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13. **Dictyomitra multicostata, Zittel.**—Shell slender, conical, with prominent longitudinal ribs, and from eight to ten deep strictures. Length and breadth of the joints gradually increasing, the eighth joint being twice as long and broad as the fourth joint. Pores regular, circular, one series in each longitudinal furrow, three to four pores in each joint.

14. **Dictyomitra polypora, Zittel.**—Shell slender, conical, rough, with six to nine deep strictures. Length and breadth of the joints gradually increasing, so that the eighth joint is twice as long and broad as the third. Pores regular, circular, in transverse rows in each joint, the last joint having from five to six rows.

15. **Stichocapsa tyrrelli, n. sp.**—Shell smooth, slender, pear-shaped, twice as long as broad, with three deep strictures. Relative lengths of the four joints, 1 : 1.3 : 4 : 3 ; relative breadths 1 : 2 : 5 : 5.5. Cephalis spherical, hyaline, without pores. Thorax hemispherical, with four transverse rows of regular, circular pores. The fourth joint is the broadest, but is shorter than the large campanulate third joint. Pores in the second, third, and fourth joints of equal size, and all about as wide as the bars.

16. **Stichocapsa dawsoni, n. sp.**—Shell smooth, irregular, ovate, with three internal septal rings, without external strictures. The third joint is the largest, being more than half as long as the shell. Relative lengths of the four joints, 1 : 1 : 5 : 1 ; relative breadths, 1 : 2 : 4 : 3. Cephalis hemispherical, hyaline, without pores. The second and fourth joints small, with three transverse rows of regular, circular pores. The third joint ovate, with truncated poles, and from twelve to thirteen transverse rows of subregular, circular pores.

Biological Descriptions of Certain Common Hydroid Animals.

By H. L. OSBORN,

ST. PAUL, MINN.

(*Continued from page 69.*)

Podocoryne carnea ?* (figs. 17–18).

This is a marine animal. It lives attached to the shell of the spider-crab, *Libinia canaliculata*, in the muddy, shelly bottoms

* Bibliog.—1. Claus Sedgwick, Text-b. Zool., vol i, p. 237.
2. Lankester, E. Brit., ix, p. 560.
3. Gegenbaur, Comp. Anat., p. 94.
4. Parker, Elementary Zoology, p. 236.
5. Lang, Text-Book of Zoology.
6. Romanes, Jellyfish, Starfish, etc., p. 10.

Explanation of Figures of Podocoryne.

Fig. 17. Podocoryne, from nature, showing the reproductive person with the manubrium and tentacles, and the clustered medusa buds in various stages of development, showing the rhizoid, or stolon attached in this case to the shell of the spider-crab.

Fig. 18. Podocoryne from nature, the medusa; rv, radial vessel; vel, velum; S.ku, sensory organ at base of tentacle, eyespot; mar. ten., marginal tentacles in two sets, four shorter; man, the manubriums inside the bell; or, the ovary in the ectoderm on the manubrium.

of sounds and bays of the North Atlantic coast of the United States. In the air it appears like a grayish scum, but when the crab is immersed in water it forms a soft gray velvety layer, composed of the bodies of multitudes of Hydra-like members, collectively forming a colony. The single members of the colony (see fig. 17), called *hydrozooids*, bear considerable resemblance to Hydra, having a tubular body with manubrium and tentacles and central mouth, but there are no gonads nor any lateral hydraform buds, and the body is attached below to a sort of runner or *stolon*, which, by its budding, builds up the colony, the buds as they form not separating from the parent stock as in Hydra. The zooids and the stolon are both cellular and composed of ectoderm and endoderm layers. Both are hollow, and thus all the members are in open connection for purposes of circulation. The zooids are of two sizes and kinds; some larger ones (not shown in the figures) do not bear any buds, and are solely the gatherers of food for their own use and for the use of the colony; other (fig 17.) smaller ones are, besides being feeding zooids, capable of producing lateral globular buds, called medusa-buds or *gonozooids*, because they are to contain the *gonads*. The gonozooids when ready to leave the hydrozooid stock that formed them is a bell shaped gelatinous body (fig 18.)* with a *manubrium* hanging down inside and with the rim nearly closed by a thin membrane, the veil or *velum*, which has a circular opening in the centre. The margin of the bell is furnished with eight tentacles at regular intervals, four longer and four shorter, at the base of each one of which is a bright colored spot, believed to be somewhat sensitive to light. The ectodermal part of wall of the bell is highly contractile muscular cells, and from its shape determines that its vigorous contractions shall force a jet or water out through opening in the centre of the velum, the reaction of which propels the bell in the opposite direction. The gonozooids, or, as they are more commonly called, *medusæ*, as they develop, free themselves from the parent body by these contractions of the bell and then swim independently through the water by the same aid and cease to have any physical relation to the colony which produced them. The manubrium is, like that of Hydra, pierced in the centre by a mouth surrounded by tentacles and hollow within. At the base of the manubrium four *radial tubes* or vessels run out through the substance of the bell into the four larger tentacles, and a *circular tube* runs about in the margin of the bell and places all the *radial tubes* in communication. The bell is covered inside and out with ectoderm; the velum is also ectodermic, and the tentacles and manubrium are covered with it. The inside of the manubrium is endodermic, as are the radial and circular vessels and the inside of the tentacles. The substance of the bell is mainly non-cellular gelatinous matter. The ectoderm at the base of the manubrium is thickened in four

* See Parker, p. 235, fig 54.

places: these are the gonads—male or spermaries, and female or ovaries—and the sexes of the Podocoryne are separate. The eggs are set free in the water, where, if they are fertilized, they develop through stages similar to those of Hydra, and a smaller hydra-form embryo finally forms, which attaches itself and forms a new colony by the asexual process of budding. Where two quite unlike forms, like the hydrozooid and gonozooid, occur in an animal life history, and where the sexual and asexual process of reproduction alternate, it is called an *alternation of generation*, the eggs not being produced directly by the individuals which grew from eggs, but from a generation of individuals produced asexually from those produced from the egg.

Hydractinia echinata.* (fig. 19).

This marine hydroid forms a pinkish film on the shells of snails, *e. g.*, *Lunatia* tenanted by hermit-crabs. It is a polymorphic colony—that is, a colony composed of several kinds of zooids or members; these are first the stolon or spreading network of tubes of ectoderm and endoderm, which, by budding, give rise to the entire colony; then there are the feeding zooids or nutritive polyps, which compare closely with Hydra or Podocoryne, being tubular, terminated with tentacles surrounding a manubrium, also the *dactylozooid* or protective person, which has no mouth or tentacles, but is very mobile and sensitive, and, moreover, is armed with a very formidable array of nettle-cells, and also the generative zooid, a stem terminated with nettle-cells but bearing on its sides numerous large spherical bodies which contain ova; these are believed to be degenerate medusæ, comparable with the gonozooids of Podocoryne. There are no medusæ, but the eggs are set free in the water from the generative zooid; there is thus in this case no true alternation of generations. Hydractinia has a skeleton surrounding the stolon at the base of the colony and projecting in the form of hard spiny prominences which must offer perfect protection to the stolon and considerable protection to the zooids when they are contracted to their utmost. In this case we can see that polymorphism is carried even farther than in Podocoryne.

Tubularia divisa.†

This is a colony of salt-water hydroids, common in many places on our coast, growing on wharf piles and other submerged objects. It is notable for the large size attained by the zooids, they being often as much as $\frac{1}{4}$ inch across. There are distinct stems,

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*Lankester, E. Britt. ix., p. 561.
Agassiz, Seaside Studies, p. 73.
Packard, Zoology, p. 56.

Explanation of the Figure of Hydractinia.

Fig. 19. From nature; part of colony scraped from Lunatia, showing the rhizoid or stolon (Rz), and its branchings and three forms of persons: nut, the nutritious person; dac, the dactylozoid or sensory and killing member, and med, the medusa producing poison; in this case the medusæ are rudimentary, and do not become free.

†Agassiz, Seaside Stud., p. 72. Riverside Natural History, vol. i, p. 80.

long and somewhat wavy and sometimes slightly branched, arising from a ramified basal stolon and shielded with a chitinous external shell; the stems are terminated above by the zooid, which is never covered by any skeleton, the cuticle of the stem stopping short at the base of the zooid. The zooids of the colony are all alike and there is no polymorphism. Each zooid presents a broad basal portion bearing numerous basal tentacles in a circle. Within them is the pear-shaped body at whose base are minute stems bearing numerous spherical *medusa* buds, and at whose summit is the mouth, surrounded by a number of short oval tentacles. The body and stark are both composed of cells arranged in two layers, as in the other cases already described. The medusa buds become separated from the colony, not, however, in the form of a swimming bell, as in Podocoryne, but in a peculiar creeping form known as *actinula*, and from this the egg development takes its start.

Obelia dichotoma* (figs. 20, 21).

This, a graceful hydroid, forming colonies rarely more than an inch in length, covering submerged objects of all sorts in the purer ocean waters, it is one of the common hydroids attached to seaweed on rocky shores of outer harbors. The colony slightly magnified (fig. 20) presents a zigzag stem, bearing alternate zooids. The zooids are very small, much smaller than in Podocoryne, etc., but the same structural plan can be detected in them. A main stem runs up from the stoloniferous base, and this stem is a fleshy tube, covered with a horny outer skeleton. This latter is made up of successive joints like each other, but leaning either way alternately. At each joint of the cuticular stem the fleshy tubular stem within gives off a branch which is the special stem of a zooid. This stem is covered by a ringed cuticular covering, terminated with an exquisitely delicate cup, "hydrotheca" or "calycle," into which the zooid can retreat for protection. This zooid is a feeding member (hydrozooid) of a polymorphic colony. It has a circlet of tentacles surrounding a central manubrium. All the fleshy parts of the body are cellular, ectodermal and endodermal, and they differ from Hydra in no essential respect, but only in details of form. Besides the numerous hydrozooids there are occasionally borne, at joints of the stem, larger bodies, composed of a vase-shaped cuticle, gonotheca, protecting a delicate stalk within which is open below to the channels of the main stalk and on the side to numerous globular buds, which are medusæ in process of development, which latter are to escape in the water as free medusæ, there to

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* Biblio.—Brooks, Inv. Zool., p. 30.
Riverside, Nat. Hist., p. 84.
Lankester, E. Britt., ix, p. 560.
Agassiz, Seaside Stud., p. 50.

Explanation of Drawing of Obelia.

Fig. 20. Obelia colony as it appears to the naked eye.

Fig. 21. Small part of 20 highly magnified, showing the chitinous outer skeleton of the main stem and of the zooids, and the two forms of zooids, the nutritive zooid and its cover, the calycle or hydrotheca, and the gonozooid or medusa producing person and its cover, the gonotheca.

reproduce sexually or found other colonies like the one from which they sprang. These medusæ are broad and flat, not bell-shaped, and have no veil, but they have marginal tentacles, radial vessels manubrium, and mouth. (The devolopment of the obelia egg is described by Haddon, Practical Embryology, p. 49.)

Sertularia pumila.*

Here, as in Obelia, we have a colony of extremely minute zooids, the colony itself having the appearance of a plant, whence its name of sea-moss has been applied to it. The colonies are generally found abundantly on the green rock-weeds (*Fucus*), so very numerous on the rocky shores of the New England and Middle States. The colony as a whole is short and usually closely applied to the rock-weed. It consists of a central stem and lateral branches which arise from it and slant away from the base of the colony. The stem appears to be notched; these notches when closely examined reveal the chitinous hydrothecæ, which lodge the extremely small feeding zooids. The cups are sessile on the stem, not stalked as in *Obelia*, and they are opposite each other (they are alternate in *Hydrallmania*), and each one has a little cover, *operculum*, to close the end of the hydrotheca when the zooid is retracted. The feeding zooids are connected by the fleshy main stem, so that, as in all hydroid colonies, the combined product of their digestive processes can form a sort of blood, and circulate throughout the entire colony and supply every member. The colony includes, besides the feeding zooids, fewer gonozoids; these are contained in larger capsules of chitine; they present a stem which produces medusæ by budding. The medusæ, in the case of *S. pumila*, however, and in many of its allies, have no mouth and never become free, but they produce eggs or spermatozoa, and set them free, after which they are of no further use to the colony.

Nanomia cara.†

In all the hydroids mentioned up to this point I think any one

*Bibliog.—Agassiz, Seaside Stud., p. 66.
Packard, (S. abietina) Zool., p. 61.
S. argentea, Riv. Nat. Hist., p. 86.

Explanation of the Figure of Sert. pumila.

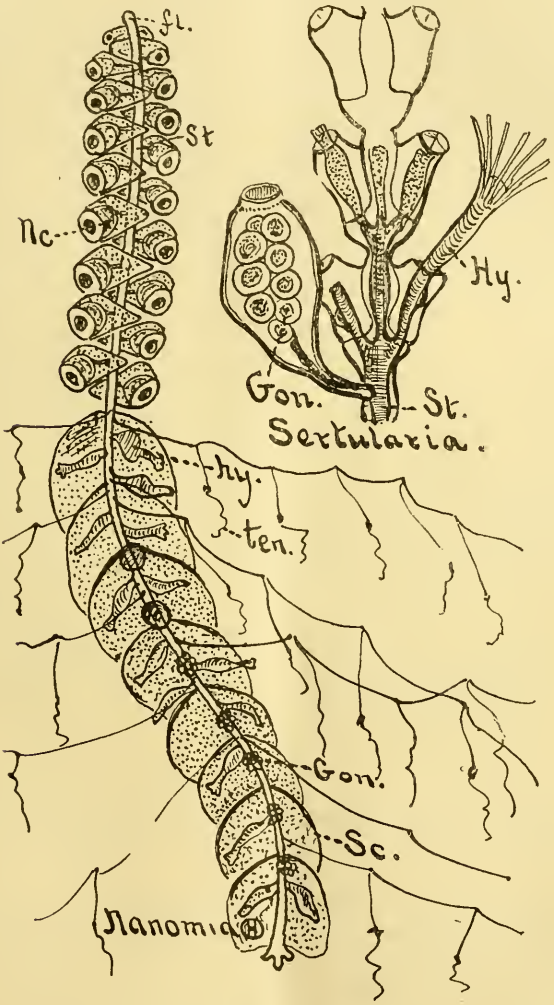
St., common stem of one of the ultimate subdivisions.
Hy, single feeding zooid, and shows also its hydrotheca; the operculum shows in the one above.
Gon, a gonozooid stem; the sexual buds, and the large gonotheca covering them.

†Bibliog.—Agassiz, Seaside Studies, p. 76.
Lankester E. Britt, ix, p. 564.
Fewkes, Bull. Mus. Comp. Zool., xiii, p. 213.
Huxley, Oceanic Hydrozoa.

Explanation of Figure of Nanomia cara.

From Fewkes with slight changes.
Fl, the float at the closed end of the main stem.
St, the main stem, at the lower end of which is the parent zooid of the colony.
Nc, nectocalyx or sterile bell for swimming.
Hy, one of the feeding zooids.
Ten, portion of one of the tentacles.
Gon, gonozooids.
Sc, hydro-phyllum or scale covering the zooids.

would see that the individuality of the colony as a whole is not very prominent, and would think of the colony not as an animal but as a colony of animals, each zooid impressing him by its own individuality. But just as in Hydra the individualities of the cells



are lost in the higher unity of the resultant animal, so in hydroid colonies it is possible to find some in which the entire colony is such a unified whole that the separate zooids sink to the level of organs in the higher individuality of the whole organism. This view is very clearly illustrated by *Nanomia*, a member of the

order *Siphonophora*. *Nanomia* is a pelagic organism; that is to say, it is found only in the ocean surface waters, usually out at sea. It is translucent, whitish, with numerous long filaments trailing after a central straight body, which moves forward with gentle impulses. The elongate body is buoyed up by a bubble at one end so as to maintain an oblique but nearly vertical position. It is a hydroid colony. A main stem runs through from the bubble, which equals the base of a fixed colony, to a terminal zooid at the opposite end; just below the float are about 20 sessile medusa-bells which are diverted from their reproductive function and never become free, and their powers of locomotion are utilized for the benefit of the colony as a whole. In return they are relieved of the labor of capturing and digesting food and are supplied from the main stem. These persons are called *nectocalyces*. Below these are located nutritive zooids; these have no tentacles but are hollow tubes with a terminal mouth open below to the main stem, and their exclusive function is to digest food which is captured for them by the long tentacular streamers armed with formidable nettle-cells which reach out over a considerable area and sweep into their destruction innumerable denizens of the surface water of the ocean to be the food of the colony. The base of the tentacle and feeding persons are covered by broad thin *shields* which are so placed as to lap over each other from above downward. The main stem carries modified medusæ which produce the generative elements and throw them off into the water, where they develop and form new colonies. *Nanomia* is thus comparable with an entire colony of other hydroids, and yet its individuality is such that we are not so likely to notice it as a colony except as we compare it through a series like that we have been considering. Other forms of Siphonophores are even more highly specialized so that their colonial derivation is even less easily discernible, such, for instance, as the beautiful Porpita and the Portuguese man-of-war.

A Sliding-Carriage and Stage for the Microscope.

By GEO. WHITFIELD BROWN, Jr.,
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The following description and drawing of plan and section of an improved sliding-carriage and stage for the microscope may be of interest. If put into actual use it will, I hope, bring as much comfort and satisfaction as it has brought to me.

After considering the qualties useful in a good stage, Dr. Dallinger concludes (Carpenter, 7th ed., p. 169) that an efficient substitute may be found for a mechanical stage in what he terms a "super-stage," so arranged that the bearings shall be glass, and friction reduced to a minimum. He says that "against its employment is the fact, first, that the slide is clipped into a rigid