A New Fresh-water Hydroid from Otago.

Cordylophora lacustris Allman var. *otagoensis* n. subsp.

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CONTENTS.

INTRODUCTION AND CLASSIFICATION.

THE species described grows fairly abundantly in Tomahawk Lagoon, Dunedin, and was discovered early in March, 1926, by the Rev. Dr. J. E. Holloway of Otago University.

The thanks of the writer are due to Professor W. B. Benham and Dr. H. J. Finlay for their advice and assistance, and to Professor R. Speight, of Canterbury Museum, and Mr. G. H. Briggs, of Sydney University, for the loan of specimens.

The species is evidently a member of the family Cordylophoridae Finlay, which according to Farquhar's list of New Zealand hydroids (Farquhar, 1895) is represented in New Zealand by two species only—*Tubiclava rubra* Farquhar, 1894, and *Cordylophora* sp. Hamilton, 1883. Hilgendorf (1897) later identified a hydroid from the Dunedin wharf as *T. fruticosa* Allman, but Bale (1924) considers that Hilgendorf's species is probably identical with *T. rubra.*

Comparison with a specimen of *T. rubra* from Canterbury Museum shows that, as regards size and general appearance, the species from Tomahawk Lagoon superficially resembles *T. rubra* rather than *Cordylophora.* The detailed structure and the method of attachment of the gonosomes are, however, entirely different from those of *T. rubra,* but, when compared with Allman's descriptions and figures of gymnoblastic hydroids (Allman, 1871), show close agreement with *Cordylophora,* a genus which is considered by most authorities to be represented by the single widely distributed species *C. lacustris* Allman, and its more restricted local varieties. The form from Tomahawk Lagoon nevertheless shows sufficient differences from *C. lacustris* to rank as a definite subspecies, for which I now propose the name *Cordylophora lacustris* Allman subsp. *otagoensis* n. subsp.

The *Cordylophora* sp. of Farquhar's list (1895) was found by Hamilton (*loc. cit.*) in the Esk River near Napier, and doubtfully identified by him as *C. lacustris* Allman. Farquhar (1894) considered it possibly identical with the Australian *C. whiteleggei* Lendenfeld, 1886, which Stechow (1912) has placed as a synonym of *C. lacustris,* or at the most as a possible variety of that species.

The species from Tomahawk is, as already indicated, somewhat different from the typical *C. lacustris*; but, since the description given by Hamilton (*loc. cit.*) of the Esk River form is very generalized and gives no information as to detail of structure, it is very probable that it is identical with the species described in the present paper.

In a recent paper Finlay (1928), in discussing the nomenclature of the Cordylophoridae, gives his opinion that the name "*C. fluviatilis* Hamilton" was definitely proposed for the Esk River (Petane) form by Hamilton in his paper of 1883. Now Hamilton merely states that,

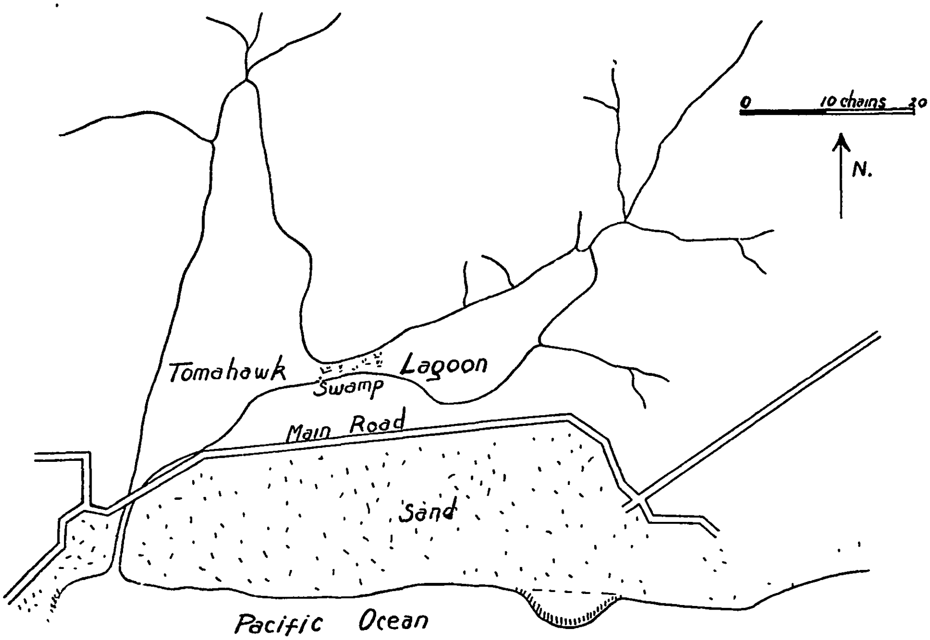

FIG. 1.—Map of Tomahawk Lagoon.

in view of the occurrence of the Petane hydroid in river and not in lake waters, *fluviatilis* would be a more appropriate name for the species, but at the same time he definitely identifies it with the European *C. lacustris.* To suggest that he proposed the name *C. fluviatilis* for the Esk River species, seems to the present writer to be stretching the facts a little too far, and in any case the absence of figures or any description of distinctive characters appears to be sufficient to invalidate his name. Since, on account of its previous indefinite standing, Finlay now proposes to validate Hamilton's name *fluviatilis,* the question arises as to whether, if *C. fluviatilis* Hamilton is invalid, *C. fluviatilis* Finlay may nevertheless still be substituted as a valid name. Here again, however, in the absence of detailed description, figures, or any information of diagnostic value other than a statement of the locality of its occurrence, *C. fluviatilis* Finlay appears to the writer to rest upon only a very insecure foundation. Furthermore, the writer of the present paper has been unable to examine material from Petane, so that though the species from that locality is probably identical with that from Tomahawk Lagoon, identity has not been proved. Consequently it seems better to provide a new and definite name for the Tomahawk species, rather than to add to the confusion by applying to it either of the extremely doubtful name *C. fluviatilis.*

HABITAT.

Tomahawk Lagoon (see Fig. 1) is a shallow sheet of water consisting of two separate arms which communicate with one another by means of a narrow strip of almost stagnant swamp, bridged by a small culvert. The western arm opens into the sea by a narrow outlet, across the mouth of which drifting sand has accumulated as a bar through which the sea breaks only at abnormally high tides. The water in the outlet and in the western arm of the lagoon is therefore brackish, while in the eastern or upper branch it is quite fresh.

In every instance except one where the hydroid was collected, it was found attached to the stems of a sedge *Ruppia maritima*—not to the fresh green stems near the surface of the water, but to the blackened dead-looking stems at some small depth below the surface. This is probably due, not to any preference on the part of the hydroid for an old stem, but to the fact that the green *Ruppia* grows where there is a fair current of water, or floats on the surface in the sunlight, whereas the hydroid prefers a sheltered situation where the water moves slowly and the sunlight is not so bright. The hydroid was not found at all in the waters of the eastern arm, although a number of patches of *Ruppia* were observed there growing in shallow water; but in the almost stagnant fresh water beneath the culvert at the junction of the two arms, it was found in small quantity attached not only to decayed *Ruppia,* but also to a green *Chara.* The main supply was obtained from the outlet of the west arm of the lagoon, which is moderately deep with *Ruppia* growing plentifully on either bank. No specimens were observed along the west bank which receives the force of the current from the lagoon; but all along the opposite side as far as it was sheltered from the direct course of the current, the hydroid grew in profusion below the surface, attached to blackened stems of *Ruppia.* It would seem then that the hydroid from Tomahawk shuns the direct sunlight and favours a sheltered situation in slowly moving fresh or slightly brackish water.

This corresponds with the description of the localities recorded for *C. lacustris* in various parts of England,* but is, on the contrary, quite the reverse of the conditions described by Clarke (1878, p. 232) for *C. lacustris* in Curtis Creek, near Baltimore, U.S.A. In this latter case, the mouth of the creek has a narrow channel on one side

*See for example *Nature,* 1891, vol. 44: J. Bidgood, p. 106; T. Shepheard, p. 151; H. Scherren, p. 445.

flowing out into the sea, and Clarke describes the locality thus:—"In the Channel where the sunlight is the strongest, owing to the much less abundant growth of vegetable life, where the current is most rapid and nearest to the mouth, where the changes in the

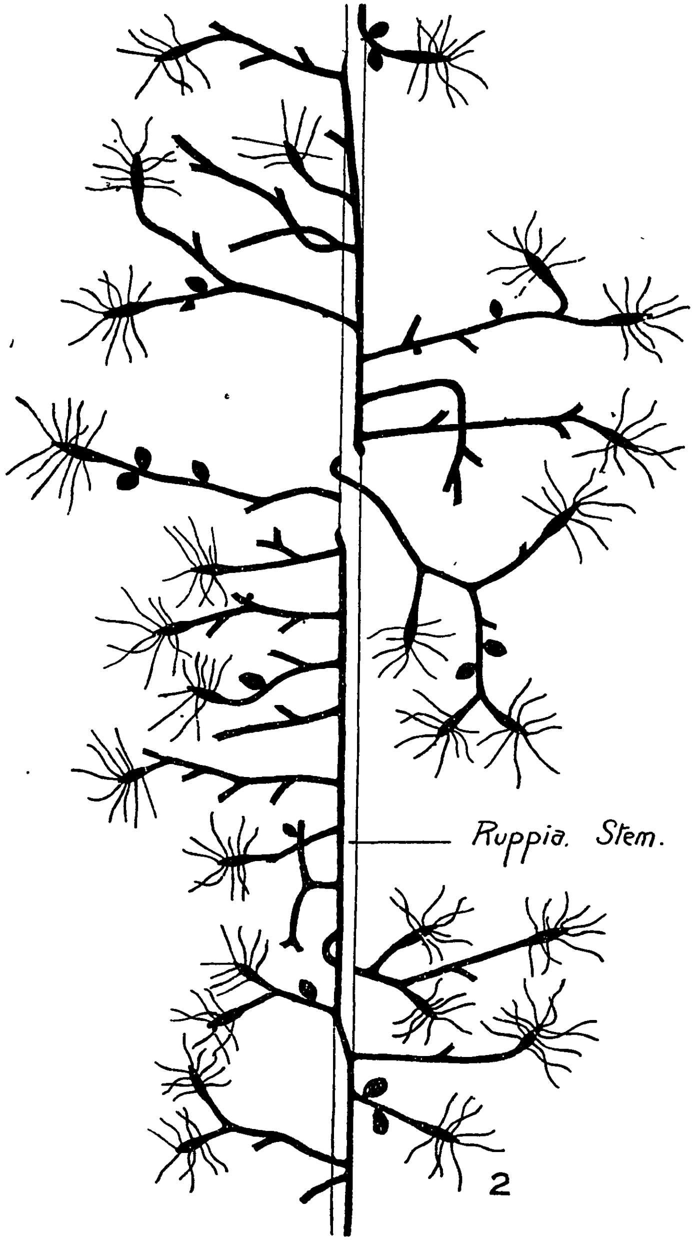

FIG. 2.—A Colony of *Cordylophora lacustris* var. otagoensis attached to the Stem of *Ruppia maritima.*

surrounding conditions must be greatest, there we found the colonies in their greatest luxuriance." *C. lacustris* must, then, be capable of adapting itself to a complete change of habit, and it follows that the new variety here described also may later be found to flourish under conditions somewhat dissimilar to those described in this paper.

Specimens from the outlet were collected at various times throughout the year from March to September. The colonies were largest and most abundant during March and April. Those collected at the end of March had female gonosomes only, but in the middle of April the colonies were found to be nearly all males with occasional females. At the beginning of June the older colonies were not so flourishing and carried only occasional female gonosomes, while a fortnight later these had all disappeared and the majority of specimens collected were young growing colonies. Unfortunately, during the period of wet weather which then intervened, the lagoon rose rapidly, making it impossible to collect from the outlet. In September, when the waters had regained their normal level, it was found that the outflowing current had carried away all the *Ruppia* from the banks of the outlet, and with it the hydroid. The only specimens that could then be found were those from under the culvert at the junction of the two arms, and these bore no gonosomes.

Detailed Description.

The Trophosome: The hydrophyton consists of a moderately branched hydrocaulus springing from a long, straight (or slightly turning), unbranched hydrorhiza (see Fig. 2), occasionally observed dividing into 2 branches, each twining along a stalk.

The stems from which the hydranths spring do not differ in any way—colour, thickness, texture, general appearance, etc.—from the main stalk which attaches itself to the *Ruppia*-stems. This main stalk seems to be the hydrorhiza and is quite different from that of the typical *C. lacustris,* which is much branched. In most cases the hydrocaulus is relatively small—under 2 cm.— and little ramified; but in some specimens from deeper water, what seems to be the hydrocaulus is much longer—up to 4 cm.—and more branched. As fragments of weed are occasionally found attached to this, and as the weed easily rots away, it is uncertain whether this is a well-branched hydrorhiza or whether the hydrocaulus is capable of attaching itself to the weed.

The hydrocaulus in the smaller and younger colonies is usually unbranched. In the fully developed colonies it is irregularly branched, the average number of hydranth-bearing branches (exclusive of the terminal hydranth) being three, though the maximum number observed was five. The average height in the large colonies is about 10 mm. to 18 mm., while the largest hydrocauli in the smaller colonies do not usually exceed 7 mm. to 9 mm.

The perisarc is transparent, with about ten close annulations at the origin of each branch, and gradually loses itself on the neck of the hydranths.

The hydranth (see Fig. 3 B) possesses the same general shape as in *C. lacustris,* i.e., the proximal half is cylindrical, very slowly

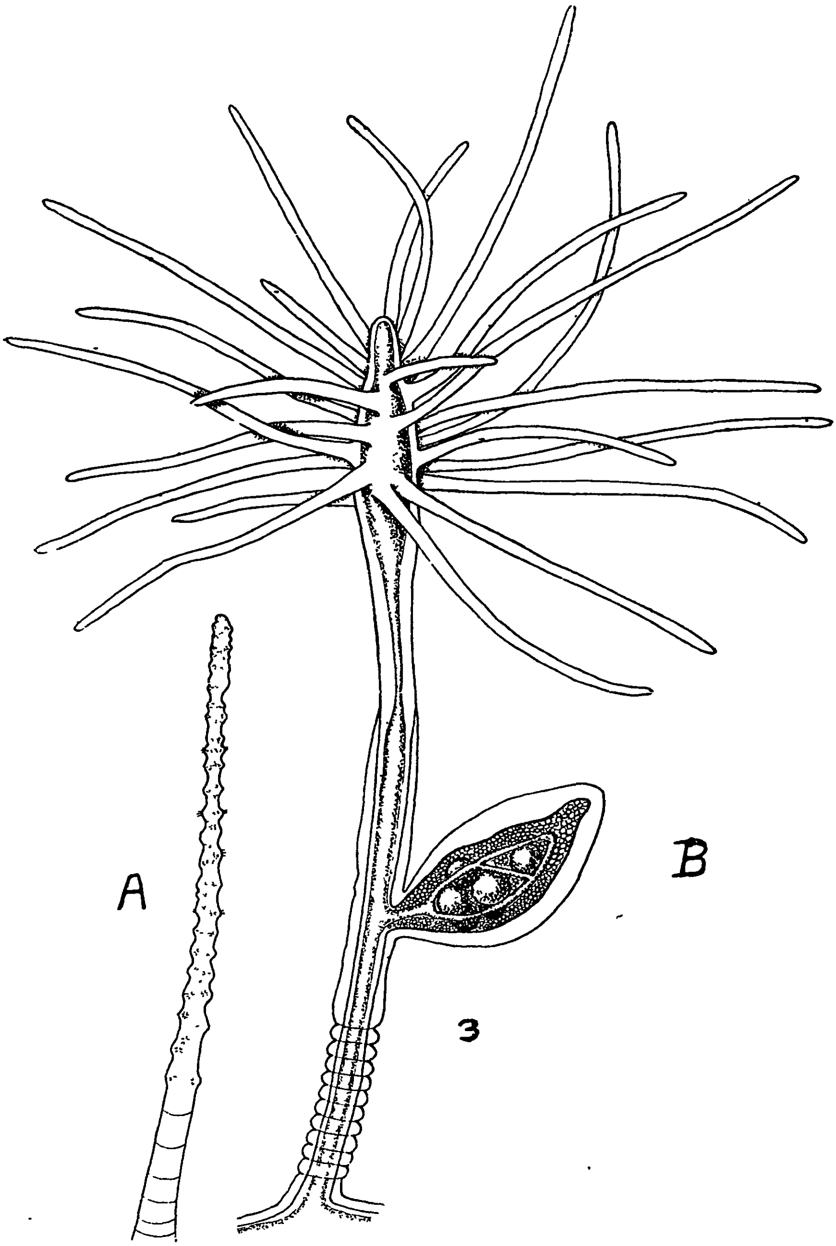

FIG. 3A.—A Tentacle enlarged to show the nematocysts.
FIG. 3B.—Hydranth with young female gonosome.

swelling to a point below where the tentacles commence, and thence swelling rather more rapidly to a point where there is a contraction and prolongation into a distinct snout—like hypostome. The colour is milky white and translucent, deepening to pale buff towards the base of the hypostome. The tentacles vary in number from about thirteen on young hydranths to an observed maximum of thirty on a large polyp (average about twenty-three). They are simple, filiform and very slender, being about one-sixth the width of the lower part of the hydranth; minute nematocysts are scattered over the whole surface as in the typical *C. lacustris,* and the extremities are very slightly thickened (see Fig. 3 A). The tentacles are twice as long as the gastrovascular cavity, and are characteristically disposed as follows: none project forward in line with the hydranth; those that grow on the distal quarter of the hydranth (about two-thirds of the total number) spread out in angles up to 45 degrees, while the remainder project at right angles to the hydranth or even bend backwards a little. The tentacles, even when fully retracted, do not all point forward as in Allman's figure of *C. lacustris* (Allman, *loc. cit.,* pl. 3, Fig. 1) but at least one-third of them still point horizontally or backwards.

The Gonosome (see Fig. 3 B) is adelocodonic, ovoid in shape, with the proximal portion broadened. The gonotheca is almost filmy in thickness, in contrast with the several layers shown in Allman's figure of *C. lacustris* (Allman *loc. cit.,* pl. 3, Figs. 1, 3), and is separated by a wide space from the perigonium which is also a thin film of the same general outline as the gonotheca.

(a) *The Female*: The gonosome is at first moderately elongate and bluntly pointed. (See Fig. 4.) Inside the perigonium can be seen several arms of the spadix enclosing obscurely outlined eggs. These arms are continuous with the coenosarc and are marked by larger and darker dots. In the early stages they are short and only slightly branched, but later become more branched and extend to the distal end of the gonosome. As development proceeds, the gonosome becomes more spherical, the arms of the spadix gradually disappear, and the whole space enclosed by the perigonium is completely filled by about 10 to 15 large, globular eggs. The ripe gonosome is larger than a fully contracted hydranth, and is about half as long as an expanded one. The spadix also is much reduced, there being no trace of the long, hollow, club-like process seen in the typical *C. lacustris* of Europe, but what remains is only a short stalk terminating in a cup-shaped body a little broader than an egg (see Fig. 5). In some specimens, four equidistant pointed projections were distinctly visible at about right angles to the axis of the stalk, and it may be that these projections represent the extremely reduced remnants of the radical gastrovascular canals. (See Figs. 5, 6.)

During development the eggs increase in size and often become fewer in number. This is perhaps due to the fact that the perigonium encloses both egg-cells and nutritive cells, the former of which grow at the expense of the latter. Moreover, in a few specimens of well-developed gonosomes, very small cells were observed among the larger ones (see Fig. 5)—in one case five of each kind—which would suggest that the small cells are reduced nutritive cells. One or two

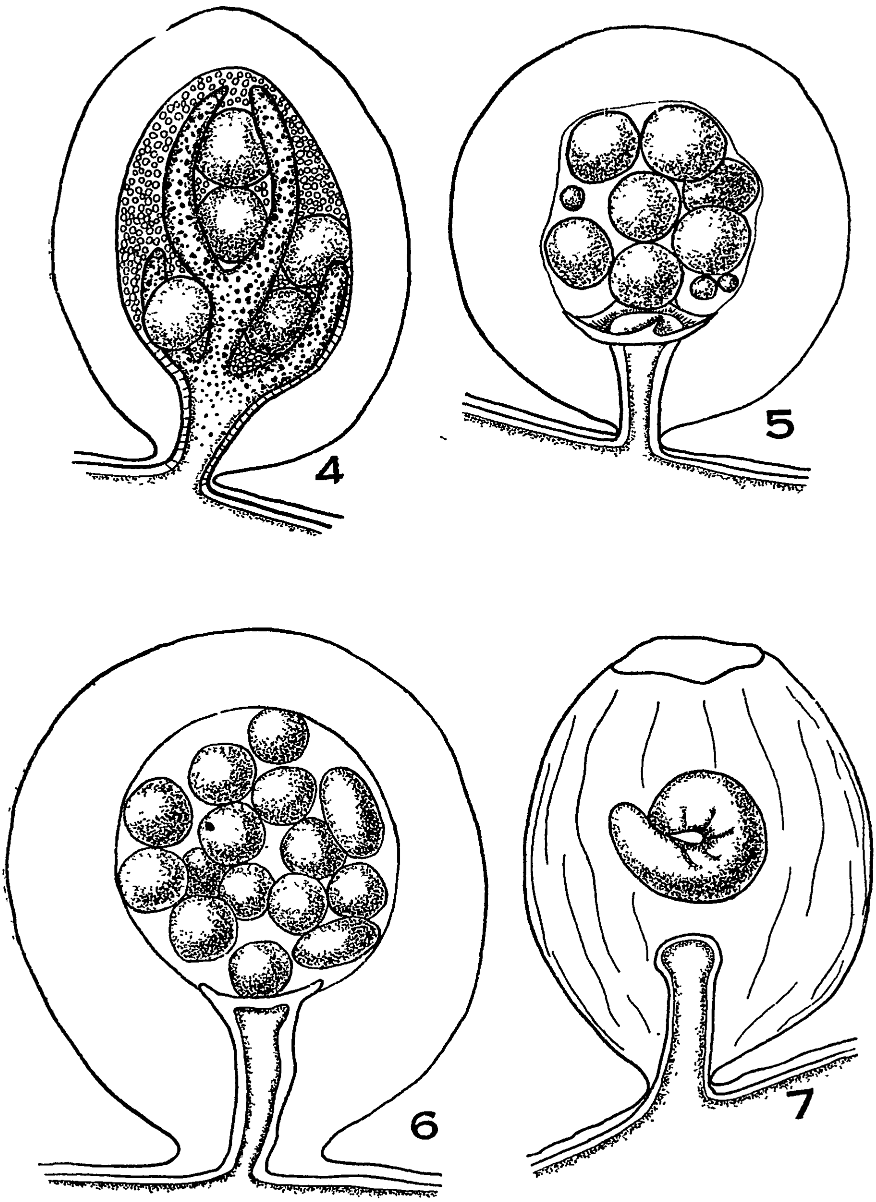

FIG. 4.—A female gonosome containing ova which are enclosed in the branches of the ramified spadix.

FIG. 5.—A female gonosome more advanced than Fig. 4; the ramified spadix has disappeared.

FIG. 6.—A further stage in the development of the female gonosome in which two of the ova have become planulae moving about inside the perigonium.

FIG. 7.—A ruptured female gonosome from which all the planulae have escaped except one.

such cells are often found inside the gonosome after the escape of the planulae.

Although fertilization and development of the ova take place inside the gonosome, it was not discovered how the spermatozoa reach the ova inside the gonotheca and perigonium. Careful examination of both membranes showed no aperture through which the spermatozoa might enter, and it was only later that the planulae in escaping ruptured the wall of the gonotheca. The fertilized egg-cells become slightly oval and gradually develop into elongated ciliated planulae which may be seen inside the gonosome moving sluggishly over the eggs which have not yet completed their development (see Fig. 6). There are usually about seven fully developed planulae in one gonosome, and these do not escape immediately but move round inside for several days. In one gonosome the planulae were observed moving for six days before the first one escaped. After the escape of the planulae, the spadix rapidly atrophies and disappears, and the gonotheca breaks off and floats away.

(b) *The planula* (see Figs. 7, 8): The planula escapes almost imperceptibly from the gonosome, moving slowly from side to side through the orifice till it is quite free when it moves off much more quickly. It is much longer than that of *C. lacustris* (s. str.), being the same length as the entire gonosome. It is cylindrical and slightly tapering, and when escaping from the gonosome, it orientates itself

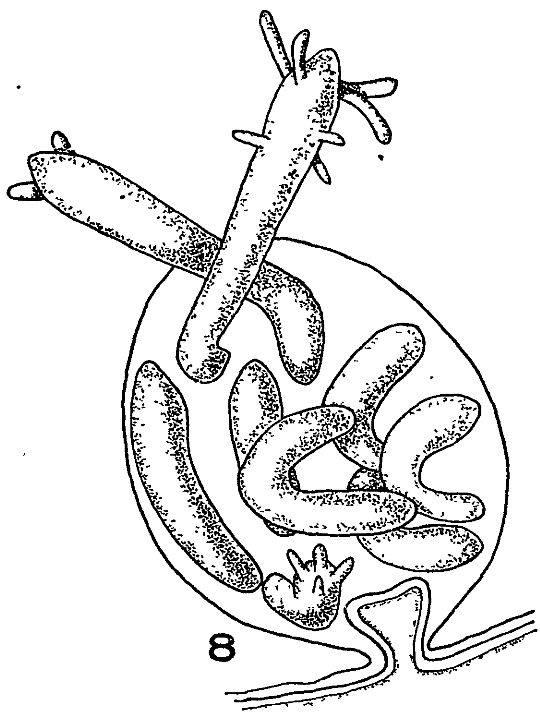

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FIG. 8.—A female gonosome containing planulae, some of which have already developed tentacles.

so that the blunt end escapes first (see Fig. 8). Under high magnification, dense and extremely fine cilia are observable, longer and finer than those represented in Allman's figure of *C. lacustris* (Allman, *loc. cit.*, pl. 3, Fig. 5); they are as long as the width of the ectoderm, but move so rapidly as to be hardly discernable. Occasional planulae which had evidently been delayed in escaping were observed with well formed tentacles, while still inside the gonosome (see Fig. 8), but this does not seem to be the general rule.

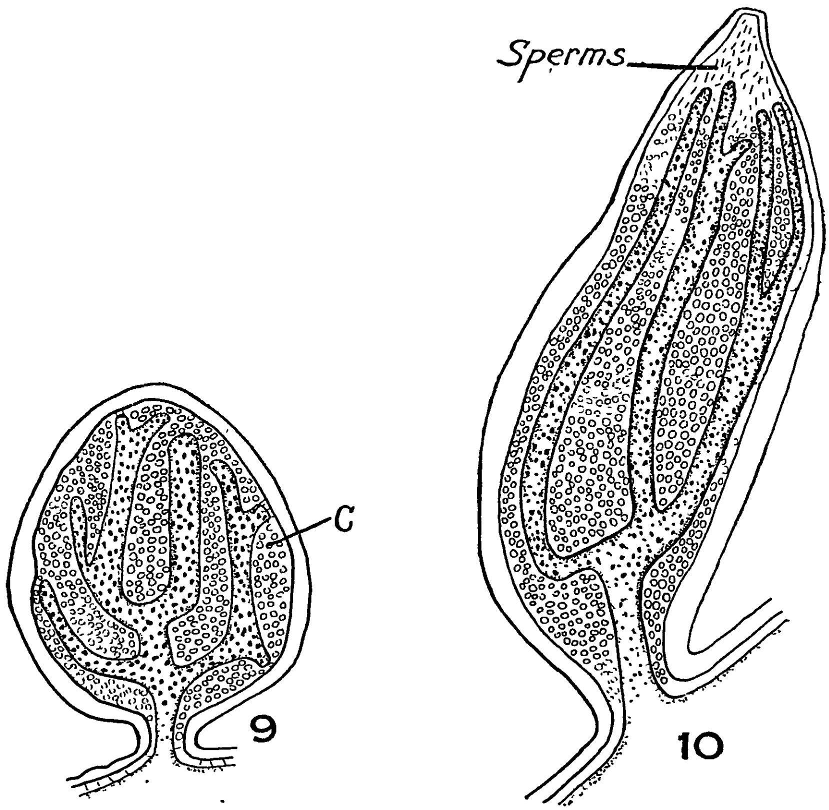

FIG. 9.—A young male gonosome with ramified spadix enclosing sperm mother cells (C).
FIG. 10.—A male gonosome more advanced, showing the fully developed spermatozoa at the distal end.

How long the planula leads a free-swimming life was not discivered, owing to the difficulty of keeping specimens alive under laboratory conditions, and although several planulae remained active for about ten days, after that period they became sluggish and gradually died.

(c) *The Male* (see Figs. 9, 10): In the early stages the male gonosome is much the same size as or slightly smaller than the female. It is subspherical, and inside it can be seen the arms of the spadix which are more branched than in the female and are similarly marked with dark dots. During development the gonosome becomes very much longer and narrower, tapering to a point at the free end (see Fig. 10), so that the ripe elongated gonosome presents an entirely different appearance from the rounded gonosome of the female. The branched arms of the spadix remain throughout the development, and in between them can be seen under the low power of the microscope, numerous highly refringent dots which are the heads of the spermatozoa.

The escape of the spermatozoa takes place in the following manner. During the day previous to their escape the spermatozoa are seen in the clear distal end of the gonosome, moving about continuously (see Fig. 10). Just before their release there is a sudden intensity of movement which forces the end off the gonosome. The spermatozoa escape forthwith in a stream of mucilaginous material in which they remain entangled, moving hither and thither until the surrounding water slowly diffuses through it. All the spermatozoa do not escape at the same time, but the discharge takes place at intervals which may continue over a space of one or two days. A gonosome was mounted on a slide with fluid, the act of putting the cover on top being sufficient to force out the contents of the gonosome. Under high power these actively swimming spermatozoa were clearly visible and on staining with weak iodine the head and tail were definitely shown.

DISTINCTIVE CHARACTERS OF SUBSPECIES "OTAGOENSIS."

Trophosome: Hydrorhiza unbranched or only slightly ramified; hydrocaulus attaining to 4 cm.; perisarc with about 10 close annulations at origin of each branch, and gradually losing itself on neck of the hydranth; tentacles about 23 in number, twice as long as the gastrovascular cavity.

Gonosome: Gonotheca thin, transparent; spadix in ripe female very much reduced, with characteristic cup-shaped body at the distal end: development of gonosome, March to June.

Habitat: Attached to stems of *Ruppia maritima* (or less often *Chara*) in fresh or slightly brackish water, below the surface.

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