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SOME HYDROIDS FROM PUGET SOUND.

BY GARY N. CALKINS.

WITH SIX PLATES.

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No. 13.— *Some Hydroids from Puget Sound.*

BY GARY N. CALKINS.

*With six plates.*

In 1876 Professor Clarke remarked on the scarcity of hydroids found on the west coast as compared with the east coast from Maine to New York, the ratio being nearly five to one in favor of the latter, although the eastern coast line from Maine to New York is but two thirds as long as the western. The twenty-four species which Clarke then described were collected along the coast from San Diego, California, to Vancouver Island, B. C., and did not include the forty Alaskan species which he described later in the same year. "It should be borne in mind however," says Clarke ('76a, p. 251), "that most of the collecting on the Pacific coast has been done along the shore, the dredge having been little used, and there is little doubt that when the fauna has been more thoroughly investigated the number of hydroids may be at least doubled. Such a variety as exists on the New England coast can hardly be expected from our Pacific shores south of Vancouver Island, for the waters there do not afford the same diversity in temperature." In addition to the difference in temperature must be noted the topographical differences in the two regions. The rocky, precipitous coast of the west shore with its great depths is very different from the long stretches of shallow water characteristic of the eastern coast. It will be observed, however, that the west coast hydroids have never been so extensively studied as those of the east coast, a few scattered localities only having been examined, and there is reason to believe that, when more points on the coast are searched, the number of hydroids will be found to be not only doubled but multiplied many times. When the Alaskan hydroids are more carefully investigated, the number of west coast species will be still more increased, for here the topographical conditions are less severe and, in the region about Sitka at least, the water is much more shallow and considerably warmer than farther south in the region of Vancouver, Washington, and Oregon. The collection of Sitka hydroids made during the summer of 1897 by the Columbia University zoological expedition was much more extensive than that made in Puget Sound, but the material, descriptions, and

notes were lost in the wreck of the steamship "Mexico." The present paper, therefore, deals only with the hydroids collected in Puget Sound. Here the area examined was comparatively small, two points — Port Townsend and Bremerton — being the only localities represented in the collection. These two places, however, yielded no less than thirty species, a fact which promises well for the further investigation at different points on the Sound.

Puget Sound is a very deep arm of the sea lying mainly between 47° and 48° north latitude. It connects with the sea by the Straits of San Juan, a wide and deep body of water opening at Cape Flattery which, if we exclude Alaska, is the most northwestern point of the United States. Port Townsend is situated on a small bay about eighty miles from Cape Flattery. The water here is quite deep (nine to one hundred fathoms) and very cold (fifty-one degrees at all depths). Many of the hydroids were brought up by the dredge from the stony bottom across Townsend Bay between the mouth of Scow Bay and Marrowstone Point. Bremerton is almost opposite Seattle, about 38 miles from Port Townsend. Here a series of small bays connected by swiftly running channels offers a decidedly varied field for investigation. In some of the bays the water is rarely turned and becomes almost stagnant, so that all conditions of temperature are found, and here, as might be expected, the hydroids are quite abundant on stones, piles, and wharves.

Before describing the hydroids of this region, I desire to express my obligation to Mr. Agassiz and Dr. Woodworth for their kindness in placing the hydroids of the Museum of comparative zoology at my disposal for comparison; and to Mr. F. P. Keppel, to whom I am indebted for assistance in working over the material.

## ATHECATA.

### PENNARIIDAE.

So far as I am aware, this family is represented on the Pacific coast by only a few species, three of which have been described by Clarke (*Tubularia elegans* Clarke, *T. indivisa* Linn., and *T. borealis* Clarke) and one by Agassiz ('65) (*Thamnocnidia tubularoides* A. Agas.).

Schneider ('97) calls attention to the fact that the main difference between Hincks's families, Tubulariidae and Pennariidae, lies

in the point that the oral tentacles are capitate in the latter and filiform in the former. This difference seems hardly sufficient for a family distinction, and I follow Schneider in placing the present species of *Tubularia* in the family Pennariidae which he characterizes as follows: **Hydrocaulus branched or unbranched.** Hydranths much enlarged proximally with one ring of large filiform tentacles about the base and with another set of capitate or filiform tentacles distributed irregularly or regularly. Proboscis conical, short, and not distinctly limited but passing gradually into the hydranth. Gonophores in the form of medusae or of sporophores.

#### TUBULARIA Linn.

**Hydrocaulus unbranched or slightly branched.** Hydranths with the distal tentacles regularly or irregularly arranged. Gonophores medusae (Euphysidae) or sporophores springing from above the proximal tentacles (Schneider).

##### 1. *Tubularia larynx* Ellis and Solander. Pl. 1, figs. 1, 1A.

Stems clustered, simple or slightly branched, slender, pellucid, pale horn-colored, ringed at pretty regular intervals; polypites small, light red, with white tentacles; gonophores clustered on short peduncles, oval, of a purplish red color. (Hincks.)

The Puget Sound form of this species is not constant in the above characters. The fourteen specimens are, with one or two exceptions, perfectly simple, and even the exceptions are not so fully branched as Hincks's. The adjective "small" conveys no meaning whatever. The hydranths in the western forms measure from 1 to 1.5 mm. in length and from 1.5 to 2.5 mm. in diameter at the basal region. Basal tentacles, in well-expanded individuals, measure about 2 mm. The stems are from 25 to 50 mm. in length and about 1 mm. in diameter, and taper slightly from the hydranth to the creeping stolon. In most cases the stems are irregularly annulated; when branched there is a set of three or four rings above the point of branching; in other cases the annulations extend from the stolon part way up the stem, a distance of 15 or 20 mm., but become indistinct as they reach the upper portion. In still other cases there are no annulations at all.

The gonophores "clustered on short peduncles" are from 6 to 8 in number on each, and in 8 or 9 clusters. The larger gonophores

bear four tubercles, which in some cases are drawn out into tentacles 1 mm. long.

The aboral tentacles are several times longer than the oral and twice as numerous (18-19 aboral, 9-10 oral).

The hydranths in most cases are erect (fig. 1), but may occasionally droop as in fig. 1A. The color of the entire hydranth is pale red, or pink with darker red gonophores; the stems are light horn-colored.

*Habitat.* Dredged in 15 fathoms off Marrowstone in Port Townsend harbor. Mediterranean (Pallas); Mouth of the Elbe (Kirchenpauer); Grand Manan (Stimpson); Nova Scotia (Dawson).

#### CORYNIDAE.

Hydrocaulus branched or unbranched. Hydranths spindle-formed or cylindrical, with simple or branched **capitate** tentacles distributed regularly or irregularly and occasionally with a lower whorl of filiform tentacles; proboscis conical and short, not distinctly marked from the rest of the body. Gonophores medusae or sporophores. (Schneider.)

#### 2. **Coryne mirabilis** Agassiz. Pl. 1, figs. 2, 2A, 2B.

*Sarsia mirabilis* Agassiz. *Coryne mirabilis* Agassiz. *Syncoryne gravata* Hincks. *Tubularia stellifera* Couth.

Stem smooth, simple, or slightly branched; hydranths small, slender, with sixteen tentacles in the adult stage; gonophores globular, borne among the tentacles or immediately below them.

There is extreme difficulty in placing this species in accordance with the usual grouping. If the medusa-buds found among the tentacles are on the way towards a free adult life, the hydroid would be placed unquestionably in the Corynidae. But if they are fixed medusae expelling their generative cells while attached to the hydroid, they may be placed in the Syncorynidae of Ehrenberg. Based on the appearance of the medusa-buds the present species might be assigned to the Corynidae, but the number of tentacles and the general character of the hydroid indicate a connection with the other family. In view of these differences the question naturally arises as to the value of the mere attachment of the gonosome as a differential character. The name *Coryne* was originally given by Gärtner, but its limits seem to have been left quite unsettled, for

many entirely dissimilar forms, such for example as *Hydra squamata*, were soon included with it. Sars ('28) attempted a revision by giving to *Hydra squamata* the name Coryne, while to Gärtner's original Coryne he gave the name Stipula. Ehrenberg later agreed to the revision of the old Corynes as expressed by Sars, but objected to Sars's name Stipula on the ground that it was already in use, and Ehrenberg substituted the name Syncoryne for Stipula, including Gärtner's original Coryne under it. Thus Coryne, Syncoryne, and Stipula became synonyms. Allman followed Ehrenberg in the use of the names Coryne and Syncoryne, but separated them into two families based upon the differences in the gonosome, and this causes the present difficulty: is the present species a Coryne or a Syncoryne? that is, is the medusa attached permanently or does it become free? and what, after all, is the real value of Allman's differential? From the observations of Agassiz and Clarke it appears that this differential has no value, for in this very species these observers noted that the gonosomes are of two kinds, free and fixed, the former produced during the earlier months of the year. Allman admitted that these observations, if verified, would be fatal to his proposed division, but he doubted the accuracy of the observations, and his two families have been widely accepted. Finally, Schneider ('97) regards the entire matter as leading to confusion through the multiplication of types, and returns to the earlier nomenclature, giving the original generic name Coryne to all of these questionable forms, a view which Levinsen ('93) substantially held. Schneider's remarks in connection with this change are so excellent and so pertinent to all matters of taxonomy, particularly in view of the past and present inclination to found new species and genera on the strength of slight structural differences, that I give briefly his main ideas.

The relationship of one form to another is so close and the connecting links so numerous that we must make the genera embrace many more species if we would have a consistent and natural group of the Corynidae. It is untenable to isolate the medusa-bearing forms, the trophosome of the two groups, as is well known, showing complete agreement. It can make very little difference to the colony whether the sexual individuals are movable or are attached to the colony, if the nutritive polyps are not affected by the difference. It cannot be said that the medusa-forming colonies are superior to the others, either in robustness or complexity. In the struggle for existence a Syncoryne appears to be no more hampered than Coryne, and the Syncoryne condition has been brought about only by degeneration from the more primitive medusa-bearing

condition. The medusa-bud does not reach the condition of growth necessary for locomotion, and the sexual products are liberated in the immediate vicinity; — herein lies a point relating only to the reproduction of the genus, not of sufficient taxonomic value to separate otherwise closely allied forms. Whether medusa or sporophore, therefore, is a question of importance only for the species in question, but without importance in fixing relationship to any other forms. It is only changed conditions of existence that can affect changes in the trophosome, and these changes are of phylogenetic value. The sexual products do not arise in the medusa, but in the trophosome—the medusa is only an apparatus for distributing them over a wide area. Their form also is not the result of the completely different mode of life from that of the nutritive polyp but in all essentials depends upon the form of the latter. The medusae change step by step only as do the polyps, and no sufficient differences exist to distinguish *Coryne* and *Syncoryne*.

The principle by which Schneider divides his genera may be expressed as follows:—

A species must be considered as a sharply circumscribed group of individuals which can be safely distinguished from all others. All species form an unbroken chain with a great number of side branches; this chain often appears incomplete and with many gaps owing to our incomplete knowledge. The groups of species so distinguished from all other groups are the genera. The chief aim, therefore, of the systematist should be, not to create new genera, but to show the relationships of species to each other. Wherever we find transitional forms between groups of species, the artificial bounds of one should be stretched until, if necessary, 100 or 500 or more species are relegated to a single genus. The richer the genus is in species,—that is, the more forms we can place in close phylogenetic connection,—the nearer we come to the hypothetical ideal of the unity of animal forms. But the more we split up species into genera the more difficult does this become, although such splitting is of unquestionable value in the handling of a group; but it must always be borne in mind that a word like *Syncoryne*, for example, represents nothing but a certain number of closely allied species of one far-reaching genus.

The Puget Sound forms vary somewhat from *S. gravata* Hincks, but more especially in the size. The British form is very small, “only about a quarter of an inch in height,” whereas the western forms are from  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch (12 to 18 mm.).

When alive the trophosome is colored a delicate rose, due, according to Agassiz, to colored granules lining the digestive cavity and chymiferous tubes.

*Habitat.* Found growing on the edge of wharves and sunken logs, and floats, in great quantities at Bremerton in June, the mass having a delicate rose tinge. England (T. S. Wright; T. H.

Hincks); Greenland (Sabine); Grand Manan and Eastport, Me. (Stimpson); Massachusetts Bay (**L. Agassiz**).

#### ATRACTYLIDAE.

#### PERIGONIMUS Sars.

Coenosarc sheathed in a chitinous polypary, stem branching or simple, rooted by a thread-like stolon; polypites fusiform with a single verticil of filiform tentacles round the base of a conical proboscis; gonophores developed from the coenosarc. (**Hincks**.)

**3. Perigonimus repens** T. S. Wright. Pl. 1, figs. 3, 3A, 3B, 3c, 3d.

*Atractylis repens* (Wright). *Perigonimus pusillus* (Allman). *Perigonimus repens* (Allman).

Stems simple, erect, about 6 mm. high. Hydranth club-shaped, white, partly retractile into tube, tentacles 10 to 12. Gonophores pedicilate and borne on the stems.

In the Puget Sound form the stem of the gonophore is very long and the character is constant. The difference in length, however, does not seem sufficient to raise the form to an independent species.

*Habitat*. Found covering the back of the carapace and the appendages of a species of *Pisa*, dredged in Townsend Harbor. Wright describes it as growing on the Sertularians and upon the spider crab in the Firth of Forth, Alder on *Dentalium entalis* and other shells; and Allman on the operculum of *Turritella communis* in Shetland.

#### CALYPTOBLASTEIA or THECATA.

The bulk of Pacific coast hydroids is made up of thecate forms. In the region of Puget Sound these do not impress one as being very abundant, due probably to the absence of many large branching forms like *Obelia* and *Laomedea*. Most of the thecates belong to Campanularia or allied genera which do not grow to large colonies. At Sitka, on the other hand, the piles and rocks are covered with great forests of *Obelia* and related forms, and one is impressed with their abundance. In regard to the smaller forms at Sitka I cannot speak. The Calyptoblastea have been a difficult group to deal with, and, as time goes on, the task becomes more difficult. This is

largely because of the multiplication by various observers of species and genera and even families on small details of difference and often on insufficient ground. Of late there seems to be a reaction, however, and with it, it is to be hoped that the taxonomy of the hydroids will gradually be simplified. The trouble is probably due to the absence of an adequate differential.

Hincks ('68) divided the suborder Thecaphora into nine families, some of which have been retained, but many have been suppressed. These original families were, 1, Campanulariidae, 2, Campanulinidae, 3, Leptoscyphidae, 4, Lafoeidae, 5, Trichydridae, 6, Coppi-nidae, 7, Haleciidae, 8, Sertulariidae, and 9, Plumulariidae. From this collection of more or less artificial groups it was the work of succeeding observers to weed out what was unnecessary and to bring together those families which showed natural affinities. For example, the first four families were distinguished by very imperfect differentials or sets of characters which in the same family showed as many variations as in the different families. The dividing line was purely arbitrary, and in the critical examination which always follows such arbitrary divisions the weakness was pointed out. The first step in the reduction in number of families was taken by Levinsen ('93) who brought together in the family Campanulariidae all the forms possessing hydrothecae without opercula, with the form of a beaker, a bell, or a tube, and with a circular mouth opening. This family included most of Hincks's Campanulariidae, and the inoperculate forms of the Lafoeidae. All forms resembling the Campanularians in structure of the hydrotheca but provided with an operculum, and all the operculate Lafoeidae of Hincks were included by Levinsen in Hincks's second family — the Campanulinidae. The chief differential between the families, it will be noticed, lay in the presence or absence of an operculum. A further reduction in these families was made later by Schneider ('97) who showed that the opercular apparatus is only a modification of the toothed structure with which, in varying degree, nearly all Campanulariae are provided. In other respects the Campanulinidae as modified by Levinsen agree well with the first family, and Schneider accordingly reduces the two families to the one Campanulariidae. He distinguishes, however, between the Campanularian-type and the Lafoea-type, forming the subfamilies Campanulariinae and Lafoeinae.

Four of the nine families of Hincks have thus been reduced to

one. Of the remainder, the Haleciidae is the most primitive of the thecate forms and with the closest athecate connections, as shown by the method of branching (see Driesch, '90) and the nature of the hydrotheca so-called. It was shown by Levinsen that the Coppinidae (with Hincks only a single species) are only gonothecae of species of the genera *Lafoea*, *Filellum*, and *Grammaria* (Marktanner-Turneretscher).

The Sertulariidae and Plumulariidae are retained as well-marked families, although Levinsen apparently takes a backward step in splitting the latter into two families, Plumulariidae and Aglaophe-  
niidae.

These eight families including all of the true thecate hydroids are thus reduced to four and may be arranged in the following order: *Haleciidae*, *Campanulariidae*, *Sertulariidae*, and *Plumulariidae*.

#### HALECIDAE.

The Haleciidae are usually regarded as one of the most highly differentiated forms of thecates because of the small cups, the incomplete retraction of the hydranth, and the peculiarity of the gonophores in that the blastostyle protrudes beyond the gonotheca and then gives rise to one or two hydranths. Levinsen ('93) showed the close connection between Haleciidae and Campanulariidae in the presence of stalked hydrothecae, lack of opercular apparatus, and circular mouth. He also found a ring of peculiar chitinous particles about the lower and wider part of the hydranth by means of which the hydranth is fastened to the cup, the same thing, he says, being characteristic of the Campanulariidae.

According to Levinsen a still closer connection is with the Plumulariidae, shown primarily by the shallow and wide beakers or cups, which have a well-developed diaphragm; the chief differential, he thinks, in distinguishing the Campanularians. In addition to this character the incomplete retraction of the hydranth and the occasional occurrence of nematophores on some Haleciidae are features common to the two families.

Schneider ('97) admits the close relationship of Campanulariidae, Haleciidae, and Plumulariidae, but points out that Levinsen gives no clue to the origin of the Haleciidae. He says these forms cannot be derived from the Campanulariidae, 1, because the branched Hale-

ciidae never have a free stalk, the Campanulariidae invariably; 2, because the hydrothecae of the latter family are never so reduced as those of the former; 3, because the branching of Haleciidae is never regular like that of the Campanulariidae but more nearly resembles that of the Athecata, being midway between the racemose type of the Gymnoblastera and the cymose type of the Calyptoblastera. The smallness of the cup is better explained as a primitive than as a differentiated character, approaching closely to the type of cup formed by the enlargement of the chitinous periderm under the hydranth of many athecates, and into which some forms can partly retract. This is strikingly shown in *Halecium macrocephalum* Allman ('77), a form in which the theca is represented by only a sessile, narrow, membranous lip. Furthermore an additional point is seen in the peculiar character of the female gonophore and proliferating blastostyle mentioned above, which again shows athecate affinities.

The comparatively small family of Haleciidae is therefore of considerable phylogenetic importance and for the present at least may be regarded as the nearest approach to the gymnoblastic hydroids.

Comparatively few Haleciidae have been found in North American waters, while those which have been found on the Atlantic coast, according to Agassiz, appear to be confined mainly to the most northern waters. *H. halecinum* (Johnston) has been found in Greenland (Fabricius), on the northern coast of Maine (A. E. Verrill), and Massachusetts Bay (L. Agassiz). *H. muricatum* Ellis and Solander is reported from Nova Scotia (Anticosti expedition), from Eastport and Grand Manan (A. E. Verrill). On the Pacific coast, Clarke reports *H. tenellum* (Hincks) from San Diego, Cal., *H. halecinum* from Unalaska, Alaska, *H. plumularoides* from Nunivak Island, and *H. scutum* (Clarke) from Semidi Island to Unalaska.

Hydrocaulus unbranched, slightly, or much branched, hydranths without free stem, usually regularly and alternately arranged, hydrotheca flat, shell-like, never large enough to take in the hydranth, and without operculum. Sporophores. Female blastostyle a slightly reduced double hydranth, male blastostyle greatly reduced.

## HALECTIUM Oken,

The hydranths are very long, the lower part of the body being spindle-shaped, while the tentacle region of the body is strongly marked off, proboscis conical.

**4. *Halecium wilsoni*** sp. nov. Pl. 1, figs. 4, 4A, 4B.

*Trophosome.* Hydrocaulus erect, polysiphonic (stem and main branches), delicate, irregularly and slightly branched. Branches divided by more or less oblique joints into internodes 150  $\mu$ m. long, each internode giving rise to one branch which is similarly divided into internodes, each one of which gives rise to one hydrotheca. In some cases there is an axillary branch which is always more or less annulated; each internode has a single annulation immediately above the joint. Hydrothecae more or less tubular with slightly everted margin.

*Gonosome.* Gonophore (male). Large circular discs with peculiar and decidedly characteristic blastostyle. Orifice at extremity directly in the center or very slightly to one side. Often placed on comparatively long stems having one, or occasionally two, distinct annulations. Irregularly placed on the colony stalk. Color of gonophores light red running into salmon. Color of trophosome very light horn. Similar in many respects to Alder's *H. labrosum* but smaller, more delicate, and quite different from the latter in shape and position of the gonosomes.

*Dimensions.* Height of colony, 50 mm.; diameter of main stem, .5 mm.; length of internodes, .15 mm.; length of male gonophore, 1.7 mm.; diameter of gonophore, 1.5 mm.

*Habitat.* Found at Bremerton in June on piles and floats.

**5. *Halecium densum*** sp. nov. Pl. 1, figs. 5, 5A, 5B, 5C.

*Trophosome.* Hydrocaulus erect, shrubby, 20–40 mm. in height, densely and irregularly branched, deep brown in color. Branches often, but not invariably, arising from shoulder-like processes, sometimes as many as three coming from a common point, and each with a single constriction or annulation just above the point of origin. Branches divided by constrictions into internodes of unequal length, usually one lateral branch to an internode, but sometimes with none at all. Hydrothecae tubular with much everted rims, placed irregularly, but with a tendency towards sub-alternate positions, and as a rule situated immediately below the joint. Gonosome not known.

The general appearance of this species recalls Clarke's description of *H. scutum*, but differs from this form in all of the details. All stems are divided into joints, which are of dissimilar size, many of them without branches or hydrothecae. Clarke notes, however, that his species is quite variable, and it is possible that the present form is one of these variations.

*Dimensions.* Height of trophosome, 35 mm.; length of hydranth, .3 mm.; width of hydranth, .1 mm.

*Habitat.* The under side of the wharf at Bremerton.

#### CAMPANULARIIDAE.

It is to this family that the majority of the Puget Sound hydroids belong, a family which offers the greatest difficulty in classification. Hincks remarks in a footnote to his "key": "In this group the trophosome offers no generic characters. If the reproductive bodies are absent the student must treat it as a single genus and identify his zoophyte by reference to the specific description." Generic differences based on the absence of reproductive bodies have led to the multiplication of species and synonyms, until the family has become badly confused. The structure of the hydrotheca, as Hincks intimates, has played little part in classification. The method of reproduction, however, is an unsuitable differential. Campanularia and Gonothyreae, for example, form reproductive bodies either as sporophores or as undeveloped medusae which never become free. Clytea and Obelia, on the other hand, produce free-swimming medusae, those of the latter belonging to the genus Euclope. The trophosomes of Gonothyreae and Obelia agree in having a free branching stem, but they do not agree in the gonosome. Campanularia, on the other hand, includes both branched and simple species. To the branched forms Lamouroux gave the name Laomedia and to the simple forms the name Clytea. The classification based on the trophosome was given up by Hincks as not representing the natural affinities, and he, with Agassiz and others, made the gonosome the chief differential.

Allman ('88) limits the genera very strictly to the characters of the gonosome, regarding the presence or absence of a free-swimming medusa of sufficient generic value. He distinguishes Campanularia and Obelia in the following manner:—

Campanularia: "Trophosome. Hydrotheca pedunculate, campan-

uliform, with serrate or entire margin, destitute of operculum and with the cavity distinctly differentiated by a perforated diaphragm from that of the peduncle; peduncle springing from the sides of a simple or a ramified, free or adherent hydrocaulus. Hydranths with a trumpet-shaped hypostome. Gonosome. Gonophores adelocodonic, *i. e.* never issuing from beneath the cover of the gonangium."

Obelia. "Trophosome. Hydrocaulus simple or branched, fasciated or monosiphonic. Hydrotheca campanuliform, destitute of operculum, pedunculate, with the cavity distinctly differentiated from that of the peduncle. Gonosome. Gonophores medusiform, vesiculate planoblasts with shallow umbrella, four radial canals on which the gonads are developed, short manubrium with four-lobed mouth, numerous rather rigid marginal tentacles whose roots are plunged into the substance of the umbrella, ootocysts carried each close to the base of a tentacle, velum rudimental."

He makes a similar difference between the genera *Laomedea* and *Gonothyraea*. The trophosome is similar in both, the gonosome with free-swimming medusa in one (*Laomedea*), with reduced medusae in the other. This division of the genera is as satisfactory as any can be when based solely on the presence of gonosomes, but when these are absent the problem is as complicated as ever. To offset this difficulty, Levisen has proposed the adoption of a new differential in the "diaphragm," which had been earlier recognized by Allman as a family characteristic. Levisen claims that the diaphragm has a certain definite structure in the various species of Campanulariidae and that, according to the similarity of structure in various cases, the species can be grouped into genera. The differences in diaphragms he finds correlate fairly well with the mode of growth of the trophosome, and with this differential he could retain the older division of the family as made by Lamouroux.

In the simplest form the hydrotheca encloses a simple space which connects directly with the hollow in the peduncle, but in Campanulariidae the connection is not direct, the cavity of the hydrotheca opening into a second space,—the "basal chamber" of Levisen,—which connects with the cavity of the peduncle. The basal chamber is separated from the hollow of the hydrotheca by a chitinous partition—the diaphragm—Levisen's chief differential. It is of variable thickness and is perforated by a more or less wide aperture for the coenenchyme. According to this observer, all

forms of Campanulariidae having a free, branched, primary stem are classed under the genus *Laomedia s. ext.* with three subgenera, *Obelia*, *Gonothyrea*, and *Laomedia s. str.*, including in the latter all of those branching forms which have hitherto been placed in the genus *Campanularia*. Finally, the latter genus is characterized by a simple, unbranched primary stem and by a thick diaphragm which consists of two parts, one "thick and rather high, a ring-formed process from the beaker; the other a thin chitinous membrane which is secreted from the basal part of the hydranth." In genera, on the other hand, which are characterized by a free, branched, primary stem "the diaphragm shows no such distinction in outer and inner parts" (Marktanner-Turneretscher, '95, p. 400).

The application of this latter differential in placing species leads only to "confusion worse confounded." Levisen and Marktanner-Turneretscher use *Campanularia integra* as a type showing the double diaphragm in which the lower layer is extremely thick. This is undoubtedly true here, and a thin "membranous" layer is found above it, as shown in fig. 12 F, Pl. 6, but in the closely allied *C. caliculata* we find the extremely thick portion, with no trace whatsoever of the thin membranous partition (Pl. 6, fig. 11D). Again in the free branching forms, according to these observers, the diaphragm "shows no distinction between inner and outer parts." *Campanularia gracilis* is a branching form with free and erect stem (Pl. 3, fig. 13), but the diaphragm has two distinct layers, an upper and a lower (Pl. 6, fig. 13D); and *Obelia dichotoma*, another branching and erect form has a distinctly double diaphragm. What now becomes of the differential?

Schneider has severely criticised the use of the diaphragm as a differential character and comes to the unequivocal conclusion that "die Diaphragmabeschaffenheit hat für die Systematik der Genera gar keine Bedeutung" ('97, p. 512).

Thus the question stands, and we are no nearer well-defined diagnostic characters than heretofore. The diaphragm, however, may be more important than Schneider is inclined to believe, for in the Puget Sound species there are well-defined differences and all gradations in the different genera and species. In *C. caliculata* the thickened portion at the base of the polyp is not a part of the stalk but an inner thickening of the hydrotheca, and to all intents and purposes is a diaphragm (Pl. 6, fig. 11D). In no case is the diaphragm anything but an ingrowth of the chitinous periderm, but

in *C. caliculata*, *C. integra*, etc., it is much thicker than in others (cf. 17, 9, 27, 21, etc.). Sometimes the diaphragm bears a circular ridge upon which the polyp rests (Pl. 6, fig. 8, 9D). Again, there may be a thin lamella extending inward from the thickened part, as Levinsen maintained (*C. integra*), in which case the diaphragm might be called double, and finally in still other forms the diaphragm is exceedingly delicate and finely drawn out (Pl. 6, fig. 20D). What real value the diaphragm has in classification remains to be proved. The differences presented by the Puget Sound forms certainly indicate a well-defined differential, although perhaps not of such importance as Levinsen and Marktanner-Turneretscher assume.

In connection with the diaphragm we must take into consideration the configuration of the coenosarc immediately below the hydranth. In nearly every case the living substance owes its shape to the structure of the diaphragm and basal chamber. When there is a space it tends to spread out, where there is a chitinous partition or wall it is confined. *C. integra* (Pl. 6, fig. 12F) is a good illustration to the point. Here there is a well-defined basal chamber, also a thin partition upon which the polyp rests, and a thickened lower part of the diaphragm. The coenosarc spreads out in the free space of the basal chamber but contracts to pass through the smaller aperture of the projecting diaphragm. In the various forms of bases the characteristic shape of the coenosarc can be readily seen. It is of course not infallible; in many cases there may be a space without a corresponding swelling of the coenosarc, while in other cases a distinct tube is secreted by the coenenchyme in the basal chamber (Pl. 6, fig. 5E).

Schneider characterizes the family Campanulariidae as follows:—Trophosome unbranched or branched. Hydranths (at least the branched forms) invariably with free stalks; regularly alternate. Hydrotheca large, with the upper part of the stalk swollen out into a single cup; usually conical or tubular, with or without operculum, and capable of taking in the entire polyp. Schneider's genus *Campanularia* is included in the subfamily Campanuliinae which he characterizes as follows:—Trophosome unbranched or branched. Hydrotheca conical or slightly cup-formed, with distinct base invariably on a free stalk. Gonophores in the form of medusae or sporophores. Gonothecae separated.

## CAMPANULARIA.

Hydrotheca with smooth or toothed margin without operculum. Blastostyle producing medusae or sporophores — a number always developing at the same time.

**6. *Campanularia johnstoni*** Alder. Pl. 1, figs. 6, 6A, 6B, 6C. Pl. 6, fig. 6D.

*Sertularia volubilis* Ellis and Solander. *Campanularia volubilis* Johnston. *Eucope campanulata* Gegenbaur. *Clytea bicophora* Agassiz.

Stems long, transparent, simple or slightly branched, ringed at base and at top with the intermediate portion smooth. Hydrotheca deep and sharply toothed (10–15 teeth). Stem ringed at base and below cup. Gonotheca with short, ringed stalk coming from rhizome and with only one deep constriction in place of the usual large number of annulations. Producing medusae (5 at one time), all from one side of the blastostyle. Diaphragm a single piece which turns downward at the aperture to form a short tube through the basal chamber (Pl. 6, fig. 6D).

**Dimensions.** Length of stem,  $1\frac{1}{2}$ –2 mm.; length of cup, .65 mm.; length of gonotheca, 1 mm.; width at apex, .35 mm.; number of teeth on theca, 13–15; number of tentacles on hydranth, 21–22; number of tentacles on medusae, 4; number of annulations at base, 8–10; number of annulations below cup, 2–5.

I refer this species to *C. johnstoni* provisionally. There seem to be some differences from the form described by Hincks, Schneider, and others, especially in regard to the gonotheca, which in the European species is strongly ringed with 7 or 8 annulations, whereas in the present species, there are at most only two formed by a single constriction in the center. I hesitate to make it a new species on this difference and regard it as only one of the many variations for which the species is noted. It may be identical with Clarke's *Campanularia denticulata* from Alaska.

**Habitat.** Found on algae at Port Townsend. Quite common and generally distributed. Previously reported from England (Hincks and others), Norway (Van Beneden), France (Lacaze-Duthiers), New England coast (Agassiz), Alaska (?) (Clarke), Rovigno (Schneider).

**7. *Campanularia johnstoni* var.** Pl. 1, fig. 7.

A minute form growing on *Halecium wilsoni*. Bell very deep, tapering gracefully from margin to base, proboscis trumpet-shaped, stem unbranched, annulated throughout the entire length or only in part, and shorter than the bell. Tentacles 10-14. Gonotheca not present.

*Dimensions.* Length of stem, 1 mm.; length of hydrotheca, .6 mm.; width at top, 3 mm.; number of teeth on hydrotheca, 9.

I find only four specimens of this delicate form and no gonophores. It is very small for *C. johnstoni*, but comes nearest this species and may be classed with it provisionally.

**8. *Campanularia inconspicua* (Forbes).** Pl. 2, figs. 8, 8A, 8B, 8C. Pl. 6, fig. 8D.

*Trophosome.* Stems short and simple or branched once, arising at irregular intervals from a creeping stolon. Much ringed, 12-13 at base and 4-5 or more below theca. Hydrotheca deep with slight taper towards the base. Margin of bell ornamented with seven large, rounded teeth.

*Gonosome.* Gonophores borne on short ringed stem which gradually enlarges from stolon to base of gonotheca. Gonotheca large, borne on stolon, widening gradually from base to apex, and with large irregular aperture situated at the wide extremity. Bears four medusae-buds on the blastostyle. The older medusae with tentacles. Diaphragm a simple partition with down-turned edge at the aperture. The hydranth rests upon an elevated annular ridge near the outer edge of the diaphragm, and the basal chamber is a part of the stem cavity (Pl. 6, fig. 8D).

*Dimensions.* Height of hydrocaulus, 6-8 mm.; length of hydrotheca, .6-.65 mm.; length of gonotheca, 1.3 mm.; width of gonotheca at apex, .35 mm.

I place this species with Forbes's *Thaumantias inconspicua* because of the small number of large teeth. It differs from *C. rari-dentata*, which I take to be a synonym, in some respects, notably in its smaller size, in the absence of "bulbous swelling" at the base of the stem, and in the large number of annulations. A very noticeable character is the annular ridge on the diaphragm which, with the exception of the closely allied form described below, was not observed in any other hydroid.

*Habitat.* Found on red algae near Port Townsend, also found in England (Alder and Hincks).

**9. *Campanularia attenuata* sp. nov.** Pl. 2, figs. 9, 9A, 9B, 9C. Pl. 6, fig. 9D.

*Trophosome.* Stems flexuous, very long, branched, given off at short intervals from a creeping stolon, 10–16 rings at base and above point of branching. The parent stem is not ringed above the branches. With from 2–7 or 8 well-marked rings below hydrotheca, but often reduced in diameter as it approaches the base of the hydrotheca. The branches are given off at long intervals and are bent directly upwards, parallel with the parent stem. The hydrothecae are large with 9 or 10 rounded teeth on the margin and have a slight taper from margin to base.

*Gonosome.* Gonotheca large, borne on short, ringed stalk on the parent stem just above the axils of the branches; smooth, oval, and with a terminal aperture. The blastostyle as a rule bears three medusae, the oldest of which are provided with a well-marked manubrium and four tentacles. The diaphragm is a simple partition with down-turned edge at the aperture. The hydranth is limited by an annular ridge which, however, is not so pronounced as in the preceding species, being more of a swelling. Coenosarc very much attenuated in basal chamber, becoming gradually thicker as it approaches the stem. The basal chamber is a part of the stem.

*Dimensions.* Height of trophosome, 4–9 mm.; length of stem to primary branches (variable) from 3.5–7 mm.; length of hydrotheca, .5 mm.; width of hydrotheca margin, .25 mm.; length of gonotheca, 1.3 mm.; width of gonotheca at apex, .45 mm.; width of gonotheca at base, .15 mm.; number of tentacles on hydranth, 16.

In some respects this species is similar to *C. inconspicua*, possessing more teeth, however, and having a different mode of growth. The parallel course of the branches and stem and their great length give the species a characteristic appearance, although it agrees with *C. inconspicua* in the size and shape of the gonosomes and in the structure of the diaphragm.

*Habitat.* On red algae at Port Townsend, Scow Bay. Like the preceding species, the stems, branches, gonothecae, and hydrothecae are covered with a small diatom belonging to the genus *Cocconeis*.

**10. *Campanularia* (*Gonothyraea*) *gracilis* Sars.** Pl. 2, figs. 10 A, 10 B, 10 C. Pl. 6, fig. 10 D.

*Laomedea gracilis* Sars. *Gonothyraea gracilis* Allman.

*Trophosome.* Stems flexuous, rather long, much and irregularly

branched, given off at intervals from a creeping stolon, 8-10 rings at the base and 3-8 rings above origin of branches. As in *C. attenuata* the branches run almost parallel with the main stem but not so noticeably as in that species. The hydrothecae are long, large, and deeply campanulate. The margin has from 10-11 large teeth. The walls of the cup are so delicate that perfect specimens are rare.

*Gonosome.* Gonothecae arise on short, ringed stems immediately above or in the axils. They are slightly longer and more slender than the hydrothecae and are deeply wrinkled. Medusae-buds 2-5, and 3-4 are usually enough developed to show the manubrium and tentacles.

*Diaphragm* slender and delicate, forming an indefinite tube around the coenosarc. The basal chamber forms a part of the stem cavity.

*Dimensions.* Height of colony, 4-12 mm.; length of hydrotheca, .75 mm.-1 mm.; width of hydrotheca at top, .5 mm.; width of hydrotheca at bottom, .1 mm.; length of gonotheca, 1.3 mm.; width at top, .25 mm.; width at bottom, .15 mm.; number of tentacles on hydranth, 18.

*Habitat.* On red algae at Port Townsend; tests of ascidians, sponges, etc. (Brady); Bergen, on *Laminaria* (Sars).

**11. *Campanularia caliculata*** Hincks. Pl. 2, figs. 11, 11A, 11B, 11C. Pl. 6, fig. 11D.

*Trophosome.* Stem simple, of variable length, with one well-marked ring immediately behind the hydrotheca; occasionally one or more irregular segments below the ring,— while from here down the stem is perfectly smooth. The base is much branched, forming a complicated meshwork of stems on the red algae to which it is attached. Walls of calyces greatly thickened, the thickening projecting inwards at base to form the diaphragm on which the hydranth rests; with clean even ring. Tentacles very numerous (22-28) and small.

*Gonosome.* Gonotheca with a short stalk, truncate at the end, and with a decidedly flattened form, wide aperture, and perfectly smooth walls. The capsule contains two sporosacs, a large one above and a smaller (very much smaller) one below. Four branched gastro-vascular canals arise from the base.

The *diaphragm* is formed solely by the ingrowth of the thick walls of the calyces. The coenosarc is not constricted by the dia-

phragm, and the basal chamber is a mere tube formed by the thickened chitin and is distinctly a part of the calycle.

*Dimensions.* Height of hydrocaulus, 6–10 mm.; length of stems, 6–10 mm.; length of hydrotheca, .45 mm.; width at top of hydrotheca, .30 mm.; width of bottom of hydrotheca, .25 mm.; length of gonotheca, 2 mm.; greatest width, 1 mm.; thickness of gonotheca, .5 mm.; number of tentacles, about 26.

This is one of the most characteristic hydroids of the entire collection; the hydranth, with its thickened, drooping bell, cannot be mistaken. There is considerable variation in the thickness of the chitin at the base, in some cases the bell being short and almost cubical with an immensely thickened diaphragm, while in others it is more drawn out and the diaphragm less thick; in short, I have found the same variations noted by Hincks, Levinsen, and others. I do not agree with Levinsen and Marktanner-Turneretscher in regarding *C. caliculata*, *C. integra*, and *C. gracilis* as merely modifications of one species. In addition to the difference in the form of the bell and in annulations below the hydranth, there is a very characteristic difference in the gonophores and in the diaphragm. The latter in *C. caliculata* has no shelf of chitin projecting inwards from the thickened hydrotheca, whereas *C. integra* (?) has such a shelf well developed. The gonophores are much more reduced in *C. integra* than in *C. caliculata* and the gonothecae are of very different size and shape. *Campanularia compressa* Clarke is very closely allied to the present species, if not the same, the difference in hydrothecae being no greater than the variations on the same specimens; while in *C. caliculata* I note the same compression of the gonotheca and the same form.

*Habitat.* On red algae off Pt. Wilson, Port Townsend, and at Bremerton. Common. Previously noted from England (Hincks, Allman, etc.); Bergen (Sars); Labrador (Hincks); Messina (Sars); Massachusetts (Agassiz); Rovigno (Schneider); Alaska (?) (Clarke).

**12. *Campanularia integra* MacGillivray.** Pl. 2, figs. 12, 12A, 12B, 12C, 12D. Pl. 6, fig. 12F.

*Trophosome.* Stems longer than in *C. caliculata*, simple, unbranched, with at least one, sometimes two or three, deeply cut rings below the hydrotheca. In some cases the stem is waved throughout the entire length, and at times, but not always, it is slightly twisted at the base. The hydrothecae are slightly thickened at the base and on the walls. The thickening at the base

forms only a part of the diaphragm (Pl. 6, fig. 12 F). The margin is perfectly smooth. The hydranth has many tentacles (28-30). The hydrorhiza is much branched.

*Gonosome.* Gonothecae borne on hydrorhiza, elongate, slightly oval with truncate end. The blastostyle produces eggs directly (Pl. 2, fig. 12). The wall of the gonotheca is heavily ribbed.

*Diaphragm.* The thickening at the base forms a part of the diaphragm, but the hydranth rests mainly upon a thin ledge or shelf of chitin which extends inward from the upper part of the thickened portion. This shelf gives a characteristic appearance to the coenosarc which, in order to pass through the narrow aperture, is considerably constricted at this point, swelling out below to partly fill the basal chamber (Pl. 6, fig. 12 F).

*Dimensions.* Length of stem, 6-8 mm.; length of hydrotheca, .6 mm.; width of margin, .3 mm.; number of tentacles, 28-30; length of gonotheca, 1.5-1.8 mm.; greatest width, .65 mm.

*Habitat.* On red algae off Point Wilson, Port Townsend, and Bremerton. Common. Previously reported from England (various authors); Labrador (Hincks); Spitzbergen (Marktanner-Turneretscher); Alaska (Clarke); Greenland (Levinsen).

**13. *Campanularia exigua*** Sars. Pl. 4, figs. 19, 19 A, 19 B.

*Laomedea exigua* Sars.

Stems very delicate, slightly flexuous, giving off simple pedicels at each bend, ringed at base and above each branch. Hydrotheca small, regularly funnel-shaped, with smooth and even rim. Gonothecae (Hincks) axillary, elongate, smooth, somewhat fusiform.

The *diaphragm* is simple, extremely fine and difficult to see. The basal chamber is contained in the hydrotheca.

Without the gonophore I cannot place this species more definitely. It is a ragged looking form, the rough and irregular coenosarc filling the stem. The margin of the bell is often sinuous and wavy.

*Dimensions.* Height of colony, 6-7 mm.; length of hydrotheca, .4 mm.; width at margin, .3 mm.

*Habitat.* Port Townsend, on stones, etc.

**14. *Obelia gracilis*** sp. nov. Pl. 3, figs. 13, 13A, 13B, 13C. Pl. 6, fig. 13D.

*Trophosome.* Hydrocaulus erect, simple, or slightly branched, growing on a creeping and slightly branched hydrorhiza. Primary stem with from four to six annulations at the base and with from one to three above each branch or hydrotheca stem. The branches

as well as the primary stem have four or more annulations at the base and are occasionally provided with tendril-like processes. Hydrothecae placed regularly and alternately at the angles formed by the very slight zigzag of the main axis. Usually there are two hydrothecae at each angle, but in the older angles one of these is borne on a comparatively long stalk having four annulations at the base and three below the hydrotheca. The other hydrotheca is on a stalk borne in the axil of the former. While the stalk in the latter case is much shorter than that of the former, the cup on the other hand, and with it the hydranth, is perceptibly larger. The difference is so constant and so noticeable that it can be measured. The smaller hydrothecae, *i. e.*, those on the longer stalks, are on the average .32 mm. long and .19 mm. wide, while the larger or axillary hydrothecae are .36 mm. long and .32 mm. wide. Not only is there a difference in size, but the shape, as shown by the dimensions, differs as well. All hydrothecae have plain margins. Hydranths with about 28 tentacles.

*Diaphragm.* The diaphragm is distinctly double, consisting of a lower portion with a tendency to follow the coenosarc down into the stem, and an upper shelf-like part which supports the hydranth. The basal chamber forms part of the stalk cavity. (Pl. 6, fig. 13D.)

*Gonosome.* The gonothecae are borne in the axils of the lower hydranth and correspond in position to the long-stalked hydranth higher up. They are distinctly club shaped, enlarging gradually from the base to the extremity, which is surmounted by a well-defined collar, and they are slightly wrinkled. Medusae-buds spring from all sides of the blastostyle. The older ones are flat with about 28 closely pressed tentacles, and with a four-cornered mouth.

*Dimensions.* Height of hydrocaulus, 6-20 mm.; length of larger hydrotheca, .36 mm.; length of smaller hydrotheca, .325 mm.; width at margin of larger hydrotheca, .34 mm.; width at margin of smaller hydrotheca, .19 mm.; length of gonotheca, .750 mm.; diameter at extremity, .26 mm.

*Habitat.* On grasses at Scow Bay, Port Townsend Harbor.

The present species agrees with *Campanularia coruscans* Schneider in dimensions but differs in other respects. The trophosome resembles that of Agassiz's *Eucope diaphana* except that the hydrotheca-stalk is ringed throughout in the latter; the gonosome on the other hand differs completely.

**15. *Obelia surcularis*** sp. nov. Pl. 3, figs. 14, 14A, 14B. Pl. 6, fig. 14c.

*Trophosome.* The hydrocaulus is erect, and borne on a creeping and branched hydrorhiza. There is never more than one branching primary stem. The branches are regularly alternate, turned upwards, and generally end in long filiform tendrils slightly expanded at the extremity and bearing, in some cases, one or two hydrothecae. Six to eight annulations are found at the base of the main stem, three or four above each branch. The stem of the hydrotheca is often ringed throughout, tapering from the point of origin to the calycle. The hydrotheca is a little swollen at center and has a slightly everted and smooth margin.

*Diaphragm.* A simple shelf projecting inwards from the cup. The basal chamber is not separated from the cavity of the stalk.

*Gonosome.* Gonothecae are borne in axils and on the branches, on short ringed stalks; it is questionable whether they are ever borne on the hydrorhiza. They expand rapidly from base to extremity, where they end in a flattened top with a very shallow and flat projection containing the aperture. Medusae develop on all sides of the blastostyle, in most cases as many as 28 developing at once. The older ones are flat with a four-cornered mouth and about 24 tentacles.

*Dimensions.* Height of colony up to 25 mm.; length of hydrotheca, .3 mm.; diameter of hydrotheca at margin, .25 mm.; length of tendril-like processes, 1.2-5 mm.; length of gonotheca, .75-.90 mm.; greatest diameter of gonotheca, .15 mm.; number of tentacles on hydranth about 24.

The tendril-like processes which form such a striking feature of this species are decidedly characteristic and cannot be mistaken. Other characteristic features are the long regular branches, each of which bears two or three gonothecae always in axils of branches or hydrothecae-stems.

*Habitat.* On water grasses. Abundant in Scow Bay, Port Townsend Harbor.

**16. *Obelia fragilis*** sp. nov. Pl. 3, figs. 15, 15A, 15B. Pl. 6, fig. 15c.

*Trophosome.* Hydrocaulus clinging and never erect. Stems polysiphonic, long, flexuous, branched at regular intervals, branches also comparatively long and flexuous, slightly ringed at the base and with four rings above each branch. Hydrotheca deep bell-

shaped; the chitinous periderm is exceedingly delicate and easily wrinkled or folded. Hydrothecae placed alternately and at some distance apart. Margin sinuous; stems short and annulated throughout. **A single hydrotheca in the axil of each branch.**

Gonophores unknown.

*Diaphragm* a simple well-defined shelf below the hydranth. Basal chamber a part of the stem (Pl. 6, fig. 15c).

*Dimensions.* Length of colony, 30 mm.; length of branches, 9 mm.; distance between branches, 1.5 mm.; length of hydrotheca, .5 mm.; width of margin, .4 mm.; number of tentacles, 22-24.

This exceedingly graceful hydroid recalls Marktanner-Turneretscher's *O. chinensis*, which according to this author resembles Hincks's *Gonothyraxa hyalina*. I cannot carry the resemblance so far, and it differs also from *O. chinensis* in its much smaller dimensions (*O. chinensis*—internodes .2 mm. thick and often 4.5 mm. long) and in the length of the stem bearing the hydrothecae.

*Habitat.* Dredged in Port Townsend Harbor on *Aglaophenia struthionides*.

**17. *Obelia dichotoma* Linn.** Pl. 3, figs. 16, 16 A, 16 B, 16 C, 16 D. Pl. 6, fig. 16 E.

A few good specimens of this species were found at Bremerton. Hincks's description is as follows: "Stem filiform, slender, nearly straight, irregularly branched, ringed above the origin of the branches, of a deep horn color; branches suberect; often very long and more or less ramified; ringed at intervals and with a single calycele in the axils. Hydrothecae alternate, broadly campanulate and deep; polyhedral above, each side corresponding with a very slight sinuation of the margin borne on ringed pedicels. Gonothecae axillary, slender, smooth, widening from base upwards and terminating above in a raised somewhat conical aperture."

*Diaphragm.* A shelf consisting of two portions, the upper forming the main part of the diaphragm and extending inwards to confine the coenosarc; the other or lower portion bends downwards to form a tube confining the coenosarc, and connects with a second diaphragm at the first annulation. The coenosarc at this portion is smooth and even, but below the first annulation it becomes ragged and irregular.

*Dimensions.* Length of hydrotheca, .35 mm.; diameter at margin of hydrotheca, .2 mm.; number of tentacles on hydranth, 22-24; length of gonotheca, .8 mm.; diameter at extremity, .3 mm.

*Habitat.* On piles and stones at Bremerton. Common.

**18. *Obelia plicata* Hincks.**

This species with its exceedingly delicate calyces was not very abundant or in good condition. The polysiphonic stems and the method of branching together with the short-ringed pedicels place it in this species.

**19. *Obelia gelatinosa* Pallas.**

A fine specimen of this widely distributed species was dredged at Discovery Bay, but it was not in fruit.

*Diaphragm* a simple partition below the hydranth turning down to form a tube about the coenosarc. The basal chamber is a part of the stem.

**20. *Obelia griffini* sp. nov.** Pl. 4, figs. 18, 18A, 18B, 18C. Pl. 6, fig. 18D.

*Trophosome.* The stems are much branched growing on creeping stolons. Branches are regularly alternate and about .5 mm. apart, giving a much-branched appearance to the colony. The primary stems are ringed at the base (6 rings) and above the joints up to middle of the internode. The hydrothecae are borne on stems .1 mm. long, ringed, as a rule, throughout the entire length (about 9 rings). The hydrothecae are alternately arranged, with plain rim, deep and gracefully curved. **Tentacles on hydranth about 24.**

*Diaphragm* a simple partition with down-turned edges. The coenosarc broadens out below to fill partly the basal chamber which is a part of the stalk.

*Gonosome.* The gonothecae are elongate, borne on short ringed stalks, rather attenuate and nearly uniform in diameter. From six to eight medusae develop on the blastostyle at one time. The older medusae are discoid, with about 24 tentacles.

*Dimensions.* Height of colony, 25-50 mm.; distance between hydrothecae, .08 mm.; length of hydrotheca, .25-.35 mm.; length of gonotheca, .8-1. mm.; diameter at widest part, .25-.3 mm.

CALICELLA Hincks (in part).

Schneider does not consider the operculum of sufficient importance to distinguish genera and unites with his family Campanulariidae the four families of Hincks as follows: (1) Campanulariidae, (2) Campanulinidae, (3) Leptoscyphidae, (4) Lafoeidae. He

regards the operculum as little more than a toothed margin, the teeth coming together to form a covering. The form of the polyp, which according to Levinsen is of little moment, is quite similar in all four families, and the constancy of type should be recognized. The operculum on the other hand is an adaptive structure.

**21. *Calicella syringa*** Linn. Pl. 4, figs. 20, 20A, 20B, 20C. Pl. 6, fig. 20D.

This form agrees perfectly with Hincks's description.

*Diaphragm* a simple shelf of dissimilar thickness, thickest at the outer extremity and running out to a very fine ledge under the hydranth. The basal chamber is part of the stem.

*Habitat.* On stems of *Tabularia larynx*, *Hydrallmania fulcata*, etc., at Port Townsend Bay. Also reported from Iceland (Hincks); Alaska (Clarke); East Spitzbergen (Marktanner-Turneretscher).

#### SERTULARIIDAE.

It has been difficult to characterize this family, and to find a chief differential of value. Hincks's early description is insufficient. It is: — "Hydrothecae perfectly sessile, more or less inserted in the stem and branches; polypites wholly retractile with a single wreath of filiform tentacles round a conical proboscis; gonozooids always fixed." Levinsen endeavored to improve upon this by finding a chief differential in the structure of the operculum. He says: — "Forms with a well-developed segmented stem, whose bilaterally placed operculated hydrothecae are usually stemless, and frequently sunk into the stem or branches." His diagnosis is based upon comparatively few genera and species, and the nature of the operculum, its insertion, and the opposite-placed "collar" are points which necessitate a complete rearrangement of the old family Sertulariidae. Until these characters have been approved by further investigation and upon living material, and until the natural affinities are better understood than they are at present, it seems a better plan, in a work of the present kind, to adhere to the older system notwithstanding Allman's objection to Gray's division of the family. Schneider's division of the family into a number of types is very convenient and probably represents as nearly as possible, considering our present knowledge, the natural affinities of the groups.

1. *Sertularella* group. The hydrothecae distinctly alternating,

with a more or less distinct joint between each two. Mouth of the hydrotheca toothed, operculum of many parts (all of Hincks's *Sertularellas*; also those of Allman and Bale).

2. *Dynamena* group. The hydrothecae opposite, a joint between each pair; side branches, when present, arising from one or from both components of the pair of hydranths; mouth of hydrotheca generally with two teeth; operculum simple. To this group belong Hincks's *Diphasia rosacea* and *D. attenuata*; *D. fallax* Johnston; *D. pinaster* Ellis & Sol.; Pallas's *D. lamarisca* and *D. pinnata*; Hassall's *Sertularia pumila* and *S. gracilis*; *S. operculata* Hincks; *S. bispinosa* Gray; *S. minima* Thompson; *S. macrocarpa* Bale.

3. *Thujaria* group. Hydrotheca more or less alternating, often almost opposite, closely placed and many to an internode. Side branches invariably arising from a singly-placed hydranth. Mouth of the theca generally smooth, operculum simple. Here belong Hincks's *Diphasia alata*; Ellis and Solander's *Sertularia filicula*, *S. abietina*, *S. argentea*; *Sertularia cypressina* Hincks; *Thujaria thuja* Hincks; *T. louchitis* Hincks; *Sertularia diffusa* Allman; *S. elongata*, *S. tenera* Sars; *S. maplestonei* Bale; *S. huttoni*, *Diphasia mutulata* Busk; and *Dynamena tubuliformis* Marktanner-Turneretscher.

4. *Pasythea* group. Hydrothecae opposite; a variable number of pairs closely packed upon the middle portion of an internode. Here belong a few easily recognized forms, e. g., *P. denticulata* Ellis and Solander.

5. *Selaginopsis* group. Hydrothecae arranged in more than two rows, closely packed together in great numbers on an internode. *Selaginopsis cylindrica* Clarke and *S. fusca* Johnston.

6. *Hydrallmania* group. Hydrothecae on side branches distinctly in one row, many packed together upon an internode. *H. falcata* Linn.

### 1. *Sertularella* group.

#### 22. *Sertularella conica* Allman. Pl. 4, figs. 22, 22A, 22B.

Hydrocaulus attaining a height of about an inch and a half, simple or with an occasional branch. Hydrothecae springing from points close to the distal ends of the internodes; they are tumid towards the base and narrowed towards the orifice and slightly marked with corrugations on the upper side.

*Dimensions.* Height of colony, 10 mm.; length of hydrotheca, .7 mm.; length of internodes, .65 mm.

The specimen which I place here was of very small size and without gonosomes. The only character, and this a small one, by which to distinguish it from the very wide-spread *S. polyzonias*, is the well-marked wrinkling on the adcauline side of the hydrotheca.

*Habitat.* Attached to stone dredged in Townsend Harbor.

**23. *Sertularella tricuspidata*** Alder. Pl. 4, figs. 21, 21A, 21B, 21C.

*Trophosome.* Stems slender, alternately branched or divided dichotomously, often bipinnate at the top, jointed above each caly- cle and twisted at intervals. The hydrothecae are distant, cylindrical, smooth, slightly expanded and everted above, and have a 3-toothed aperture.

*Gonosome.* The gonotheca is large, and strongly cross-ribbed, with a plain funnel-shaped aperture which arises from a bowl-like expansion.

*Dimensions.* Height of colony, 35–40 mm.; length of hydrotheca, .4 mm.; diameter at top of hydrotheca, .15 mm.; broadest diameter, .2 mm.; length of gonotheca, 1.6 mm.; greatest diameter of gonotheca, .6 mm.; length of internodes, .5 mm.

Except for the expanded and slightly everted margin the Puget Sound form agrees perfectly with Hincks's description of this species. The joints are very slightly marked and often difficult to see.

*Habitat.* Port Townsend Bay, dredged in 15 fathoms of water, off Marrowstone. Previously reported from Iceland (**Hincks**); Greenland (**Buck**); Strait of Belle Isle (**A. S. Packard, Jr.**); Alaska (**Clarke**).

**24. *Sertularella nodulosa*** sp. nov. Pl. 5, figs. 29, 29A, 29B.

*Trophosome.* Stems simple or slightly and irregularly branched, branches also irregularly subbranched, the latter arising immediately below the hydrothecae. Hydrothecae large, smooth or slightly waved, with a slight bulge below and a taper at the extremity. The margin bears three teeth and a three-parted operculum. The joints are slightly oblique and hydrothecae are deeply inserted midway between them. The hydranth contracts with a peculiar fold which is highly characteristic.

**Gonosome.** Gonotheca large, conical, given off midway between two adjacent hydrothecae. Characterized chiefly by the presence of nodules on the distal half. These are arranged in three circles. The first circle is made by four nodules at the extremity. The second circle is about one quarter of the length of the gonotheca from the extremity, and consists of 6 nodules; the third row is about midway between the apex and the base and consists of eight nodules. The aperture is small.

**Dimensions.** Height of colony, 25–50 mm.; distance between joints (length of internodes), .5 mm.; length of gonotheca, .58 mm.; greatest diameter, .35 mm.; length of gonotheca, 1.1 mm.; greatest diameter of gonotheca, .8 mm.

**Habitat.** Dredged in 15–20 fathoms off Marrowstone, Townsend Harbor. Not common. It bears a slight resemblance to Heller's *S. crassicaulis*.

### 3. *Thujaria* group.

#### 25. *Thujaria thuiaroides*.

A small specimen of this hydroid was found among algae and not in very good condition. Gonothecae absent.

Described also by Clarke from Alaska.

#### 26. *Sertularia fabricii* Levinsen. Pl. 5, figs. 24, 24A, 24B.

The shoots are bushy with a spiral arrangement of the branches. The latter turn upwards and give a characteristic spiral appearance. The branches are given off alternately about  $1\frac{1}{2}$  mm. apart, and they are branched and subbranched in turn to form fan-shaped offshoots. The hydrothecae are subalternate, narrowed towards the upper part which is free and divergent; from 5–7 to an internode; the latter are of different lengths. The aperture is small and oblique. Gonothecae (Hincks) broad at the top, attenuated downwards, with two spines above (or sometimes only one) and a slightly raised circular aperture.

**Dimensions.** Height of colony, 35 mm.

**Habitat.** Dredged off Marrowstone, Townsend Bay, 15–18 fathoms. Previously reported from England (Hincks and others); mouth of Elbe (Kirchenpauer); Greenland (Fabricius); North Cape (Sars); Southern Labrador (A. S. Packard, Jr.); Nova Scotia (Dawson); Grand Manan (Stimpson); Massachusetts (Agassiz); South Africa (Busk).

5. *Selaginopsis* group.

**27. *Selaginopsis cylindrica*** Clarke. Pl. 3, figs. 17, 17A.

*Thujaria cylindrica* Clarke.

The hydrocaulus is erect, simple, stout, gradually tapering from the distal end to the base, and divided by oblique joints into internodes of variable length; 3-4 annulations at the base, regularly branched; branches alternately arranged, cylindrical or polygonal in section. The hydrothecae are tubular, almost entirely imbedded, tapering at extremity and curved slightly outwards. Aperture oval. Hydrothecae on stem arranged in six longitudinal rows in such a manner that the appearance of oblique transverse rows is given. Gonophores not known.

*Dimensions.* Length of main stem, about 45 mm.; length of branches, 18 mm.; length of hydrotheca, .45 mm.; greatest diameter of hydrotheca, 2 mm.

*Habitat.* Dredged with *Aglaophenia* in Townsend Bay. Reported from Alaska (Clarke).

6. *Hydrallmania* group.

**28. *Hydrallmania falcata*** Linn. Pl. 5, figs. 25, 25A, 25B.

The stems are fairly stout, not flexuous; destitute of calyces, with 3-4 plain rings about the base. The branches are alternate, distant, regularly pinnate, and given off above each joint. The hydrothecae, 3-4 to each internode, are tubular, closely appressed, slightly tapering towards the margin, and are turned alternately towards the right and left. Joints oblique. Aperture plain. Gonothecae (Hincks) ovate, tapering below with a slightly tubular neck.

*Dimensions.* Height of stem, 25-30 mm.; length of hydrotheca, .45 mm.; greatest diameter, .2 mm.; length of internodes on stem, 1.5-2 mm.

*Habitat.* Port Townsend Bay. Not common.

PLUMULARIADAE.

**29. *Plumularia setacea***. Pl. 5, figs. 27, 27A, 27B, 27C.

*Trophosome.* The shoots are delicate, and the stem is slightly waved and regularly jointed. Pinnae alternate, one to each inter-

node, originating immediately below the joint, composed of longer and shorter internodes placed alternately, the former bearing the calyces; hydrothecae small with an even rim, very distant, separated by two joints; the nematophores are elongate, two abreast behind and above the calycle, two in a line below it, one at the origin of the pinnae, and one on each segment of the stem. Gonothecae borne on the axils of the pinnae (Hincks).

*Dimensions.* Length of stem, 40–50 mm.; length of pinnae, 2–3 mm.; distance between hydrothecae, .55 mm.; length of hydrothecae, .12 mm.; length of nematophores, .05 mm.

*Habitat.* Point Wilson on stones, etc. Common.

**30. *Plumularia echinulata*** (variety). Pl. 5, figs. 28, 28A, 28B, 28C.

The shoots are very delicate, the stem curved or straight; jointed, the internodes short and bulging in the center, bearing each a single branch. The branches are alternate, arching gracefully upwards, with two joints immediately above the axil. Hydrothecae small, basin-shaped, separated by a single joint. Nematophores very minute, simple, adnate to the side of the stem, one behind and above the calycle, one below it, and one or sometimes two (Hincks) in the axils of the branches. Gonothecae not present.

*Dimensions.* Length of stem, 13 mm.; length of branches, 2 mm.

I make this species a variety of *P. echinulata* because of the greater thickness of the branches and also because of the occasional presence of two joints between the hydrothecae. On no less than 7 of the 28 branches of one specimen I find one interthecal space with two joints, although the usual number is one. In *P. setacea* two joints between cups is the rule, here it is the exception.

*Habitat.* On algae and stones at Port Townsend. Uncommon.

**31. *Aglaophenia struthionides*** (Murray) Clarke. Variety B. Pl. 5, figs. 26, 26A, 26B.

*Trophosome.* The stems are clustered, simple, erect, divided by the oblique joints into short internodes of equal length, each bearing a single pinna; varying from light to dark horn color; the shoots tall, plumose. The pinnae are slightly curved towards each other, divided into internodes slightly larger than those of the stem, each internode bearing one hydrotheca. The hydrotheca is large and cup-shaped, expanding towards the distal end; the aperture is also large, with rim of 9 teeth more or less sharp.

Nematophores tubular, the lateral ones of medium size projecting ear-like from the sides of the cups, the anterior one long, adnate except at the extremity which is free, and extending beyond the toothed rim. Aperture small, terminal. The nematophores on the corbulae are a trifle larger, and arranged in rows which pass upwards to the dorsal side, make a short turn there, and come down again parallel. The corbulae are large and cylindrical, with numerous ridges (10-16) composed of oblique rows of nematophores, and with 4 hydrothecae at the base.

Clarke figures this corbula with rings of nematophores around the ventral ridge; but in the present specimens there are no such rings and no nematophores on the ridge except at the extreme tip where there is one.

*Habitat.* On rocks dredged from 15 fathoms at Marrowstone, Townsend Bay. Common.

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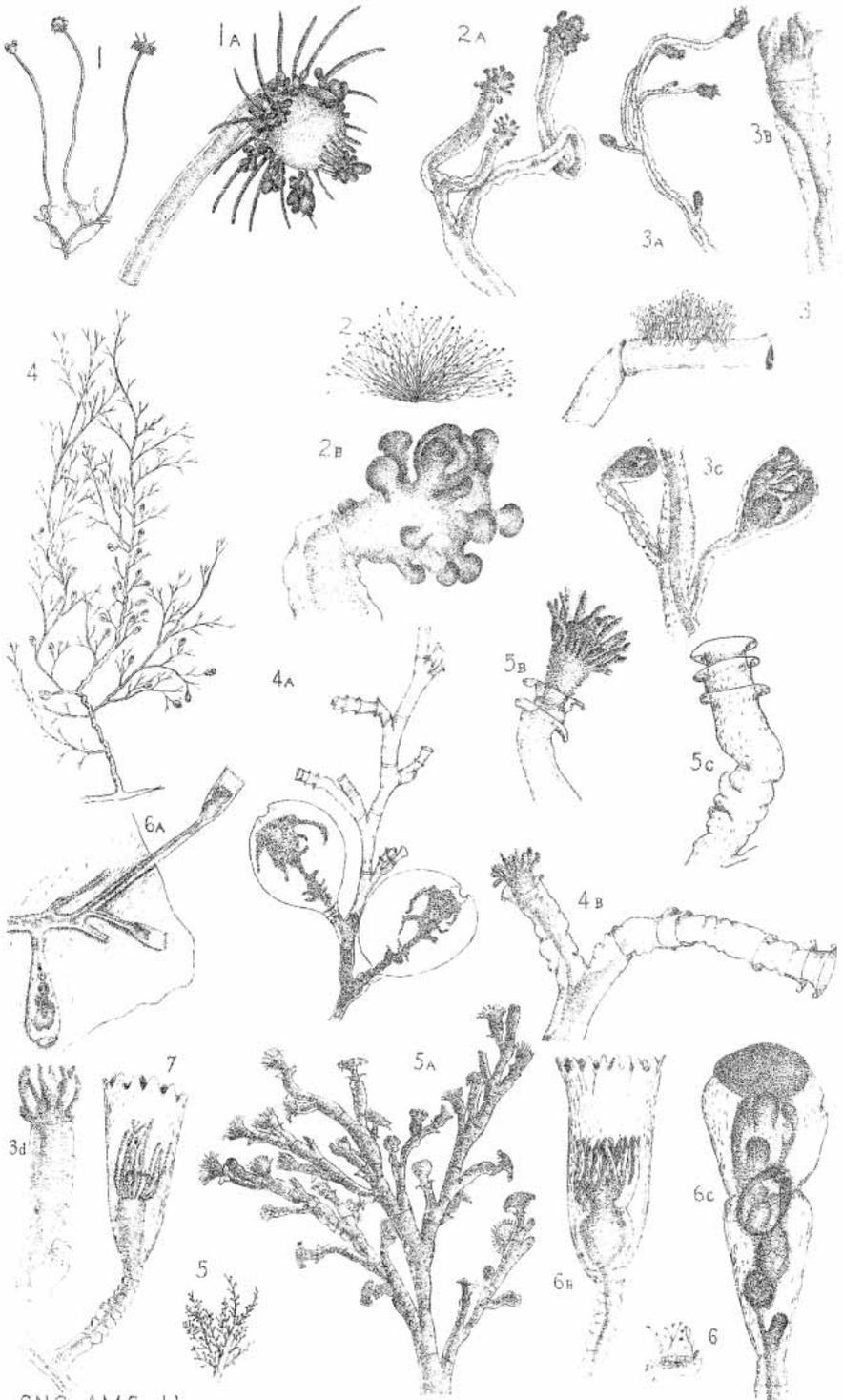
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PLATE 1.

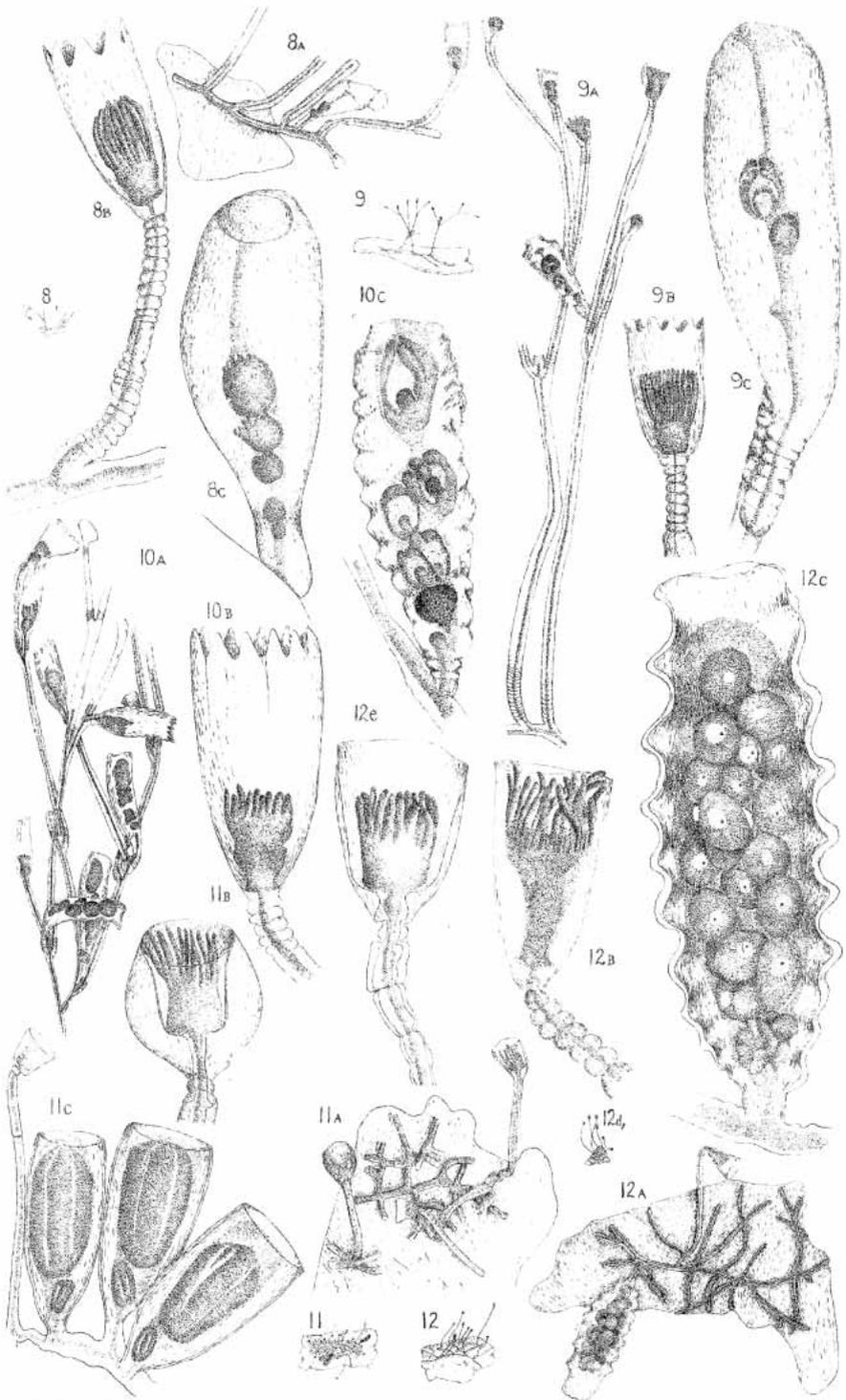
- Fig. 1. *Tubularia larynx*. Nat. size. *a.* Hydranth with gonophores.  $\times 18$ .  
Fig. 2. *Coryne mirabilis*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Medusa-  
bud.  $\times 80$ .  
Fig. 3. *Perigonimus repens* on leg of *Pisa*. Nat. size. *a.* Hydrocaulus.  $\times 18$ .  
*b.* Hydranth.  $\times 80$ . *c.* Medusae-buds.  $\times 80$ . *d.* Hydranth.  $\times 80$ .  
Fig. 4. *Halecium wilsoni*. Nat. size. *a.* Male gonophores.  $\times 18$ . *b.* Hydro-  
theca.  $\times 80$ .  
Fig. 5. *Halecium densum*. Nat. size. *a.* Portion of hydrocaulus.  $\times 18$ . *b.*  
Hydranth.  $\times 80$ . *c.* Hydrotheca.  $\times 80$ .  
Fig. 6. *Campanularia johnstoni*. Nat. size. *a.* Portion of hydrocaulus.  $\times 18$   
*b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ .  
Fig. 7. *Campanularia johnstoni* var.  $\times 80$ .



G.N.C.+A.M.C. del.

PLATE 2.

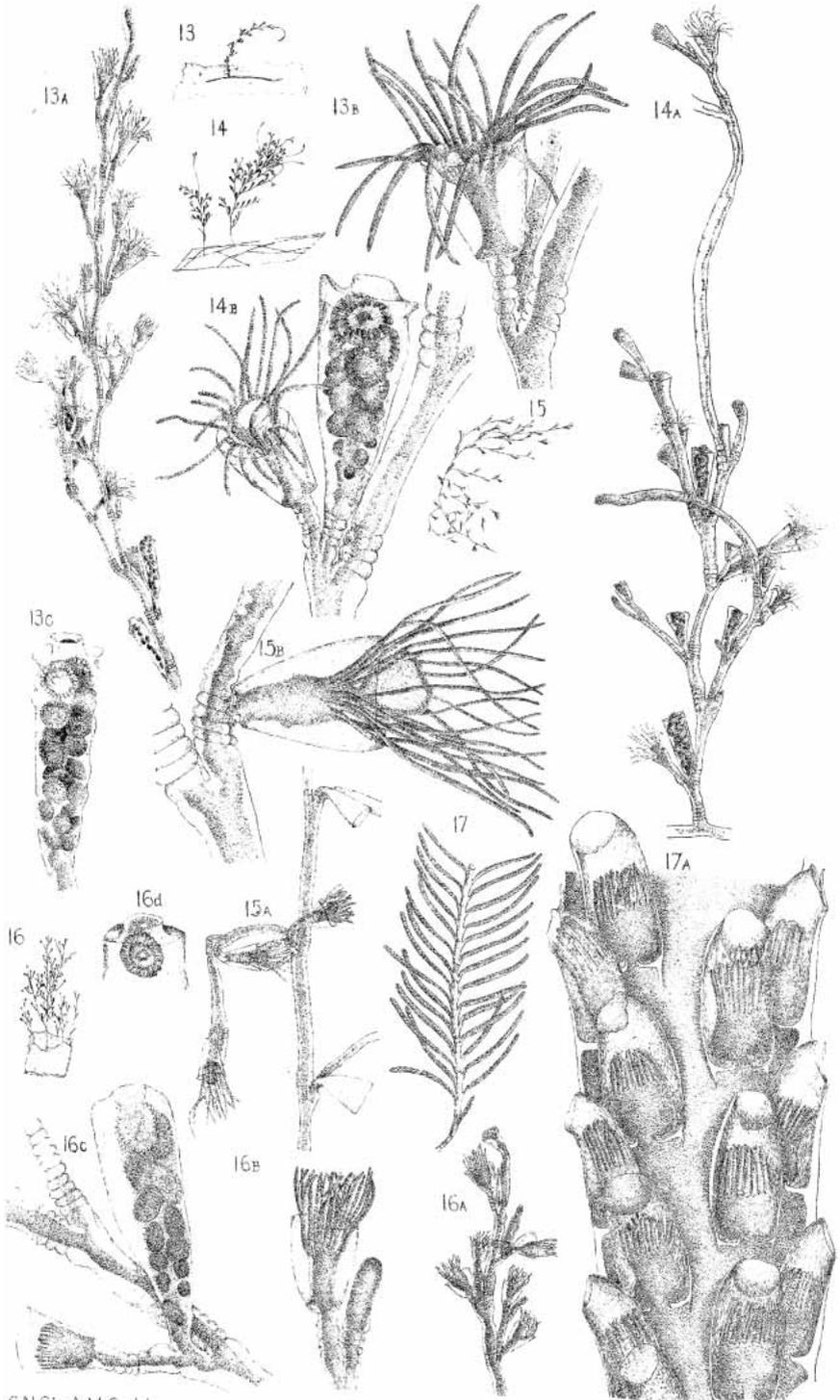
- Fig. 8. *Campanularia inconspicua*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca, hydranth, and stalk.  $\times 80$ . *c.* Gonosome.  $\times 80$ .
- Fig. 9. *Campanularia attenuata*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ .
- Fig. 10. *Campanularia gracilis*. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ .
- Fig. 11. *Campanularia calculata*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosomes.  $\times 80$ .
- Fig. 12. *Campanularia integra*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ . *d.* *C. integra* var. Nat. size. *e.* Hydrotheca and hydranth.  $\times 80$ .



G.N.C. & A.M.C. del.

PLATE 3.

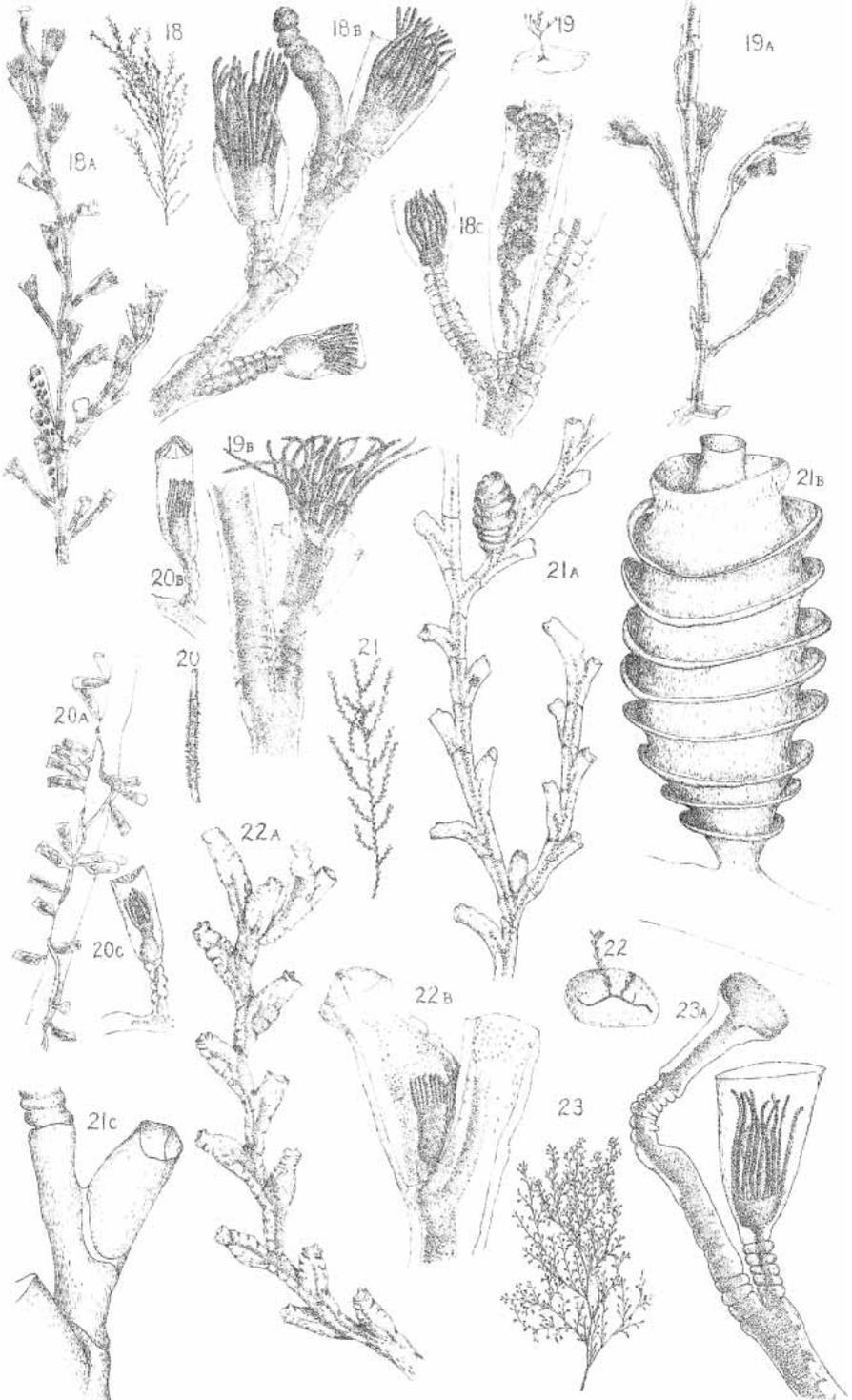
- Fig. 13. *Obelia gracilis*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ .
- Fig. 14. *Obelia surcularis*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca, hydranth, and gonosome.  $\times 80$ .
- Fig. 15. *Obelia fragilis*. Nat. size. *a.* Portion of hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ .
- Fig. 16. *Obelia dichotoma*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ . *d.* Distal end of gonosome.  $\times 80$ .
- Fig. 17. *Selaginopsis cylindrica*. Nat. size. *a.* Portion of pinna.  $\times 80$ .



G.N.C. & A.M.C. del.

PLATE 4.

- Fig. 18. *Obelia griffini*. *a.* Hydrocaulus. Nat. size. *b.* Hydrotheca and hydranth.  $\times 80$ . *c.* Gonosome.  $\times 80$ .
- Fig. 19. *Campanularia exigua*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth.  $\times 80$ .
- Fig. 20. *Calicella syringa*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca and hydranth; operculum thrown out.  $\times 80$ . *c.* Hydrotheca and hydranth; operculum drawn in.  $\times 80$ .
- Fig. 21. *Sertularella tricuspida*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Gonosome.  $\times 80$ . *c.* Hydrotheca.  $\times 80$ .
- Fig. 22. *Sertularella conica*. Nat. size. *a.* Hydrocaulus.  $\times 18$ . *b.* Hydrotheca.  $\times 80$ .
- Fig. 23. *Obelia plicata*. Nat. size. *a.* Hydrotheca and hydranth.  $\times 80$ .



G.N.C. & A.M.C. del.

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PLATE 5.

- Fig. 24. *Sertularella fabricii*. Nat. size. *a*. Hydrotheca.  $\times 80$ . *b*. Hydrocaulus.  $\times 18$ .
- Fig. 25. *Hydrallmania falcata*. Nat. size. *a*, *b*. Front and side views of hydrotheca.  $\times 80$ .
- Fig. 26. *Aglaopenia struthionides*. Nat. size. *a*. Hydrotheca.  $\times 80$ . *b*. Gonosome (corbula).  $\times 18$ .
- Fig. 27. *Plumularia setacea*. Nat. size. *a*. Hydrocaulus.  $\times 18$ . *b*. Hydrothecae and nematophores.  $\times 80$ . *c*. Nematophore, much enlarged.
- Fig. 28. *Plumularia echinulata*. Nat. size. *a*. Hydrocaulus.  $\times 18$ . *b*. Hydrotheca and nematophores.  $\times 80$ . *c*. Nematophore, much enlarged.
- Fig. 29. *Sertularella nodulosa*. Hydrocaulus. *a*. Hydrotheca and hydranth, the latter contracted in a characteristic manner. *b*. Gonosome.



G.N.C. & A.M.C. Fl.

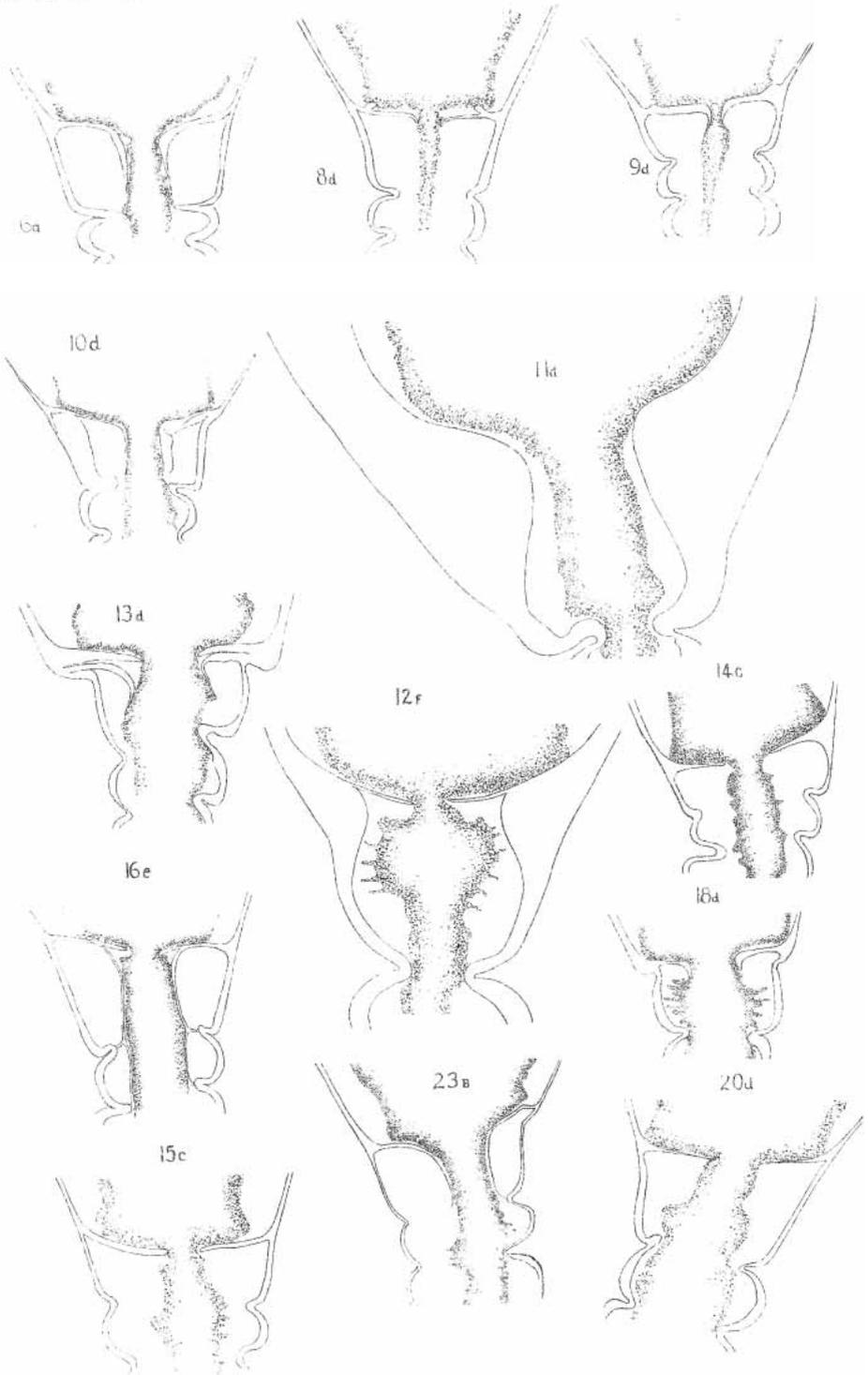
PLATE 6.

VARIATIONS IN THE DIAPHRAGM.

- Fig. 6d. *Campanularia johnstoni*. Diaphragm prolonged to form a tube around the coenosarc.
- Fig. 8d. *Campanularia inconspicua*. An elevated ridge on the diaphragm.
- Fig. 9d. *Campanularia attenuata*. Diaphragm with small wing-like elevations.
- Fig. 10d. *Campanularia gracilis*.
- Fig. 11d. *Campanularia caliculata*.
- Fig. 12f. *Campanularia integra*.
- Fig. 13d. *Obelia gracilis*.
- Fig. 14c. *Obelia surcularis*.
- Fig. 15c. *Obelia fragilis*.
- Fig. 16e. *Obelia dichotoma*.
- Fig. 18d. *Obelia griffini*.
- Fig. 20d. *Calicella syringa*.
- Fig. 23b. *Obelia plicata*.

All figures magnified 375 diams.

All figures drawn with camera lucida from permanent preparations.



GNC & AMC. del