movements may be checked or changed; in all of which it shows irritability, which is an unmistakable evidence of some sort of sensation.

Last, though by no means least, it absorbs oxygen and gives out carbon monoxide, which is, of course, nothing else but breathing.

But while such a large proportion of unicellular organisms live free and independent lives, others exist as component elements of higher unities, and as such constitute the multicellular and more complex plants and animals. In these the many-sidedness of function is lost, or at any rate in abeyance, and that in exact proportion to their degree of subordination. Certain sorts predominate in contractility, others in irritability, others in secretion, others again in storage, and so on. Thence arise muscle cells, nerve cells, glandular cells, fat cells, and the like.

But while this building up of animals from living cells has long commanded the study and the investigation of our greatest and most profound students of physiology, the development of composite animals from those so built up, compound aggregates of complex creatures, has not, the writer believes, received as a general subject any adequate attention from men of science.

The habits of certain social insects, ants, bees, and termites, tend to so intimate a relation of the members of one hill or hive as to suggest an organic whole governed by one intelligence or instinct, and composed of parts each of which is in turn made up of smaller units, and each of which has its special office to fulfill. Both bees and certain species of ants have the habit of temporarily clinging together in masses, forming one body of all the members of the community. The Suaba ant of South America collects in large globular masses when overtaken by a flood of water, and floats upon the surface. Belt tells us that he has seen temporary nests of this ant formed entirely of members of the community, in which were galleries and chambers where were sheltered the young and their attendants.

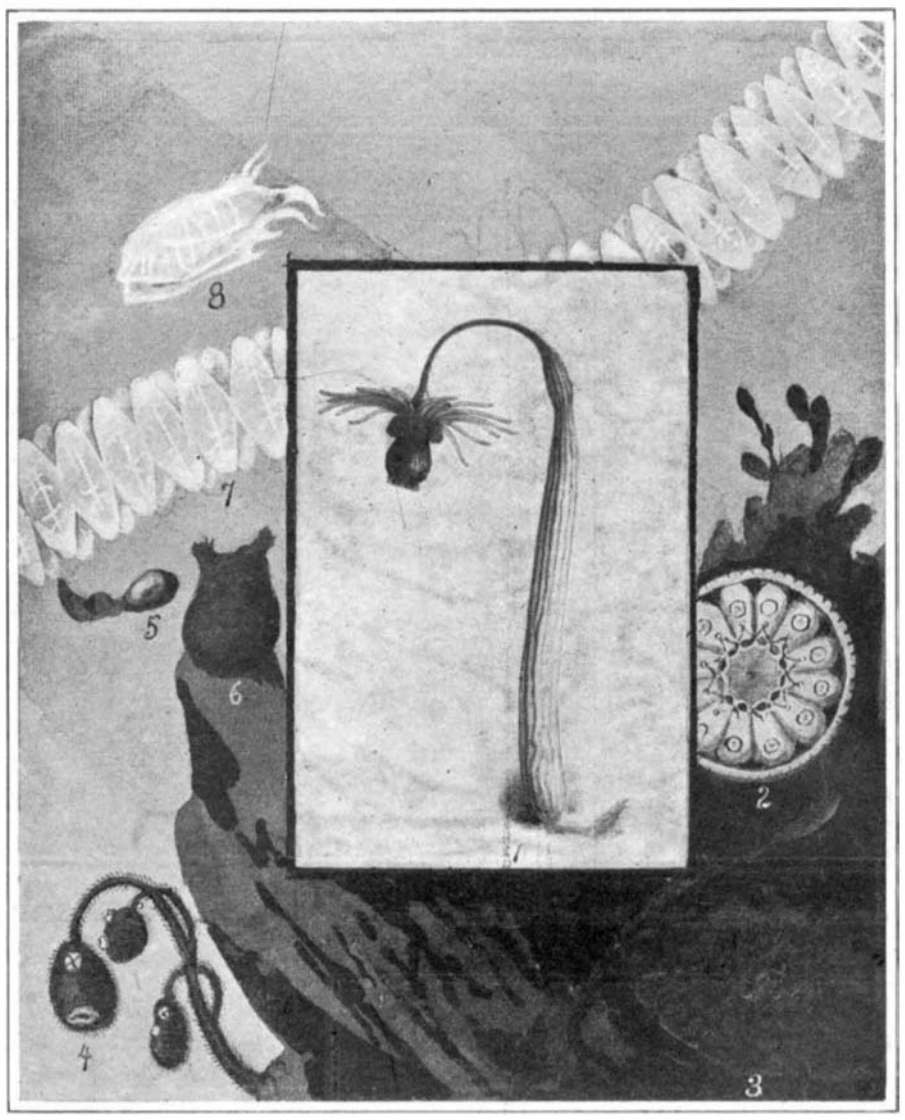
In examining the pebbles, seaweed, and other flotsam and jetsam left by the retreating tide, little globular bodies of a red or a yellow color may be often discerned, fastened to some sub-aquatic object, perhaps in a pool among the rocks. These bodies, one of which may be seen in Fig. 6, are furnished with two projections. Through one of these necks the sea squirt, as it is called, takes in water that after it has passed through the meshes lining the interior of the body, which strain out the minute creatures contained, is ejected from the other tube. The promptness with which these sack-like creatures spurt out the water inside of them, when they are touched, has given them their name of sea squirt.

Simple in structure and low in the scale of animated existence as sea squirts, or ascidians, appear to be, they are placed by systematic naturalists among the vertebrata, and have even a still lower tribe of creatures interposed between them and the invertebrates. As first observed by Kovalevsky in 1866, a number of species of this class of animals start out with a promise of reaching a point high in the ranks of living creatures, but afterward turn about and degenerate into an adult condition displaying very little, if any, resemblance to the vertebrates among which they began life.

The young sea squirt is not unlike the tadpole of a frog (see Fig. 5 in the illustration) being when it leaves the egg provided with a sort of backbone of gristle called a notochord, and above this a spinal cord, and possessing at the forward end of the bulbous-shaped body proper organs of hearing, sight, and so on, with a mouth, gill clefts, and a brain, and at the other a long tail with which to propel itself forward. If you happened to be unacquainted with its subsequent transformations, you might from its appearance fancy that it must develop into some kind of a backboned animal, as highly organized at least as say a frog. Instead of doing this, however, a complete retrogression soon sets in. Projections furnished with sucking disks grow from its body, which fasten it permanently to the first support it encounters; both head and tail disappear together with notochord. spinal cord, brain, and it becomes the mere leathery bag known as a sea squirt.

All sea squirts do not degenerate to such an extent, and even among those that do, a number of species exist during their whole lives as separate and distinct individuals. Others, however, although they resemble the solitary species in structure, are united as parts of a plant growing upon a stalk, as seen in *Boltenia pedunculata* (Fig. 4). Each individual has its own heart, respiratory system, and organs of nutrition, but is inseparably united. Following this in exhibiting a still closer inter-relation are the social sea squirts, in which the parent sends out a root-like process bearing upon its extremity an individual that in turn does the same, until a large colony is formed, consisting of sea squirts fixed upon bases or roots common to the whole group.

Attached to large stones or seaweed are often to be found translucent, jelly-like masses, investing whatever surrounds them with a glairy coat of various hues of orange, yellow, blue, purple, green, or gray. These things are as inert as are sponges, requiring a strong magnifying power to detect the currents of water that play about minute apertures in their surfaces; they belong to the group called compound sea squirts, in which the integument or skin, while common to all of the colony, is fused and united into a featureless envelope, inside of which are imbedded a number of sea squirts snuggled together about a cavity, into which the various ducts of their bodies open. If in our examination of one of these masses of gelatinous matter we cut it up, we find that the apparently single animal is really a commonwealth of individuals bound together by indissoluble and vital ties. Each of the starlike markings that appear is a family, each group of stars a community. Individuals are linked together into clusters, clusters are combined into systems. Each individual has its own life interests, but also must share in the operations which relate to the interests and well-being of the mass. Anatomical investigation alone can show us the wonderful inter-relation and the complexity of organism exhibited by these compound ascidians. A figure showing the regular forms often assumed by the animals in their grouping may be seen at Nos. 2 and 3 in the illustration. The most remarkable of the ascidians or sea squirts is without doubt the Salpa. These pelagic animals are as transparent as glass. Their structure and their life history are complicated. In the latter there is an alternation of generations. There are asexual forms or "nurses," from which there grows out a long ventral stolon or cord. This stolon is segmented into a chain of sexual buds, and the whole chain set free moves as one animal. (See Fig. 7 in the illustration.) As the individuals become mature they separate from each other, and we have the extraordinary spectacle of a compound organism breaking up into separate individuals. Each of these polyps produces an ovum, which after fertilization develops into an embryo and into an asexual form.



1. Typical hydroid, *Monocaulis pendula*. 2. Compound ascidian, *Botrillus*. 3. Compound ascidian, *Amarucium*. 4. Stalked ascidian, *Boltenia pedunculata*. 5. Tadpole of sea squirt. 6. *Mongula manhattensis*. 7. Chain of Salpa.

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A Curious Industry.

Very often while the busy world is tearing along seeking fortunes in wide and well-known fields, hidden away quietly there is some modest little industry going along and bringing in a nice little sum to the sharp mind that has known how to seek wealth in untrodden or little-known paths. Among such out-of-the-way enterprises we may mention a curious agricultural industry which is being profitably carried on at Varedales, near Meaux, France. It consists in the manufacture of preserved sorrel, which is put up in tins or small casks. and exported to all parts of the world, for use as a culinary and table accessory. This industry was started at Varedales in the year 1860, but it still remains practically unknown to the world at large. It requires a motive power of about 8 horse-power while a quantity of steam (representing 17 horse-power) is also used for boiling and cooking purposes. As the water used must be extremely pure, an artesian well has been sunk in the grounds of the factory, and yields a supply of the necessary medium which, like the immortal Bayard, is "*sans reproche*."

Sorrel can only be grown four years in succession upon the same land, which must then be put under other crops for about twelve years. Hence the land bought up for the purpose covers a superficial area of 120 hectares (296 acres). When picked (for which sixty women are employed) the leaves are conveyed, as quickly as possible, to the factory; here they are carefully washed by mechanical means, and are then well cooked in specially-designed digesters or boilers. This interesting industry, which is by no means unprofitable, would well repay consideration, as there is plenty of room for a much larger trade to be done in preserved sorrel—by no means an unpalatable table adjunct.

Two steam turbine sets of 10,000 horse-power each are being installed at a Rhenish-Westphalian power station. They are the largest in Europe.