OUTLINES

OF

COMPARATIVE ANATOMY,

PRESENTING A SKETCH OF THE PRESENT STATE OF KNOWLEDGE, AND OF THE PROGRESS OF DISCOVERY, IN THAT SCIENCE; AND DESIGNED TO SERVE AS AN INTRODUCTION TO ANIMAL PHYSIOLOGY, AND TO THE PRINCIPLES OF CLASSIFICATION IN ZOOLOGY.

BY

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CONTAINING

PART FIRST,

Organs of Relation or of Animal Life,

AND

PART SECOND,

Organs of Vegetative or Organic Life.

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OUTLINES

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COMPARATIVE ANATOMY.

CHAPTER FIRST.

ORGANS OF SUPPORT, OR OSSEOUS SYSTEM.

FIRST SECTION.

General Observations on the Osseous System of Animals.

As animals are organized to select and obtain foreign matter for their subsistence, and to convey it into their digestive organs, to be transported with them from place to place, they generally require some solid means of support for the attachment of their active organs of motion. These denser parts of the body serve as a solid frame-work to give form and solidity to the whole fabric, and to protect the more delicate organs. They consist for the most part of earthy materials separated from the food by the vital processes of the animal, and may be placed on the exterior or in the interior of the soft parts. These inert materials, or passive organs of locomotion receive their forms from those of the soft parts, and are liable to change with the varying conditions of the contiguous living parts. When placed on the exterior of the body, they may, without being organized,

keep pace with the progress of growth in the living parts, by being periodically cast off and renewed; or they may increase by the addition of more extended layers to their surface; or their dimensions may be continually influenced by the contact of the parts which formed them. But when this solid frame-work is internal, and is everywhere surrounded by the soft parts, giving attachment to muscles, or enveloping and protecting delicate organs, it cannot be conveniently removed from the system in a mass, nor preserve its proportions by the mechanical addition of layers to its surface, and is generally organized or permeated in every point by the soft parts which absorb the decayed materials and renew them particle by particle. The earthy materials thus formed by animals for the support of their soft parts are various, and their particles are generally united together by means of a condensed albuminous or gelatinous matter, which gives firmness and tenacity to the mass. Silica is found in the lowest forms of radiated animals; carbonate of lime in the molluscous classes; carbonate and phosphate of lime in the articulated animals, and phosphate of lime in the organized skeletons of the vertebrata. These earths, in consolidating, assume forms by the influence of laws which are in accordance with their ordinary physical properties, this we observe most obviously in the lowest animals, and least in the highest classes where the crystalline arrangement of the particles is most equivocal; but under every condition they alike form a normal part of the structure, a solid frame-work more or less complete, constant in its form and structure in the same species, and varying in its form with the specific differences of animals. This solid framework forms the osseous system of animals, or the *skeleton*, as it has been termed from the dry and earthy nature of the materials which compose it. The osseous system, though not the most important nor the most universal system of animal organization, is met with under some form in every class of the animal kingdom, though not in all the animals of each class.

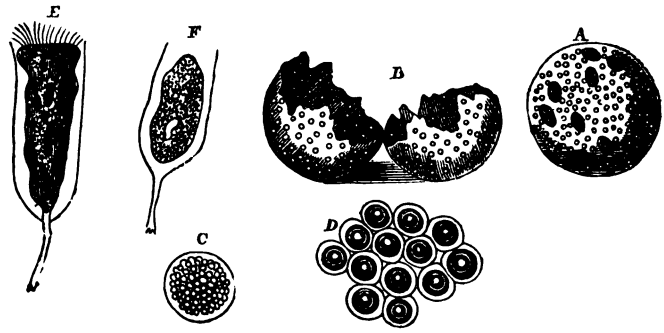
SECOND SECTION.

Organs of Support in the Radiated, or Cyclo-neurose Classes.

THE skeletons are as various as the forms of the animals in this lowest division of the animal kingdom, and scarcely indicate in their composition or structure a determinate plan common to the whole. They are sometimes external, most frequently internal, often composed of minute pieces symmetrically arranged, or of one solid mass, often of a thin flexible diaphanous horny consistence, or composed of dense silicious or calcareous spicula, or of masses of carbonate with a little phosphorate of lime. The osseous parts in these classes appear to be extravascular, and to grow by the juxtaposition of new portions, and from the simplicity of the general structure and functions of these animals, and the internal situation of their solid parts, they are not exuviable.

I. *Polygastrica.*—Many of the minute and soft polygastric animalcules possess an exterior firm, elastic covering, which protects the more delicate internal parts. This covering sometimes consists only of a more condensed form of the common integument, enveloping every part of the body, in others it forms a distinct thin pellucid sheath into which the animal can withdraw its soft parts for protection. The exterior surface, even of the softest and most naked animalcules, supports the organs of motion—the minute vibratile cilia by which they are carried to and fro, and consists apparently of a thin film of the general cellular tissue of their body, rendered more firm in its texture by the continued action of the surrounding element. This condensation of the exterior integument is the origin of most of the skeletons of invertebrated animals, which have generally the organs of support thrown over the surface of their body to afford them at the same time protection. We have an example of one of these loricated animalcules in the *volvox globator*, (Fig. 1. A) so common in stagnant pools of fresh water, and which often owe their green colour to the abundance of this animalcule. This sperical transparent green

FIG. 1.



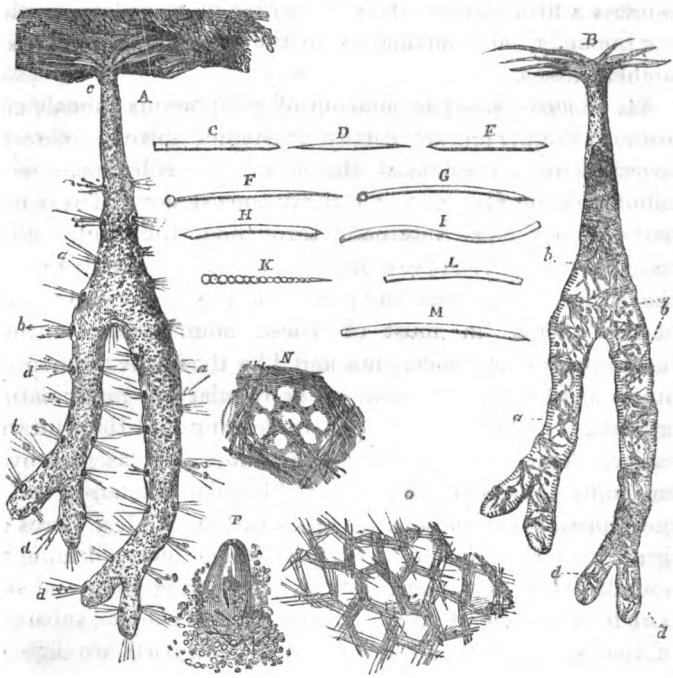
coloured, tuberculated animalcule exhibits in its interior numerous smaller, round, spotted, and similarly formed beings moving to and fro, as seen at A, and the entire volvox does not change or vary its external form while it is seen swimming about slowly with the enclosed young. When the exterior capsule, or the parent animalcule bursts, as is represented at B, and the young have escaped, we observe its fragments to retain their original form with some degree of elasticity when they are tossed about in the fluid by the motions of other animalcules. We see the same transparent elastic integument giving form and support to the *volvox morum*, (Fig. 1. C.) which contains a much greater number of young in its interior, and the same is seen also enveloping the separate globules which compose the body of the *gonium pectorale*. (Fig. 1. D.)

But the most distinct form of the skeleton met with in this class, is that which envelopes the body as a sheath, into which the animalcule can withdraw its soft parts when alarmed, and from which it can extend its ciliated anterior portion for the purposes of nourishment, respiration, or progressive motion. This vaginiform, exterior, thin, pellucid, elastic covering is seen in the *vaginicola innata*, common in sea water. This animalcule, formed like a *vorticella*, is seen in Fig. 1. E, extending its ciliated anterior margin from the opening in its sheath, and swimming by the action of its cilia. The same animalcule is represented at Fig. 1. F withdrawn into its transparent covering and fixed by its candiform projecting posterior part. This form of the skeleton seen in the *vaginicola* leads to the vaginiform horny coverings of *campanulariæ*, and other forms of *keratophytes*. There are

about thirty known genera of polygastric animalcules which possess a firm elastic exterior covering, more or less enveloping the body, and analogous to the more solid skeletons of higher classes.

II. *Poriphera.*—The skeleton of poripherous animals consists of separate minute, earthy, crystalline spicula, connected together by a condensed, elastic, cellular substance; or of tubular elastic filaments of a horny consistence. These hard parts are developed internally throughout the whole cellular tissue of the body, and are often protruded externally through the surface, to protect the pores, or the large vents. The earthy spicula in most of these animals are silicious, in many they are calcareous, and, like the horny filaments of other species, they appear to be tubular like many natural crystals, and to have no aperture leading into their internal cavity. The spicula are generally united into fasciculi by an enveloping glutinous, or condensed cellular substance, and by the junction of these fasciculi in various modes, fibres are formed which traverse every part of the body, forming the boundaries of canals and orifices, and giving form and support to the whole of the gelatinous or soft cellular substance of the animal. The forms of these hard parts are different in every distinct species of these animals, and they are constant in the same, so that they present useful characters for the distinction of species in this polymorphous class. They are formed from materials due to the vital energies of the animal, and they form normal and necessary parts of its structure, like the solid skeletons of higher animals. In Fig 2 is represented at A the *haliclona occulata ;* one of these soft animals, with a *silicious* skeleton. It is represented as alive, suspended from a rock by its spreading branched base of attachment (*c*,) the currents of water are seen at (*a*) rushing in through the pores, and issuing from the internal canals by the large orifices or vents at (*b*). The pores, canals, and orifices are seen exposed in the longitudinal section of the same poripherous animal at B. Fibres composed of bundles of spicula generally extend in a longitudinal direction in these animals from the base of attachment to the remotest points of the surface. Smaller transverse fibres of the same composition connect those which are disposed longitudinally, and form the frame-work of the internal

FIG. 11.

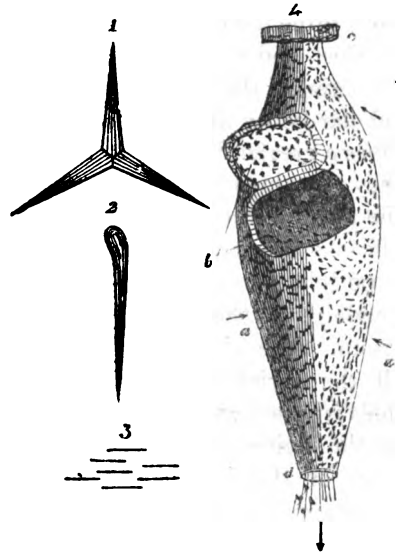


canals. The form of the spicula which belong to several distinct species of poripherous animals are shewn in Fig. 2. at C. D. E. F. G. H. I. K. L. M., each of these forms belonging to a distinct animal, and serving to characterize it. The pores are surrounded with groups of spicula disposed in such a manner as to strengthen and protect the parietes of these minute orifices, and to form a delicate net-work over the whole surface of the body, as shewn on a magnified scale at O, and a single pore is shewn at N still more magnified, with its bounding and defending spicula, and a delicate gelatinous net-work, which protects it from the entrance of small foreign particles floating in the water. The silicious spicula are found in some of these animals while they are yet floating gemmules newly detached from the parent mass, and seeking a suitable place to fix and develope. One of these gemmules is figured at P, highly magnified, and broken to show the spicula already developed in the cellular substance of this minute embryo. Similar silicious spicula occur abundantly

in plants with which these poripherous animals are the most nearly allied.

Several of the animals of this class have the skeleton composed of calcareous spicula which have generally more complex forms than the silicious. They are disposed in the same manner and for the same object through the interior cellular substance of the body. They impart a white colour to the whole body of the animals in which they occur. They do not appear to occur along with silicious spicula in the same animal. The skeleton is generally more loose and friable in the calcareous poriphera, and the connecting glutinous and cellular matter is less abundant. One of these white friable calcareous poriphera, the *leuconia compressa*, very common in our seas, is represented in Fig. 3 at 4 in form of a compressed lengthened sac suspended by its peduncle from any submarine substance (*c*).

FIG. III.

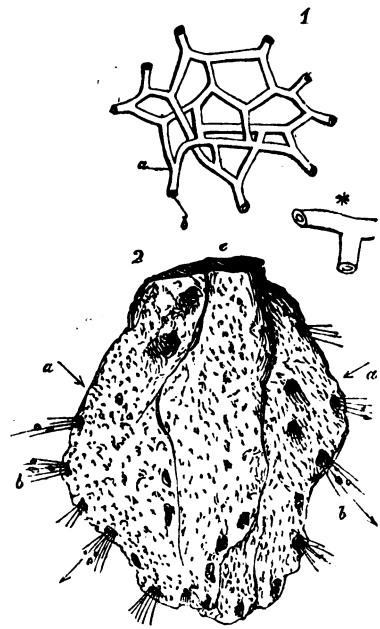


The pores through which the currents are conveyed into this sack are seen all over the exterior surface, as at *a a*; the canals are contained within the thickness of its parietes, and the large vents or fecal orifices here open into the interior, as seen where it is broken open at *b*. The sac being open only at its pendent extremity *d*, the whole of the inhaled water rushes incessantly out through that general aperture. In the silicious skeletons of this class we find but one form of spiculum for each animal; but in the calcareous generally two, and one of these has a triradiate form, as represented in Fig. 3 at 1. This triradiate form of calcareous spiculum is accompanied by one of some other form, as by that clavate form of spiculum belonging to the *leuconia compressa*, shewn in Fig. 3 at 2; the small spicula in Fig. 3 at 3, found in the same animal ap-

pear to be only fragments of triradiate spicula. The triradiate spicula chiefly bound the pores, canals, and orifices, while the curved ends of the clavate spicula hang over the exterior entrance of the pores to protect them. The calcareous spicula do not appear to occur in any of these animals along with silicious forms, and the true horny tubular filaments appear also to occur alone in the more tropical species, without either silicious or calcareous spicula. The calcareous forms of these animals appear to be much more rare, and generally much smaller than the silicious or the horny species.

In the horny species of poriphera the skeleton consists of thin elastic tubular translucent filaments united together and distributed around the pores, canals, and vents. These horny, tough, flexible threads have a close analogy in their mode of distribution through the whole interior of the body to the tough connecting matter of the spicula in the earthy species, and they give form and support to the whole fabric. Sometimes the internal canal which extends through these tubular horny filaments is filled with an opaque matter which gives a greater friability to the threads; but most frequently they contain only a transparent colourless fluid, as we see in the fibres of the common officinal sponge, which is a poripherous animal belonging to this horny group. The skeleton of all the poripherous animals is so soft and flexible in the living state, that none of the lengthened forms appear to be capable of growing in an upright position from their base of attachment. They hang down from the under surface of submarine bodies, as represented in these figures. A specimen of the common officinal sponge with a horny fibrous skeleton, is repre-

FIG. IV.



sented in fig. 4 at 2, as alive and cut from its point of attachment, *c*. The circular minute pores by which the streams of water enter the internal tortuous canals are seen all over the surface, as at *a a*, and the large vents by which the currents issue from the body are seen on the most prominent parts, as at *b b*. The manner in which the horny filaments are united to each other throughout the whole mass of the body is seen at fig. 4, 1, where the broken ends of the fibres show their tubular character, and this is still more magnified at fig. 4.* The meshes formed by these horny fibres, though apparently without order or regularity when the soft parts are removed, have the closest relation to the pores and the tortuous canals which wind through every part of the body. Now we see in these simple skeletons of poripherous animals, as in many vegetables still more remote from human organization, that nature begins the formation of an internal framework for the support and protection of the soft parts, by the deposition of detached earthy spicula throughout the cellular substance of the body, as we see in the human embryo the deposition of minute spicula of phosphate of lime in various parts of the soft gelatinous bones begins the consolidation of the skeleton. The abundance of silicious needles in the skeletons of the lowest poriphera assists in their conversion into flint, when their remains have been exposed for ages in chalk or other strata traversed by silicifying percolations.

III. *Polypiphera.*—The skeletons of zoophytes present a great variety of forms and characters, being branched or globular, or filiform, free or fixed, solid, massive, and calcareous, or soft, flexible, and horny, external or internal. The animals of this class obtaining their food by polypi, or highly organized sacs developed from the fleshy substance of the body, we generally find the skeletons, whether external or internal, to present cavities or cells for the reception and protection of these delicate organs; and the various forms of these cells constitute a principal distinction among the skeletons of this class. The simplest forms of the skeleton are presented by the horny zoophytes, or keratophytes, where it sometimes consists of tough, soft, flexible filaments which surround the cells of the polypi throughout the whole mass of the body, as in the *alcyonium* and *lobularia*. These form a transition from the horny species of poriphera to