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(With plates 21 and 22.)

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The following 'notes' on a few Hydromedusae obtained at Naples during the spring and summer of 1903 comprise a series of observations upon several species, some of which are believed to be new, others more or less rare, and all of more than ordinary biological interest. It is believed that the account submitted may have some value both as to the morphological and faunal facts concerned as well as a contribution toward a clearer knowledge of some hitherto disputed problems.

Pachycordyle Weismanni sp. nov.

During the month of May I obtained several colonies of an interesting hydroid which in many respects seems closely allied to *Pachycordyle napolitana* Weismann, but which will be seen to have some sharp differences. The colonies were obtained from the Bay of Naples at comparatively small depths and all inhabiting the shell of a living snail, *Fusus rostrata*. The hydroids live fairly well in the aquarium, having been kept under observation for as much as a week at a time. During this time several medusae were liberated, thus affording opportunity for critical study of the entire life history of the species, excepting that of the embryo. As intimated above, the hydroid seems to live 'fairly' well in the aquarium. It was, however, evident that with successive days under this changed environment there was more or less decline in vigor, both of the hydroid and developing medusae, for the first medusa, which was born during the first day in the aquarium, exhibited a vigor and activity

quite lacking in those born several days later. The colony continued to live, however, and medusae were liberated during an entire week, at the end of which time the hydroids were killed and preserved for subsequent study of morphological details here-in-after described. Most of the material was fixed in alcoholic-corrosive solutions, and in 10 % solutions of formalin in sea-water.

It may be remarked, incidentally, that of the preserved material some was worked up soon after preparation, and other portions after my return several months later, and with an experience similar to that which I have elsewhere mentioned, namely, that better results were obtained from the newly prepared material than from that long preserved. This I believe may be regarded as a general rule having few exceptions so far as coelenterates are concerned. Sections were in almost all cases stained by means of HEIDENHAIN's iron-haematoxylin, followed in some cases by Bordeaux-red, with excellent results.

Systematic.

The genus *Pachycordyle* was instituted for a hydroid found by WEISMANN at Naples, and described by him in his monograph[1]. It is unnecessary to cite in detail his description of the hydroid except on certain points involved in comparisons.

As I have noted above, the general features of the present hydroid have much in common with that described by WEISMANN. The one feature in particular which would seem to sharply distinguish the two is the fact that WEISMANN's species is recorded as having only sessile gonophores while in the present case, as already cited, the gonophore is a free medusa, however, a short-lived one.

It should be noticed in this connection that WEISMANN's specimens were all male, while strangely enough in the present case I was only able to obtain female colonies. Whether this circumstance of itself affords room for doubt as to the specific difference of the two may be open to some question, of course, tho so far as my observations have gone, as a rule where the medusa is free in one sex of a given species it is almost invariably free in both. I have elsewhere shown[2] that occasionally specimens of *Pennaria tiarella* are found in which many of the female medusae discharge their

[1] Die Entstehung der Sexualzellen bei den Hydromedusen. Jena 1883 pag. 87.

[2] Amer. Natural. Vol. 34 1900 pag. 391.

eggs without becoming free, tho I have not noticed this feature among male colonies.

It should also be said that in the species under consideration the gonophores in their earlier stages of development show every aspect, whether of form or structure, of sessile sporosacs. But since these come to maturity within a few days it would seem as if WEISMANN could hardly have failed to distinguish the development of the medusa and its probable birth. Moreover, he describes the gonophore as having a ramified spadix. While this may be the case during early development, in the mature medusa it has entirely disappeared. Whether here again the difference of sex may involve difference of structure must remain an open question, at least for the present.

Incidentally it may be worthy of remark that WEISMANN's specimens were obtained from considerable depths, '40 meters', and from the shell of a species of *Murex*, while as noted above the present specimens were all found on a shell of another genus and at small depths.

While owing to the fact that only one sex has been available for these comparisons and from which to formulate diagnostic definitions there may naturally remain some doubt as to the distinctness of the species, I am, however, strongly convinced of its specific independence, and venture to propose for it the name *Pachycordyle Weismanni*, in honor of the author of the genus and his distinguished contributions to hydroid morphology.

Specific Diagnosis.

Trophosome: Colony arising from a delicate, reticulated hydrorhiza. Hydrocaulus sparingly branched, from 3—8 mm high. Perisarc somewhat dense, not extending beyond the base of the hydranth, dull yellowish brown in color. Hydranths club-shaped, with sub-conical hypostome. Tentacles from 8—16, filliform, becoming delicate and thread-like when fully expanded (Pl. 21 Fig. 1).

Color: Hydranth body orange or reddish, hypostome whitish.

Habitat: Upon the shell of *Fusus rostratus*.

Gonosome: Medusa buds borne on side of stem, rarely on lateral branches, pear-shaped as they approach maturity, seldom more than two or three on a single polyp, the entire gonophore enclosed within a sheath of perisarc (gonangium?). The medusa escapes from the capsule by rupturing or dissolving the distal end, after which the

capsule may often be found in a partially collapsed condition upon the stem or branches.

Medusa piriform, with prominent apical projection. Size 2 mm high by 1.3 mm broad. Velum narrow, velar opening very small. Manubrium rather large, conical and devoid of peduncle. Bell very transparent, with scattered nematocysts over the exumbrellar surface. Radial canals lacking, marginal canal simply a fissure of varying size between the layers of ectoderm with vestiges of entodermal lining near the margin. Tentacles entirely lacking. The medusa is devoid of color except on the manubrium, which varies from orange to dark brown. Mouth wholly lacking. When first liberated the medusa swims with a short, jerky motion, tho of limited vigor, a few contractions appearing to exhaust the little creature. Eggs are discharged almost immediately after the birth of the medusa, the life of which is very ephemeral, not exceeding one or two hours (Fig. 2).

Origin of the Germ Cells.

Concerning the origin of the germ cells my observations upon this species agree in most points with those of WEISMANN on the related species, in so far as actual conditions are concerned. He finds these cells in the entoderm, and there only, yet rather insists upon the probability of their descent from ectoderm cells, while as yet in an indistinguishable stage. His specimens being all male in which, as he says, the primitive germ cells are small and correspondingly difficult of recognition, affords some plausibility for his contention, tho he likewise makes similar claims concerning the ultimate source of egg cells in other genera.

These speculative deductions are without any support from my own observations, tho as already noted, they were restricted to female colonies entirely and therefore cannot of course be claimed to prove those of WEISMANN to have been wholly in error. In the species under consideration the germ cells originate in the entoderm and are not found elsewhere at any time during their growth or maturation. As is very well known, the size and character of the egg cells render them easily distinguishable even at a comparatively early period in their development. In sections of the hydroid stem in both long and cross series and stained by various methods I have found no evidence of their occurrence other than in the entoderm.

Moreover, these sections failed likewise to afford any evidence of WEISMANN's so-called "Keimzone". While eggs are found usually in greater numbers in the immediate region of the gonophore buds, as might be naturally expected, than in other portions, still they are found in not inconsiderable numbers at points more or less remote from this region, both above and below.

As a rule the egg cells are found in the deeper portions of the entoderm, tho not unusually they are found to occur likewise on the surface as shown in Fig. 3. Occurring in greater numbers in the region near the origin of the gonophore, and possibly also inciting its development, they seem to be carried into the bud during its formation and development. It would seem, however, that there is a migration of egg cells directly into the gonophore from adjacent portions of the stem, since it hardly seems probable that the large numbers which finally occupy the gonophore could have originated in immediate contact with it. Such a migration is well known in many other hydroids and may be accepted as occurring here, tho no direct evidence of it has been observed in the course of the present research. With the growth of the gonophore there seems to be a segregation of eggs into groups, or nests, about which there are developed follicular folds of the entoderm, as shown in Figs. 4, 5, in some cases entirely enclosing them. Others continue to lie in close contact with the entoderm lamella and finally form the superficial layer in the free medusa.

Development of the Gonophore.

As already intimated, the gonophore arises as a bud from the side of the stem, or more rarely upon a branch. It is at first indistinguishable from an ordinary hydranth bud, involving a direct evagination of both ectoderm and entoderm. The presence of eggs in immediate contact with it usually reveals its true character. From the first and throughout its entire development nematocysts are found in the ectoderm and multiplying during development furnish the nematocyst clusters of the exumbrella of the medusa. In iron haematoxylin preparations they stain a deep black during early development, as may be noted in several of the figures.

At first the gonophore is a simple club-shaped organ, as shown in several of the figures, but soon takes on a typical pear-shaped aspect, as shown in Fig. 5. At about this time there seems to be a cessation of the process of ovarian migration into it and very soon

the proximal portions seem to constrict to form the pedicel of the gonophore. Somewhat later the constriction cuts off the gonophore from direct communication with the enteron of the stem, as shown in Fig. 6. Coincident with these changes there appear at the distal end of the organ, which up to this time has been simply a typical two-layered sporosac, a proliferation of ectoderm cells, the dissolution of the middle lamella and the ingrowth of the ectodermic plug to form the so-called bell-nucleus (Glockenkern), as shown in Fig. 4. The presence of numerous karyokinetic figures, as well as the micro-chemical reactions of the cells betoken the intense activity of the growing tissue. At first the bell-nucleus is rather globular in form. Very soon, however, it assumes an oval outline and continues to flatten and extend laterally in all directions. With this flattening of the structure there is reestablished the supporting lamella, a layer of entoderm is formed between it and the bell-nucleus, so that the latter comes to lie between the outer layer and the inner which contains the eggs. Coincident with this development and gradual extension of the bell-nucleus there has been a differentiation of its cells. Along its entire inner surface there has been differentiated a single layer of cells, forming in section a delicate chain-like series extending the entire length of the growing band, as shown in Fig. 5.

This growth and differentiation continues, gradually extending as a delicate sheet, laterally and proximally, the inner chain-like series forming an extremely delicate ectodermal membrane over the outer egg layer, the other layer of ectoderm forming the lining of the sub-umbrella of the medusa and overlying the thin layer of entoderm, to which reference was made above. This process continues till about half of the interior cavity of the gonophore is thus supplied with a double layer of ectoderm, one covering the eggs, which in the mean time have become somewhat evenly distributed over the developing manubrium, the other constituting the lining of the bell, as just mentioned, and as shown somewhat diagrammatically in Fig. 7.

With the completion of this ectodermic investment there occurs, apparently, both an expansion of the lateral walls of the gonophore to approximately the shape of the future medusa, and also a contraction of the entodermic walls into a more nearly cylindrical and conical shape, thus giving rise to the manubrium already referred to. This contraction to form the manubrium is apparently a purely