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## ASCIDIANS FROM THE COASTS OF CANADA.

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## THE ASCIDIANS OF THE MARINE BIOLOGICAL STATIONS OF CANADA.

The writer has spent a portion of each summer for the last three years at the Marine Stations, in 1908 and 1909 at Departure Bay, British Columbia, and in 1910 at St. Andrews, New Brunswick. As the collections and observations were made during a very short time in each year, little knowledge has been acquired as to the annual and seasonal variations. However, sufficient has been learned to give some idea of the forms that are available for study at the two stations.

## (A). The Atlantic Station.

The month of July, 1910 was spent at St. Andrews. Several rocky points were visited repeatedly at low tide and much material obtained. The most favourable places are rocky ledges on precipitous shores, where can be found plenty of flat stones. The lower surfaces of these stones are usually covered with Ascidiæ. The shores on either side of the station wharf and the shore of Sand Reef Point were the most productive of those that were visited. All the species that were found at low tide, occurred in the dredgings as well, but the majority of them could be obtained more easily and in greater quantity at low tide.

The facilities at the station and the willing co-operation of the station staff made possible a large amount of dredging. The writer was especially indebted to Dr. Stafford, the curator of the station, for generous assistance in every way, both in dredging and in other collecting. Dredgings were made at various points (1) in the St. Croix River, (2) in Passamaquoddy Bay, (3) in the approaches to Passamaquoddy Bay (Letite Passages, Quoddy River, Indian River &c.), (4) near L'Etang and (5) out in the Bay of Fundy around and near the Island of Grand Manan. It was only in the last locality that any Ascidiæ were obtained from muddy or sandy bottoms. Nearly everywhere, they were obtainable on hard bottom, stones, shells and gravel.

Of Compound Ascidiæ, *Amaroucium glabrum*, *Tetradidemnum* [*Leptoclinum*] *albidum* and *Holozoa* [*Distaplia*] *clavata* were generally

distributed. Two colonies of *Aplidium spitzbergense* were obtained near Grand Manan. *Didemnoopsis tenerum* occurred at Grand Manan and in the approaches, though sparingly.

Of the *Cionidae*, a single specimen of *Ciona intestinalis* was dredged near Grand Manan. Verrill has reported it as abundant in the Bay of Fundy.

Of Phallusiids [Asciidiids], *Ascidiopsis prunum* was obtained in quantity at low tide and considerable numbers were taken in the dredge. *Phallusioides obliqua* was common at Grand Manan and a few specimens were obtained in the approaches, but none near the station.

Of the *Chelyosomatidae*, a single specimen of *Chelyosoma macleanum* was dredged in the approaches.

Caesirids [Molgulids] are very abundant. At low tide were found *Caesira papillosa*, *C. littoralis*, *C. canadensis* and *C. retortiformis*. In addition to these, the dredgings gave in the approaches, at L'Etang and near Grand Manan a fifth species, *C. pannosa*. At the last locality, a number of *Eugyra pilularis* were dredged in 10 fathoms, sand.

Of Styelids, *Dendrodoa carnea* was rather numerous at low tide, and occurred sparingly, but well distributed, with *Goniocarpa placenta*, in the dredgings. Two specimens of *Cnemidocarpa mollis* and numbers of *Pandocia fibrosa* were found near Grand Manan.

The Tethyids [Cynthiids] are well represented. *Boltenia ovifera*, *B. hirsuta* and *Tethyum pyriforme americanum* occurred in large numbers at low tide and were found generally distributed on hard bottom.

To sum up, the following are obtainable in fairly large numbers near the station:—

*Amaroucium glabrum*,  
*Tetradidemnum albidum*,  
*Holozoa clavata*,  
*Ascidiopsis prunum*,  
*Caesira papillosa*,  
*C. littoralis*,  
*C. canadensis*,  
*C. retortiformis*,  
*Dendrodoa carnea*,  
*Boltenia ovifera*,  
*B. hirsuta*.  
*Tethyum pyriforme americanum*.

The following can be procured less easily (those found at Grand Manan only are not included):—

*Didemnoopsis tenerum*,  
*Phallusioides obliqua*,

*Chelyosoma macleayanum*,  
*Caesira pannosa*,  
*Goniocarpa placenta*.

In addition to the above species, the following have been found or are to be expected in this locality, but were not obtained in 1910:—

*Aplidium pallidum* Verrill,  
*Lissoclinum aureum* Verrill,  
*Botrylloides aureum* Sars,  
*Pelonaia corrugata* F. & G.

The fauna is subarctic, consisting of species that are peculiarly subarctic, most of which are closely related to, if not identical with, European species, and other species that are found in both subarctic and arctic regions or that have their nearest allies in arctic regions.

(B). The Pacific Station.

From June to August of both 1908 and 1909 were spent at the Departure Bay Station, and in the latter year three days were spent at Ucluelet on the outer coast of Vancouver Island as the guest of Prof. Macoun.

At the station, the best collecting places at low tide are the precipitous shores of the small rocky islands in the bay. The roofs of small caverns, the under surfaces of projecting rocks and the under surfaces of flat stones that are to be found on many of the rocky ledges are the favourite spots. A considerable amount of dredging was done at various depths ranging to about 25 fathoms. The curator of the station, the Rev. G. W. Taylor, assisted me in every way and through his courtesy I enjoyed several dredging trips to Northumberland Straits on the other side of Nanaimo and one trip to Burrard Inlet near Vancouver. The best dredging places were the channels, where the bottom was stony, shelly or gravelly, although the sandy bottoms frequently yielded an abundance of a few species. Much of the bottom gives poor results, because of the absence of stones, &c. of a size that can be brought up by the dredge, although these same bottoms are doubtless well populated with Ascidians.

*Compound Ascidians.* A species of *Amaroucium* occurs in quantity at low tide and is occasionally dredged. A very dark *Trididemnum* with few or occasionally no (?) spicules was taken several times in the dredge.

*Cionidae.* *Ciona intestinalis* occurs rather frequently as shown by the dredgings, but not in quantity.

*Phallusiidae.* *Ascidioopsis columbiana* was growing in large numbers at low tide and was occasionally dredged. *A. paratropha*, a large handsome species, occurs sparingly in 10 fathoms or more and 3 specimens of *A. nanaimoensis* were found outside the bay and at Northumber-

land Straits. *Phallusia ceratodes* grows in large beds in the bay south of Brandon Rocks and also in a sponge bed near the entrance to the bay. Elsewhere only occasional specimens were obtained.

*Chelyosomatidae.* *Chelyosoma productum* is occasional at low tide and abundant in deeper water. *C. columbianum* was found in from 10 to 20 fathoms but was not abundant. *Corella inflata* was growing in numbers near low water mark and *C. rugosa* in deeper water.

*Caesiridae.* *Caesira apoploa* and *C. cooperi* were dredged in sand in about 10 fathoms in front of the station.

*Styelidae.* *Katatropa vancouverensis* and *Cnemidocarpa joannae* were abundant at low tide and the latter occurred frequently in deeper water. *Goniocarpa coccodes* was dredged in small numbers from stony and shelly bottoms and with it was found *Styela gibbsii*. The latter was very abundant in many places in from 5 to 15 fathoms, sand.

*Tethyidae.* *Boltenia villosa* was growing in quantity at low tide and was abundant in the dredgings. *Pyura haustor* was found in large masses in from 5 to 20 fathoms, sand and occasionally elsewhere. *Boltenia echinata*, *Tethyum aurantium* and *T. igaboja* were obtained only very rarely and in from 10 to 25 fathoms, stones and shells.

The list for this station is as follows:—

(1) in quantity.	(2) occasional.
<i>Amaroucium</i> sp. A,	<i>Trididemnum</i> sp. A,
<i>Ascidioopsis columbiana</i> ,	<i>Ciona intestinalis</i> ,
<i>Phallusia ceratodes</i> ,	<i>Ascidioopsis nanaimoensis</i> ,
<i>Chelyosoma productum</i> ,	<i>A. paratropa</i> ,
<i>Corella inflata</i> ,	<i>Chelyosoma columbianum</i> ,
<i>C. rugosa</i> ,	<i>Caesira apoploa</i> ,
<i>Katatropa vancouverensis</i> ,	<i>C. cooperi</i> ,
<i>Cnemidocarpa joannae</i> ,	<i>Goniocarpa coccodes</i> ,
<i>Styela gibbsii</i> ,	<i>Boltenia echinata</i> ,
<i>Boltenia villosa</i> ,	<i>Tethyum aurantium</i> ,
<i>Pyura haustor</i> .	<i>T. igaboja</i> .

The completion of the railway from Nanaimo to Alberni will make it possible to reach the outer coast of the Island in a short time by means of the railway and the Alberni Canal. This is of importance, as the fauna of the outer coast appears to differ markedly from that of the inner coast. The following account is based on collections made at Ucluelet on Barkley Sound near the mouth of the Alberni Canal by Prof. Macoun and his assistants in 1909 and by myself at the same point at the end of July and the beginning of August of the same year.

The rocks at low tide on the exposed coast are rich in Ascidians, especially the compound forms. The following were found:—

(1) in quantity.

*Amaroucium* sp. A,  
*Synoicum* (?) sp. A,  
*Trididemnum* sp. B,  
*Sycozoa* [*Colella*] sp.,  
*Holozoa* [*Distaplia*] sp. A,  
*Polycitor* (*Eudistoma*) sp. A,  
*Clavelina* sp.,  
*Perophora annectens*,  
*Katatropa yakutatensis*,  
*Styela montereyensis*.

(2) occasional.

*Corella rugosa*,  
*Chelyosoma productum*,  
*Caesira pacifica*,  
*Katatropa vancouverensis*,  
*Cnemidocarpa joannae*,  
*Boltenia villosa*,  
*Pyura haustor*,

Dredgings made in a few fathoms (5 to 10) yielded the following:—

(1) in numbers.

*Amaroucium* sp. A,  
*Synoicum* (?) sp. A,  
*Trididemnum* sp. B,  
*Clavelina* sp.,  
*Ascidioopsis columbiana*,  
*A. paratropa*,  
*Corella rugosa*,  
*Chelyosoma productum*,  
*Caesira apoploa*,  
*Cnemidocarpa joannae*,  
*Boltenia villosa*.

(2) occasional.

*Amaroucium* sp. B,  
*Synoicum* (?) sp. B,  
*Leptoclinium* [*Diplosoma*] (?) sp.,  
*Holozoa* [*Distaplia*] sp. B,  
*Polycitor* (*Eudistoma*) sp. B,  
*Katatropa uclueletensis*,  
*Styela gibbsii*,  
*Pyura haustor*,  
*Tethyum aurantium*,  
*T. igaboja*.

Dall has remarked that the fauna of the inner channels of the British Columbian archipelago is of a distinctly more northern character than that of the open coast. This is well shown in the Ascidi-ans. The list from Departure Bay includes arctic forms that are not represented at Ucluelet and among the Ucluelet species are a number of southern forms that do not occur at Departure Bay. It may be noticed that the arctic species of Departure Bay are not as plentiful and are not found in as shallow water as the corresponding species of the Atlantic Coast at St. Andrews.

(C). Some general features of interest.

Material for studying the early development of many of the Ascidi-ans can be obtained very easily, as in many cases the eggs are retained in the parent and only the free-swimming larvae escape. This is the condition of affairs in practically all of the compound Ascidi-ans, (those found at the stations). In the majority of the simple forms the eggs are not retained, apparently because the oviduct opens into the atrium very near the base of the atrial siphon and the strong current present at that point carries the eggs out. In some genera and species the oviduct opens

at some distance from the atrial siphon, where the current is not as great and as a result the eggs are usually retained. This retention of the eggs may be quite constant in a genus, may be characteristic of certain species only of a genus, or may occur only in occasional individuals of a species. In some cases the eggs are, though retained, laid in lots, so that practically only one stage can be obtained from one individual and all the individuals of one locality may have their eggs at the same stage of development. The following is a list of the simple forms of the stations that retain their eggs:—

Genera—*Dendrodoa*, eggs produced continuously.

*Katatropa* “ “ “

Species,—*Caesira cooperi*, eggs produced continuously.

*C. canadensis*, “ “ “

*C. littoralis*, “ “ “

Occasional individuals of

*Ascidiopsis prunum*, eggs produced in lots.

*Corella inflata*, “ “ “

*Boltenia hirsuta*, (?)

Young individuals, for studying the post-larval development, can be obtained in the case of the commoner species by carefully examining the free surface in individuals of those species which have a roughened test. Individuals, that were anaesthetized with cocaine, killed in the extended condition and well fixed, have furnished me with an abundance of stages of some of the commoner species. A series of sections made of an adult *Dendrodoa carnea*, yielded in addition, (1) an almost complete series of stages of the same species from the fertilized egg up to the free-swimming larvae, (2) a 'young adult' of the same species, (3) two 'young adults' of *Ascidiopsis prunum* and (4) a 'young adult' of some species of *Caesira*!

As is well known, the Ascidians harbour many commensals. *Protozoa* are to be found in the pharynx and atrial cavity in many of the simple forms of both coasts, the majority being attached to the oral tentacles. Various kinds of Copepods and Amphipods are to be found in the same cavities. Pea-crabs occur in the atrial cavity in most specimens of *Tethyum igaboja*, *Ascidiopsis paratropa* and *Phallusia ceratodes* of the West Coast. A hydroid\* is abundant at Departure Bay, coating the prebranchial zone of certain species of Ascidians and small colonies were occasionally found on the wall of the atrial cavity. Nearly every individual of *Phallusia ceratodes* contained this form and it was also found in *Ascidiopsis paratropa*, *Ciona intestinalis*, and *Tethyum aurantium*.

\*Mr. C. McLean Fraser has recently described this form (Bull. Lab. Nat. Hist. Univ. Iowa, vol. VI, No. 1) as the type of a new genus, belonging to the family *Turridae*. He has given it the name *Crypta huntsmani*.

Parasitic *Protozoa* occur in the glandular folds of the stomach in most species and in the 'liver' of Caesirids [Molgulids] and Tethyids [Cynthiids]. An Isopod was found in the endostylar vessel of *Styela gibbsii* and *Pyura haustor*.

Although Ascidians are not used for food on this continent, there are a number of species that might be so used. In most of the forms the musculature is so small in amount that when the test has been removed the great bulk of the animal consists of sea-water. In the Styelids and Tethyids, however, the musculature is well developed and frequently quite thick. Two species of *Tethyum*, very similar to or the same as those of our coasts, are, according to Oka, eaten by the Japanese. The inhabitants of Peru and Chili use as food two species of *Pyura* that occur on their coasts and species of the genus *Microcosmus* are exposed for sale in the markets of southern Europe (Grube).

#### THE HOLOSOMATOUS SPECIES OF THE WEST COAST.

The complete account of these species was sent in July, 1910, for publication in the Report of the Biological Stations of Canada. In the following account it is intended to give provisional diagnoses of the new genera and species, as well as some notes on the other species. The full extent of the variation noted in the various species is not always given in this account. Further study has shown that certain changes should be made in the original account and these have been incorporated in this article.

The writer is indebted to the Rev. Mr. Taylor for a large amount of material from Departure Bay, Hope Island, Banks Island, Goose Island, Lowe Inlet, China Hat, Stephen Island, Port Simpson, Prince Rupert, Rose Spit and Hecate Straits. Prof. Macoun communicated to the writer the collection of the Geological Survey, which contained a few specimens collected by Dr. Dawson in 1885, and a large amount of material from Departure Bay and Ucluelet, collected by Prof. Macoun and his assistants in 1908 and 1909.

Many of the Ascidian genera are inconveniently large and heterogeneous, e.g. *Tethyum* [*Cynthia*, *Halocynthia seu Pyura*], *Styela*, *Caesira* [*Molgula*], and *Phallusia* [*Ascidia*]. It would be a distinct advance to have these genera divided into smaller natural groups, so that the relationships of the species would be shown. I have attempted a division of *Tethyum*, *Styela* and *Phallusia* as far as the material at my disposal would permit. Some of these groups are quite small and it is questionable whether they should have the rank of genera. If they are given generic rank temporarily, it will call attention more forcibly to the characters which seem to be of importance in separating these groups. Many



of these characters are entirely neglected in descriptions of new species. The final determination of their rank may be left until our knowledge of all the species is such as to make revisions of the various families possible.

Family—*Perophoridae*.

*Perophora annectens* Ritter. Proc. Cal. Ac. Sc., ser. 2, vol. IV, p. 37.

In numerous colonies from Ucluelet the zooids differ from Ritter's description only in being yellowish-orange instead of yellowish-green and in having a maximum of 24 stigmata in a row instead of 18. These differences seem unimportant. The individuals in all cases formed typical social colonies and in no case were imbedded in a common test.

Family—*Agnesiidae*.

The genus *Agnesia* Mchlsn. should not be placed in the family *Corellidae* (*Corellinae*) or *Chelyosomatidae* (*Chelyosomatinae*), as has been done by Michaelsen, Seeliger and Hartmeyer. The position of the intestinal canal on the left side of the pharynx is of major importance and shows that its closest allies are the *Cionidae* and *Phallusiidae*. It differs sufficiently from either of these groups to warrant its being placed in a separate family.

*Agnesia septentrionalis* sp. n.

Shape oval, laterally flattened. Dimensions of largest specimen, 15×11×8 mm. Oral aperture terminal, atrial at anterodorsal angle. Surface entirely sand-covered, sand adhering to filamentous processes of the test. Apertures indistinctly 7- and 6-lobed respectively.

Dorsal and ventral bands of transverse muscular fibres in addition to the usual siphonal musculature.

About 30 simple tentacles, varying in size, scattered over inner surface of oral siphon. Dorsal tubercle apparently behind peripharyngeal groove, its aperture transverse and slightly bent. Six very large dorsal languets, with long 'roots.' No longitudinal bars. Transverse vessels carry a number of large sickle-shaped processes. Stigmata forming short infundibula, as many as three turns in each spiral; two rows of infundibula between successive transverse vessels.

Stomach large, smooth-walled. Intestine with the usual forwardly directed loop on the left side of the pharynx.

Ovary a rounded mass in the intestinal loop. Testicular lobes scattered over the intestinal loop near the ovary. Gonoducts accompany rectum.

Collected near Stephen Island in 1906 by Rev. Mr. Taylor.

This form differs from *A. glaciata* Michaelsen (*Zoologica*, Bd. 12, Ht. 31, p. 6), the only other species described, in details concerning the surface of the test, pharyngeal wall, &c.

Family—*Cionidae*.*Ciona intestinalis* (L.)

Specimens were taken frequently in and near Departure Bay, but never in quantity. They seem to differ from European specimens only in the small number (5) of muscular bands on each side of the body. To judge from the published figures, the number is variable in European specimens (6 or 7).

Family—*Phallusiidae*.

Genus—*Ascidiopsis* Verrill (*sens. nov.*). (= *Ascidia seu Phallusia auct. partim*).

The type species is *Ascidia callosa* Stimpson (= *A. prunum* Müller). Verrill instituted this genus for the type because of the plicated condition of the pharyngeal wall. This is a character common among Phallusiids and one that cannot be used as a distinctive feature. The diagnosis may be changed so as to include those forms with the pharynx extending beyond œsophageal aperture but not beyond the posterior side of the stomach, longitudinal bars bearing papillæ and intermediate papillæ, and renal vesicles occurring over intestinal loop and in the adjacent parts of the body-wall. Also the ganglion is close to the dorsal tubercle. This genus is intermediate between *Ascidiella* (as restricted by Hartmeyer) and the typical *Phallusiae* (e.g. *P. mentula*).

*A. nanaimoensis* sp. n.

Oblong, laterally flattened; attached by left side. Up to 27 mm. in length. Oral aperture terminal, 7- (or 5-) lobed; atrial, distant from oral from one-third to one-half the length of the body, 6-lobed. Surface nearly smooth (minute papillæ over part of surface). Musculature practically confined to right side of body.

From 45 to 105 tentacles. Prebranchial zone with indistinct papillæ. Aperture of dorsal tubercle crescent-shaped, opening between horns directed forwards. Ganglion is the width of peripharyngeal groove behind tubercle. Dorsal lamina prominently ribbed, its margin with coarse teeth corresponding to the ribs. Longitudinal bars, from 41 to 50 on the left side and from 48 to 66 on the right. Plications fewer than the bars. From 3 to 6 stigmata in each mesh.

Stomach with 17 shallow folds; intestine without typhlosole. Ovary in intestinal loop and on right side of first part of intestine. Testicular lobes in intestinal loop posteriorly, on both sides of first part of intestine and on right side of stomach. Gonoducts pass along posterior side of last bend of intestine.

Three specimens obtained at points near Departure Bay.

This species somewhat resembles in appearance *Ascidia adhærens*

Ritter from Alaska, but differs from it in the number of stigmata in each mesh, in the number of plications between successive bars and probably also in the number of bars.

*A. columbiana* sp. n.

Oblong, laterally flattened, attached by the entire left side. Up to 4.5 cm. in length, 3.5 cm. in width and 2 cm. in thickness. Apertures placed as in last species. Surface more or less roughened, with numerous short papillæ, which differ greatly in size in several varieties of this species which occur. Those near the apertures are always very distinct and longer than the others. Musculature as in last species.

From 20 to 45 tentacles. Prebranchial zone smooth. Aperture of dorsal tubercle horseshoe-shaped, the horns frequently bent inwards or outwards. Ganglion directly behind tubercle. Dorsal lamina strongly ribbed, its margin with teeth corresponding to the ribs and occasionally from 1 to 5 indistinct intermediate teeth. From 19 to 24 bars on the left side and from 21 to 26 on the right. From 1 to 2 plications between successive bars. From 4 to 20 stigmata in each mesh.

Stomach with from 12 to 22 shallow folds; intestine usually with typhlosole. Anus at level of anterior end of intestinal loop or somewhat behind it. Ovary chiefly on right side of first part of intestine. Testicular lobes on left side of loop and on both sides of stomach. Oviduct passes across lower (left) side of last bend of intestine and then along posterodorsal border of rectum.

Numerous specimens from Departure Bay, Ucluelet and Port Simpson.

Differs from *Ascidiella incrustans* Herdman from Puget Sound in the plain prebranchial zone and the toothed condition of the dorsal lamina. *Ascidia adhærens* Ritter is without the papillated surface and the peculiar course of the oviduct. Its closest ally is *A. prunum* (Müller) from the North Atlantic, which differs from it chiefly in the absence of the papillæ of the surface, and in the smaller number of bars (rt. 18 to 20, lt. 15 to 19).

*A. paratropa* sp. n.

Short cylindrical, attached by small area at posterior end. Up to 11 cm. in length and about 4.5 cm. in diameter. Oral aperture terminal, 7-lobed, turned toward the right side; atrial aperture, 6-lobed, at the end of a short siphon which extends from the anterodorsal angle to a point in front of the level of the oral aperture. Surface with large irregular tubercles. Musculature, extensive on the right side, consisting chiefly of longitudinal fibres; on the left side, longitudinal fibres from the siphons extend nearly to intestinal loop.

From 15 to 30 rather short tentacles. Prebranchial zone smooth. Aperture of dorsal tubercle as in last species; horns may be slightly coiled. Ganglion about width of peripharyngeal groove behind tubercle. Dorsal lamina ribbed on left side, its margin irregularly toothed, the largest corresponding to the ribs. On right side of œsophageal aperture and extending posteriorly is another lamina also toothed. From 28 to 34 bars on the left side and from 32 to 42 on the right. From 1 to 1.5 plications between successive bars. From 4 to 12 stigmata in each mesh.

Stomach with from 40 to 46 shallow folds; intestine with typhlosole; intestinal loop directed forwards but not bent toward dorsal side. Ovary in intestinal loop, on both sides of loop anteriorly and on right side of stomach. Testicular lobes in the loop and on both sides of posterior part of loop, as well as on both sides of stomach. Gonoducts pass along posterior side of last bend of intestine.

About 30 specimens from Departure Bay, Ucluelet, Banks Island and Goose Island, in from 5 to 20 fathoms.

No Phallusiid that has been described seems to have the peculiar shape and tubercles of this species. *Ascidiella griffini* Herdman from Puget Sound may be near it, but, as described, it differs in shape, character of surface, number of tentacles (60-70) and the presence of prebranchial papillæ.

Genus—*Phallusia* Savigny (*sens. restr.*)

Syn. *Ascidia seu Phallusia auct. part.*

This genus may be restricted to those forms that can be grouped around the type species (*Ascidia mentula* Müller ?) and which have the pharynx extending behind the posterior border of the stomach, longitudinal bars with papillæ, dorsal lamina extending behind œsophageal aperture, ganglion a considerable distance behind dorsal tubercle and renal vesicles restricted to the intestinal wall (or absent ?).

*P. ceratodes* sp. n.

About twice as long as broad, laterally flattened, attached by greater part of left side; up to 7 cm. in length, 3.2 cm. in width, and 1.5 cm. in thickness. Apertures sessile or on short siphons; oral 6- or 7-lobed, terminal; atrial 5- or 6-lobed, placed about half the length of the body back along the dorsal edge. Surface irregularly wrinkled and minutely roughened. Musculature practically confined to right side.

From 50 to 150 tentacles. Prebranchial zone smooth. Aperture of dorsal tubercle horseshoe-shaped, horns incoiled, with one turn in each coil; opening between horns directed forwards. Ganglion from 3 to 7 mm. behind tubercle. Dorsal lamina ribbed on left side, its margin finely toothed; from 2 to 5 teeth between successive teeth corresponding

to the ribs. Bars, 35 to 54 on right and 32 to 51 on left side. Papillæ at junctions, but not between. One plication or less between successive bars. From 3 to 9 stigmata in each mesh.

Intestinal canal occupies from  $\frac{1}{3}$  to  $\frac{1}{2}$  of left side, leaving from  $\frac{1}{3}$  to  $\frac{1}{4}$  of length of pharynx uncovered at both anterior and posterior ends. Stomach with about 17 folds. Intestinal loop bent forwards and somewhat upwards. Ovary in intestinal loop and on its right side. Oviduct follows posterior margin of last bend of intestine and postero-dorsal margin of rectum. Testicular lobes in a thick layer on right side of stomach and scattered over both sides of intestinal loop. *Vas deferens* on right side of first part of oviduct and in groove on the left side between second part of oviduct and rectum. As a result of this, when one looks at the lower side of the body (test removed) only a short terminal part of the *vas deferens* is seen.

In and near Departure Bay, in from 10 to 30 fathoms, locally abundant.

Its closest ally appears to be *P. longistriata* Hartmeyer from Japan, from which it differs in having the margin of the dorsal lamina toothed and in the situation of the gonads.

#### Family—*Chelyosomatidae*.

As is shown farther on, the intestinal loop in the genus *Chelyosoma* is always on the right side of the pharynx. Whether it is on the right or left side of an arbitrary median plane, is of little moment. With this genus brought into line, we have the utmost constancy in the position of the intestinal loop with reference to the pharynx in each of the genera of Ascidians. The only exceptions are those individuals that show an *inversio viscerum*. It seems right, therefore, that the genus *Agnesia* should not be placed in this family.

*Corella willmeriana* Herdman.

One specimen from Elk Bay was collected by Dr. Dawson, in 1885.

The surface is smooth. The atrial aperture is not on a distinct siphon. There are 24 bars on right side of pharynx and 22 (?) on left side. Spirals of infundibula are for the most part broken up into short stigmata.

*C. rugosa* sp. n.

Syn. *C. willmeriana* Ritter, Ann. N.Y. Ac., vol. 12, p. 604.

Oblong, laterally compressed or more or less cylindrical. Attached by posterior end or by right or left side. Apertures on same level at anterior end; atrial often at the end of a short siphon. Surface irregularly wrinkled and rough with fine irregular processes of the test. Up to 4 cm. long, 2 cm. wide and 1.5 cm. thick. Musculature consists of the usual siphonal fibres and of longitudinal fibres extending from the siphons for a short distance back over the body.

From 50 to 80 tentacles. Aperture of dorsal tubercle varying from a transverse slit to a horseshoe-shaped opening. From 14 to 20 languets. From 20 to 22 bars on each side, with a few rudimentary ones near dorsal and ventral margins of pharyngeal wall. Stigmatic infundibula deep and nearly square; the spiral of each with 5 or 6 turns, often slightly divided into shorter stigmata, the divisions occurring at the angles of the square.

Intestinal loop of the usual form, placed across posterior end of pharynx. Rectum long, reaching nearly to base of atrial siphon. Gonads on both sides of intestinal loop, the testicular lobes, but not the ovary, usually extending to beginning of rectum.

Numerous specimens from Departure Bay, Burrard Inlet, Uclulet, Banks Island and Hecate Straits.

This species differs from the last in the more anterior position of the atrial aperture, the roughened test and the smaller number of longitudinal bars.

*C. inflata* sp. n.

This is very similar to the preceding species. No intermediates have been found. It was obtained only at Departure Bay, occurring there in quantity at low tide and in very shallow water (8 fathoms or less). The most characteristic feature is the great enlargement of the atrium (the median part of the peripharyngeal cavity just beneath the atrial siphon). As a result of this, the shape is more nearly cubical than in the last species and the rectum is very much shorter (less than half the length of the body). There is a smaller number of tentacles (40 to 60) and also of longitudinal bars (16 to 18). Many of the latter (especially dorsally) are represented only by T-shaped processes, the pharynx not reaching, even in large individuals as complete a stage of development as that of the last species. The testicular lobes do not extend as far as the beginning of the rectum. The apertures are at the same level and the surface of the test is roughened with small irregular processes.

Genus—*Chelyosoma*.

There have been divergent accounts of the position of the intestinal canal in members of this genus. The most recent statements are that the loop is sometimes on the right side of the body and sometimes on the left side. As its position in other genera is quite constant, this seemed rather remarkable. An examination of a large number of specimens belonging to two species which occur on the West Coast and of a single specimen of the type species from the East Coast has shown that, in all, the loop is on the lower attached side of the body, which in this case corresponds for the most part with the right side of the pharynx, as the

endostyle has been displaced toward the left side. Although the loop is sometimes more to the right, sometimes more to the left of a plane passing through the apertures perpendicularly to the disk, it is always on the morphological right side of the pharynx, just as in *Corella*. It is directed forward, however, instead of transversely.

*C. productum* Stimpson.

Numerous specimens from Departure Bay and Ucluelet and one from Hecate Straits.

Characteristic of this species are the symmetry of the disk, the large size of mature individuals and the absence of muscle bands across many of the lines between the plates of the disk.

*C. columbianum* sp. n.

Usually flattened and depressed, attached by a broad area on side opposite the disk. Margin of disk sharp, not raised above level of disk. Disk broad behind. Apertures nearer right margin of disk than left. There are typically 2 central, 12 marginal and 2 left intermediate plates, but there is a fairly wide range of variation. Up to 19 mm. in length and 14 mm. in breadth. In addition to the siphonal and marginal muscles, there are short strands crossing all the lines that are some distance from the margin.

From 50 to 100 tentacles. From 12 to 22 languets. Aperture of dorsal tubercle a transverse slit. Funnel asymmetrical, the duct connecting with left side of tubercle. From 33 to 42 bars on each side of pharynx. Stigmata more or less coiled, with as many as 2  $\frac{1}{2}$  turns in a coil, irregularly disposed.

Gastric folds for the most part longitudinal. Intestine narrow. Loop narrow, some distance to right of posterior half of endostyle.

About 40 specimens from Departure Bay and Burrard Inlet in from 10 to 20 fathoms, stony and shelly.

Easily distinguished from the last by the presence of the series of muscle fibres connecting the central plates. It reaches maturity at a much smaller size. It differs from *C. sibogae* Sluiter of the East Indies and Japan, in the irregularity of the musculature, in the coiling of the stigmata and in the aperture of the dorsal tubercle being transverse instead of longitudinal.

Family—*Cæsiridae* [*Molgulidae*].

*Cæsira apoploa* sp. n.

Nearly spherical. Usually free in the sand. Siphons equal, in length about half the diameter of the body. Surface covered with sand grains, with the exception of that of the siphons and a variable part of the surface near them. Long simple radicial filaments over the sand-

covered surface. Up to about 15 mm. in diameter. In addition to the usual siphonal musculature, there are two circular bands (deficient ventrally) of short fibres on either side of the median plane.

From 18 to 37 tentacles, the largest bi-pinnate. Aperture of dorsal tubercle horseshoe-shaped; horns slightly inturned; opening between horns directed backwards and slightly towards right side. Dorsal lamina narrow, its margin smooth. Seven folds each side (in one specimen a rudimentary eighth on right side dorsally). As many as 4 bars on a fold, on the ventral side only. Stigmata forming the usual infundibula, each stigma forming from  $\frac{1}{4}$  to  $\frac{3}{4}$  of a circle. An occasional small accessory infundibulum between folds.

Intestinal loop very narrow, bent into a semicircle, the concavity of which is entirely filled by the left gonad. Anus with thickened smooth margin. Gonads oblong, massive, with central ovary. Testicular lobes massed along upper and lower sides of the ovary. Oviduct short, projecting upward from posterodorsal angle. Several (in one case 6) *vasa deferentia* of medium length projecting inwards along the middle of each ovary. Renal organ about equal in length to right gonad and of the usual sausage shape.

About 30 specimens from Departure Bay, Ucluelet, Alert Bay and Hecate Straits.

This form appears to be more nearly related to the following species than to any other.

*C. hecateia* sp. n.

Rounded oblong, laterally flattened. Apertures rather close together on dorsal edge near anterior end. In the contracted condition, they are at the bottom of a shallow furrow. Apertural lobes pointed. Surface (except a narrow zone around each siphon) closely covered with sand and fragments of shells. Up to 32 mm. in length, 20 mm. in depth and 15 mm. in thickness. Musculature as in preceding species, but the circular bands of fibres are more numerous (2 to 4 on each side) and irregular.

Probably about 35 or 40 tentacles, the largest bushily branched, bipinnate or slightly tripinnate. Aperture of dorsal tubercle horseshoe-shaped, directed toward right side. Dorsal lamina rather broad; its margin incised, presenting about 7 large teeth or lobes, which are most distinct posteriorly. It extends behind œsophageal aperture. Seven folds each side. Up to 6 or occasionally 7 bars on each fold, on the ventral side only. Stigmata as in last species, but the accessory infundibula are more numerous.

Intestinal loop narrow, horizontal, nearly straight. Gonads much



as in last species. Eight *vasa deferentia* were counted in the right gonad of one individual.

Several specimens were collected in Hecate Straits by Rev. Mr. Taylor.

*C. pugetiensis* (Herdman) from Puget Sound differs from this species in the extent of its musculature, in having fewer longitudinal bars (3 to 4), and in the direction of the dorsal tubercle (backwards).

*C. occulta* (Kupffer) of Europe is still nearer this species, but the short descriptions that have been given of it permit of only a few points of difference being given, viz. the shape of the body and the positions of the apertures. These seem unimportant, but it would be best to keep them separate until they can be more closely compared.

*C. sp.*

A small specimen was obtained by Dr. Dawson in 1885 between Cortez and Hernand Islands. It appears to differ from the two preceding species in the extent of the musculature (the circular or transverse fibres covering practically the whole body) and in the condition of the dorsal tubercle (a longitudinal slit).

*C. pacifica* sp. n.

Nearly spherical, 15 mm. long, 13 mm. deep and 10 mm. thick. Attached by lower surface and part of right side. Siphons contracted, atrial the longer. Surface overgrown with seaweed &c., the lower half, at least, with radicial filaments. In addition to siphonal musculature, there are irregularly scattered fine, short fibres over the surface of the body.

About 40 tentacles, the largest slightly tripinnate. Aperture of dorsal tubercle horseshoe-shaped, directed toward right side, the horns approximated. Dorsal lamina short and narrow, its margin smooth; it extends only a short distance behind œsophageal aperture. Seven folds each side. Bars on both sides of each fold, as many as 11 on a fold. Stigmata form the usual infundibula, each stigma extending from  $\frac{1}{4}$  to  $\frac{1}{2}$  of a circle. No accessory infundibula.

Intestinal loop narrow, bent into a semicircle. Renal organ and gonads as in *C. apoploa*, but only 2 *vasa deferentia* could be seen (right side).

A single specimen was obtained at Ucluelet at low tide, attached to rock.

It differs from the preceding species in having bars on both sides of each fold, and from *C. pannosa* of the East Coast in the direction of the dorsal tubercle. There are other differences in both cases.

*C. cooperi* sp. n.

Nearly spherical or flattened against the object of attachment. Apertures with small pointed lobes. Siphons very short. Surface, including that of siphons, entirely covered with closely placed sand grains, which adhere to the usual filaments. Up to 15 mm. in length. In addition to the usual siphonal musculature, there is an almost uniform layer, continuous with the circular fibres of the siphons. It is thin over the intestine, gonads, &c.

About 75 (?) tentacles. Aperture of dorsal tubercle crescent-shaped, turned toward the left. Dorsal lamina narrow, its margin smooth; it does not extend beyond œsophageal aperture. Six folds on each side, their posterior ends fringed. Up to 14 bars on a fold, occurring on both sides of each fold. Stigmata forming the usual infundibula, with 10 or more turns in each spiral. Each stigma represents  $\frac{1}{4}$  of a circle, so that more or less regular transverse rows are formed, such as are characteristic of the genus *Ctenicella* as defined by Hartmeyer.

Intestinal loop narrow, bent into a semicircle. Margin of anus smooth. Gonads much elongated. The left is in the concavity of the intestinal loop and anteriorly bent over the tip of the loop. It is thus closely applied to the intestine for a considerable distance. The right gonad is much longer than the renal organ, to which it is closely applied. The latter is of the usual shape. Each gonad consists of an axial ovary, with the testicular lobes scattered along its upper and lower margins. The *vas deferens* runs along the inner side of the ovary and projects upward with the oviduct from the posterior end of the gonad.

Several specimens were obtained in 5 to 15 fathoms, sand and gravel, in Departure Bay.

This species is doubtfully distinct from *C. regularis* (Ritter) from California. From the data available at present, there are the following differences,—a smaller number of tentacles (10), the absence of siphons (?), the aperture of dorsal tubercle a longitudinal slit, which is not curved, and the larger diameter of the stomach in *C. regularis*.

*Rhizomolgula globularis* (Pallas).

Syn. *Ascidia globularis* Pallas, Nov. Act. Ac. Petr., vol. 2, p. 241.

? *Rhizomolgula gigantea* Redikorzew, Mem. Ac. St. Peters., ser. 8, vol. 18, no. 11.

Laterally compressed, somewhat elongated parallel to a line joining apertures. Largest specimen is 19 mm. long, 17 mm. deep, and 12 mm. thick. Apertures about 7 mm. apart, not on distinct siphons. Surface sparsely covered with sand grains. On the side of the body opposite the apertures there are usually 2 short 'roots,' each with numerous long branches. The usual siphonal musculature; on each side near the

'roots' a few bands of longitudinal fibres over the surfaces of the glands; a median band of short transverse fibres encircling the body in the median plane; and a short band of similar fibres extending downwards on each side about half the length of the body. That of the left side connects with the atrial siphon and that of the right side with the oral.

From 17 to 20 tentacles, the largest tripinnate. Aperture of dorsal tubercle horseshoe-shaped, directed forwards and slightly toward the left. Dorsal lamina narrow, its margin smooth; it does not extend beyond œsophageal aperture. Six folds on each side. Bars on both sides of each fold, as many as 7 on a fold. Stigmata form the usual infundibula and some small accessory infundibula between folds. The stigmata are short and not numerous nor closely placed.

About 12 shallow gastric folds. Intestinal loop broad anteriorly, straight. Inner margin of anus fused with pharyngeal wall, outer margin smooth or with a single tooth. Gonad fills the intestinal loop and covers its inner side, consisting of a central ovary (its duct following rectum) and an upper and lower mass of testicular lobes. The *vasa deferentia* are numerous (9 in one specimen), their free portions short, placed in an irregular row above the middle of the gonad on its inner side. Renal organ below stomach. Heart along right side of renal organ. Glands small, disk-shaped. Ectodermal processes of mantle few or absent.

Several specimens were collected by the Rev. I. O. Stringer at Herschel Island, Arctic Ocean and communicated to me by Prof. Wright.

Pallas' *A. globularis* is undoubtedly a *Rhizomolgula*. The identification of these specimens with his species rests upon external characters alone. He has given very characteristic figures. Redikorzew's *R. gigantea* appears to be the same species.

#### Family—*Styelidæ*.

##### Subfamily—*Polyzoinæ*.

##### *Metandrocarpa dermatina* sp. n.

Colonies thin, encrusting, dark red or purplish in colour. Individuals irregularly disposed, about 2 mm. distant from each other. They are flattened parallel to the surface of the colony or elongated perpendicularly to it, depending upon the thickness of the colony. They are from 4 to 5 mm. in length. The colonies are up to 10 cm. in length. The apertures are transverse slits.

About 24 tentacles. Aperture of dorsal tubercle a transverse slit. Dorsal lamina narrow, its margin smooth. Five bars on each side, the two uppermost approximated. Small transverse vessels cross stigmata. Stigmata narrow, about 50 in a row.

About 15 gastric folds. Apparently about 12 atrial tentacles. Up to 10 or 11 tentacles grouped at anterior end beneath pharynx. A row of testes on each side posteriorly and ventrally. In the right row there are from 6 to 12 and in the left from 3 to 5. They are imbedded in the test.

Several colonies were obtained on the beach at Hope Island, by Rev. Mr. Taylor in 1906.

This form is doubtfully distinct from *M. dura* Ritter from Santa Barbara, California. It differs from the descriptions of the latter, given by Ritter and Michaelsen, in having a smaller number of oral tentacles and a larger number of gastric folds. The differences in the reproductive organs are probably referable to the greater maturity of the colonies from Hope Island.

*M. taylori* sp. n.

This is a social species, the individuals being connected by stolons alone. The largest individuals are  $7 \times 5 \times 4.5$  mm., in shape more or less hemispherical. Apertures are transverse slits. The surface is smooth or slightly wrinkled. The test is thin.

The structure of the pharynx is the same as has been described for the last species.

Thirteen or 14 gastric folds. Atrial tentacles minute. In one individual there were counted 11 ovaries, 9 testes on the right side and 11 testes on the left.

This form is so nearly identical in anatomical details with the preceding species, that one considers the possibility of their being different forms of the same species, just as Ritter has considered that *Perophora annectens* may form either social or compound colonies. With our present knowledge we must consider this form distinct from *M. dermatina*, the differences being,—‘social’ instead of compound colonies, larger individuals and colonies white instead of dark purple.

Subfamily—*Styelinae*.

Genus, *Katatropa* nov.

Syn.—*Styela* auct. part.

Siphons with spinules.

Four folds on each side, the second from above smaller than the first or the third. Aperture of dorsal tubercle horseshoe-shaped, directed toward left.

Normally 2 gonads on each side, placed obliquely; the anterior ends which bear the ducts, being directed downward toward endostyle. Ovary tortuous, rather short; testicular lobes grouped along either side of ovary, little (if at all) branched; their long axes are perpendicular to plane of

body-wall and not bound together, but each projects freely into peripharyngeal cavity. Eggs retained.

Siphonal vela narrow, adnate to siphonal wall, the atrial with scattered short filiform tentacles on its lower (inner) surface. Alimentary canal more or less Z-shaped. Anus with lobed margin.

Type species—*K. vancouverensis*.

This genus comprises a small group of species all from the West Coast of North America. In the current classification they would be placed in the genus *Styela*.

*K. vancouverensis* sp. n.

Short cylindrical, length being about twice the diameter. Attached by posterior end and part of ventral surface, therefore ascending from the attached surface. Surface minutely roughened, with indistinct tubercles on siphons. Up to 25 mm. in length and 9 mm. in diameter.

From 10 to 22 tentacles. Formula for longitudinal bars,—example, Right side. 2 (10) 1 (6) 1 (9) 1 (6) 1.

Intermediate (internal) transverse vessels. From 9 to 13 long narrow stigmata in each mesh.

From 12 to 18 gastric folds. From 8 to 12 anal lobes. Testicular lobes chiefly along the ventral side of the posterior part of each ovary.

Numerous specimens attached to rocks at low tide mark, Departure Bay and Ucluelet.

*K. uclueletensis* sp. n.

Cylindrical, attached by posterior end, which may have radicoid processes.

From 30 to 36 tentacles, for the most part two sizes which alternate with each other.

Eighteen gastric folds. About 16 anal lobes. Testicular lobes along both sides of posterior part of each ovary.

In other respects this species is the same as the last. They are doubtfully distinct, but as yet I have seen no intermediates.

Two specimens were obtained in a few fathoms at Ucluelet.

*K. yakutatensis* (Ritter).

Syn. *Styela yakutatensis* Ritter, Proc. Wash. Ac. Sc., vol. III, p. 239.

This is a stalked species, with smooth surface, and the oral aperture bent ventrally.

It occurs in numbers near low tide mark, attached to rocks, at Ucluelet.

*K. greeleyi* (Ritter) of Bering Sea is another stalked species of this genus. It differs from this one in having a shorter body, a longer stalk, longer testicular lobes and spinules which are acicular. In the three

British Columbian species the spinules are short, channeled above, with truncated toothed extremities.

Genus—*Styela* (*sens. restr.*).

Dorsal tubercle directed forwards or to left.

Gonads very long, ending just beneath atrial siphon, hence directed dorsally. Testicular lobes large, more or less branched. Eggs not retained. Otherwise as in last genus.

Type species—*S. canopus* (Savigny).

This genus is widely distributed in the tropical and temperate zones. *S. canopoides* Heller, *S. variabilis* Ald. & Hanc. and *S. partita* (Stimpson) belong to the genus as thus restricted and probably many other species as well, which are too insufficiently described for one to be certain of their position.

*S. gibbsii* (Stimpson).

Numerous specimens from Departure Bay, Ucluelet and Banks Island, taken in from 5 to 30 fathoms sand, gravel or shells.

*S. montereyensis* (Dall).

The stalked form of this genus.

Numerous specimens taken at low tide, attached to rocks, at Ucluelet and one specimen from Hope Island (Mr. Taylor).

Genus—*Goniocarpa* nov.

Syn. *Styela* auct. part.

Dorsal tubercle directed forward or to left.

One gonad on each side, bent more or less in the form of a right angle. The vertical limb of the gonad ends in the genital ducts, just beneath the atrial siphon. Ovary tortuous; testicular lobes grouped around horizontal limb of ovary, each one lobulated, the lobes bound together into a biscuit-shaped mass. Eggs not retained. Otherwise as in *Katartropa*.

Type species—*G. loveni* (Sars), as described by Hartmeyer (Fauna Arctica, Bd. III, 1903).

The species of this genus would currently be placed in *Styela*. It is apparently a northern group and includes *G. rustica* (L.), *G. armata* (Lac.-Duth. & Del.), *G. granulata* (Alder), *G. coriacea* (Ald. & Hanc.), *G. northumbrica* (Ald. & Hanc.) and *G. placenta* (Packard).

*G. coccodes* sp. n.

Exceedingly variable in shape, from scale-like to elongated oval. Surface pebbly, owing to the presence of rounded tubercles, from 1/16 to 1/8 mm. in diameter. Siphons short. Up to 2 cm. in length.

From 25 to 35 tentacles. Formula for longitudinal bars,—example—

Right side— 4(19) 4 (11) 4 (18) 6 (9) 4.

From 1 to 3 internal transverse vessels crossing each stigmatic row. From 3 to 7 long narrow stigmata. From 20 to 26 gastric folds. About 12 anal lobes. Testicular lobes chiefly ventral to horizontal limb of ovary.

A number of specimens from Departure Bay, Burrard Inlet, Lowe Inlet, China Hat and Prince Rupert, in from 10 to 30 fathoms, stony or shelly.

Most nearly related to *G. placenta* of the East Coast and *G. coriacea* of England, from which it seems to differ in certain details. Further study may show the necessity of uniting them into one species.

*Pelonaia corrugata* F. & G.

A few specimens were obtained by Rev. Mr. Taylor at Rose Spit in 1906 in a few fathoms, sand. They do not appear to differ in any respects from the descriptions of European and Arctic specimens.

This form does not deserve to be placed in a separate subfamily, the only respect in which it differs markedly from its nearest relatives (e.g. *Styela*, *Goniocarpa* &c.), being the absence of folds in the pharyngeal wall. This condition may be approximated in other forms when the pharynx is expanded (e.g. *Styela gibbsii*). The current statement that the intestinal canal is behind the pharynx is only partially correct. It is distinctly on the left side of the pharynx and only slightly farther back than it is in *Styela gibbsii*.

Genus—*Cnemidocarpa* nov.

Syn. *Styela* auct. part.

Spinules rudimentary or absent.

Gonads variable in number, 3 or more on each side, elongated, tortuous, radiating more or less from atrial siphon. Ducts at upper ends. Each gonad consists of an ovary on the inner side and a layer of testicular lobes on the outer side. The *vas deferens* runs along the inner side of the ovary.

Siphonal vela broad, applied to walls of siphons and reaching nearly to the margins of the apertures. A single row of tapering atrial tentacles at base of atrial velum.

Having examined only two members of this group, I am unable to give more characters. The members of this genus are currently included in *Styela*. It includes *Polycarpa finmarkiensis* Kiaer, *Styela elsa* Hartmeyer, *Glandula mollis* Stimpson, *Styela vestita* Alder and probably a large number of other species, but it is difficult to be certain in most cases because of the incomplete descriptions.

*C. joannae* (Herdman).

Syn.—*Cynthia coriacea* Stimpson, Proc. Ac. Phil., ann. 1864, p. 160.

*Styela joannæ* Herdman, Tr. Liv. Biol. Soc., vol. XII, p. 264.

*Styela stimpsoni* Ritter, Ann. N. Y. Ac., vol. XII, p. 602.

Numerous specimens from Departure Bay, Ucluelet, China Hat and Banks Island, attached to rocks &c., from low tide mark to at least 20 fathoms.

From the abundance of the material in my possession, all, as far as examined, agreeing with Ritter's description, I judge that Herdman's and Ritter's species are the same and that Herdman was mistaken in describing the dorsal lamina as being a 'plain membrane.' Stimpson's name was preoccupied by Alder & Hancock in 1848.

Family—*Tethyidæ*.

[*Halocynthiidae* seu *Pyuridae*, auct., non *Tethyidae* Hartmeyer, 1909]

In my opinion, the valid type of the genus *Tethyum* Bohadsch is the *Ascidia papillosum* of Linné. *Cynthia* and *Halocynthia* will then be absolutely synonymous with *Tethyum* and are to be replaced by it. *Halocynthiidae* and *Pyuridae* are to be replaced by *Tethyidae*.

Genus, *Boltenia* (*sens. nov.*)

Syn. *Boltenia* auct. part. + *Halocynthia* auct. part.

Body elongated parallel to a line joining apertures. Surface covered with simple or branched spines. Short, channeled, siphonal spinules.

Aperture of dorsal tubercle bent, opening between horns directed toward right side. Dorsal groove with languets. At least 6 folds on each side, the second and sixth, counting from above, being the smallest. Stigmata transverse, arranged in longitudinal rows, which are traversed from end to end by the longitudinal bars.

One gonad on each side, the left in the intestinal loop. The ducts are at the posterior end of each. Each consists of an axial ovary and peripheral testicular lobes.

Type species—*B. ovifera* (L.)

This is a very sharply defined group and includes only a few of the stalked forms that have been referred to this genus. It appears to be confined to the Arctic and Subarctic regions. In addition to the species mentioned in this article, it includes *B. thompsoni* Hartmeyer of Bering Sea. Some of these species have been placed in the old genus *Boltenia* and some in the genus *Halocynthia* or *Pyura*.

*B. echinata* (L.)

Syn. *Cynthia echinata* plur. auct., non *Boltenia echinata* Ritter, 1907.

A few specimens were obtained in 10 to 20 fathoms, stony or shelly, at Departure Bay. Hartmeyer has recently (S.-B. Ges. naturf. Freunde



Berlin, ann. 1910, p. 231) come to the conclusion that the series of forms which have been referred to the *Ascidia echinata* of Linné, cannot be divided into two distinct species. These Pacific specimens agree well with the descriptions that have been given of Arctic specimens.

*B. villosa* (Stimpson).

Syn. *Cynthia villosa* Stimpson, Proc. Ac. Phil., ann. 1864, p. 160.

*Cynthia castaneiformis* v. Drasche, Denk. Ak. Wien, Bd. 48, p. 373.

*Boltenia echinata* Ritter, Univ. Cal. Publ. Zool., vol. IV, p. 14.

Numerous specimens from Departure Bay, Ucluelet, Goose Island and Prince Rupert, from between tides to 30 fathoms, attached to rocks, sea-weed &c.

In a series of specimens taken at one locality such a range of variation is shown, that it seems impossible to consider the species listed above in the synonymy as distinct.

Genus, *Pyura* (*sens. restr.*)

Syn. *Cynthia*, *Halocynthia*, *Pyura auct. part.*

Surface rough with irregular warts, corrugations &c. Test usually more or less encrusted with sand. Siphons usually rather long. Siphonal spinules acicular (always?).

Aperture of dorsal tubercle bent, directed forwards. Dorsal groove with languets. Six folds on each side. In very young specimens the second and sixth folds are much smaller than the others. Stigmata longitudinal.

One gonad on each side, the left in the intestinal loop. Each is divided into (usually) two rows of hermaphroditic masses, the genital ducts passing back between these rows and ending near the anus.

Type species, *P. chilensis* Molina.

Michaelsen has described what purports to be Molina's species (Mt. Nat. Mus. Hamburg, Bd. XXI, p. 15). It would be included in the group of species with the above characters and hence becomes the type. Other species are *P. dura* (Heller), *P. jacatrensis* (Sluiter), *P. riiseana* (Traustedt), *P. karasboja* (Oka) &c. I have been able to examine only the one species of this group and consequently the diagnosis given above is more or less tentative. Further study will show the correct limits of this group. The most important characters seem to be the irregularity of the surface, the number of folds and the division of the gonads.

*P. haustor* (Stimpson).

Syn. *Cynthia haustor* Stimpson, Proc. Ac. Phil. ann. 1864, p. 159.

Numerous specimens from Departure Bay, Ucluelet, Hope Island and Banks Island, from between tides to 30 fathoms, usually in sand.

Genus, *Tethyum* (*sens. nov.*)

Syn. *Cynthia*, *Halocynthia*, *Pyura auct. part., non Tethyum* Hartmeyer, 1909.

Oral aperture terminal, atrial on dorsal side. Siphonal spinules acicular. Surface with simple or branched spines.

Aperture of dorsal tubercle curved, usually forming two cone-shaped coils; opening between horns directed forwards and to left. Dorsal groove with languets. Number of folds variable, increasing with age, at least 6, the second not smaller than the first and third. Stigmata longitudinal.

Two to many gonads on each side, those of the left side placed across the inner side of the intestinal loop (which is transverse to the long axis of the body). The two genital ducts open at the anterior end of each gonad. The gonads of each side are fused together posteriorly. The testicular lobes are grouped around the posterior ends of the ovaries.

Type species—*T. papillosum* Gunner.

Hartmeyer (*Zool. Ann.*, Bd. III, 1908) has indicated *Ascidia rustica* L. and *A. quadridentata* L. as the types of *Tethyum* Bohadsch. He seems, however, not to have considered Art. 30 of the International Rules, in which we find the following:

“(e) The following species are excluded from consideration in selecting the types of genera.

(a) Species which were not included under the generic name at the time of its original publication.”

It is possible that he may interpret this to mean only those species that have been named binominally. In that case he would neglect the four species of Bohadsch. Following Sherborn, he has accepted the species of Gunner as validly named. Gunner (*Trond. Selsk. Skrift.*, III) names three species which are identical with three of the species described by Bohadsch. Hartmeyer states that Gunner's article appeared in the same year as the 12th edition of Linné's *Systema Naturae* (1767), and considers that Linné's work has the priority. He has evidently not seen the original article by Gunner, which (according to Sherborn and Hopkinson) appeared in 1765, but only the German translation (*Dront. Gess. Schrift.*, III). That it antedates Linnæus is shown by a reference of the latter under *A. intestinalis*, viz. “Act. nidros. 3. p. 81, t.3. .3, 4. Tethyum.” This refers to Gunner's description and figures of *Tethyum sociabile*.

As Hartmeyer has not indicated a type from among the species originally included in the genus—either practically (those of Bohadsch) or binominally (those of Gunner)—a type remains to be indicated. Of the species of Bohadsch, the one which we can identify to-day with the

greatest degree of certainty is *Tethyum coriaceum*, the *T. papillosum* of Gunner and the *Ascidia papillosum* of Linné. This may be taken as the type of *Tethyum*.

Heller has indicated the same species as the type of *Cynthia* Savigny. *Halocynthia* Verrill and *Lais* Gistel were instituted to replace *Tethyum*. All three are therefore absolutely synonymous with *Tethyum*.

As defined above, this genus comprises a group of species, which differ from all other Tethyids in the position of their gonads. It includes *T. pyriforme* (Rathke), *T. aurantium* (Pallas), *T. roretzii* (Drasche), *T. hilgendorffii* (Traustedt), *T. igaboja* (Oka) and probably a number of others which have not yet been sufficiently described for one to be sure as to their position.

*T. aurantium* (Pallas).

Syn.—*Ascidia aurantium* Pallas, Nov. Act. Ac. Petr., vol. II, p. 240.

*Cynthia pyriformis* Dall, Amer. J. Conch., vol. VII, p. 157.

“ “ alt. auct. (Pacific).

“ *superba et deani* Ritter, Ann. N.Y. Ac., vol. XII, p. 590.

A very few specimens from various points—Departure Bay, Ucluelet, Banks Island and between Cortez and Hernand Islands, in from 10 to 30 fathoms.

*T. pyriforme* from North Europe and the Arctic Ocean has, according to Hartmeyer (1903), 4 gonads on the left side and from 4 to 6 on the right.

All the Pacific specimens, that I have been able to examine, have 3 gonads on each side. They seem to be for that reason, quite distinct from *T. pyriforme*. From Traustedt's account (Vid. Meddel. Kbhvn., 1885, p. 34), I conclude that his Korean specimens had 3 gonads on each side. That would make the Asiatic and West American forms identical, Pallas' name, being the first one given, is the valid one for this group.

*T. igaboja* (Oka).

Syn.—*Halocynthia igaboja* Oka, Ann. Zool. Jap., vol. VI, Pt. 1, p. 45.

? “ *okai* Ritter, Univ. Cal. Publ. Zool., vol. IV, p. 11.

A number of specimens from Departure Bay, Ucluelet, Lowe Inlet and Prince Rupert, in from 10 to 30 fathoms shelly or gravelly.

These specimens are in accord with Oka's description and differ from Ritter's only in regard to the inrolling of the horns of the dorsal tubercle. The gonads are quite variable, there being from 2 to 16 on the right side and from 5 to 14 on the left.

## NOTES ON THE SPECIES OF THE ATLANTIC COAST.

With the exception of the compound forms, which have been recently thoroughly treated by Dr. Van Name (Proc. Bost. Soc. N. H., vol. 34, No. 11, 1910), the species of the East Coast have for the most part been only imperfectly described. It will be necessary therefore to give an account of the anatomy of many of the species. It has been very difficult in many cases to refer, with much certainty, my specimens to the species that have been described from this coast, owing to the imperfect descriptions of the older authors. As many of the specimens have been obtained from or near the localities which gave the types of the species, the identifications should have a greater probability of being correct. Dr. Van Name, who is at present engaged in work on the simple Ascidiaceans of this coast, has been most kind in giving me help in the identification of my specimens with Verrill's species. He has corrected some errors into which I had fallen and confirmed some of my surmises.

*Aplidium spitzbergense* Hartmeyer, Fauna Arctica, Bd. 3, Lf. 2, p. 341.

A single capitate colony was obtained in Long Island Bay, Grand Manan, in about 8 fathoms. This species has been previously reported only from Spitzbergen. The agreement with Hartmeyer's description seems, however, to be perfect.

The colony is 15 mm. by 10 mm., with a thick stalk 8 mm. long. The test contains very numerous sand-grains.

The zooids are about 2.5 mm. long. Oral aperture 6-lobed. Atrial aperture round, at the end of a short tubular siphon, placed opposite the interval between the first and second stigmatic rows. A long atrial languet is present a short distance in front of the siphon. Four stigmatic rows. Four gastric folds. Abdomen and postabdomen together are slightly longer than the pharynx. Ovary small and no embryos present.

Another colony, not capitate, 20 mm. long, 9 mm. wide and 6 mm. thick, seems to be referable to the same species. There are much longer and narrower zooids with the ovaries well developed, embryos in the peripharyngeal cavity, and the postabdomen nearly equal in length to the thorax and abdomen together. The colour of this colony, when living, was decidedly greenish.

This second colony was obtained off Long Island, Grand Manan, in about 35 fathoms shelly and muddy.

Of the characters which distinguish *Aplidium* from *Amaroucium* the only one possessed by this second colony is the small number of stigmatic rows. It might be best to place it in the genus *Amaroucium*, near *A. diaphanum* (v. Drasche).

*Amaroucium glabrum* Verrill.

Numerous colonies, apparently belonging to this species, were obtained at nearly all points at low tide and in the dredgings.

*Tetradidemnum albidum* (Verrill).

Both the white and salmon-coloured varieties of this species were found generally distributed at low tide and where dredgings were made.

*Didemnoopsis tenerum* (Verrill).

Syn. *Lissoclinum tenerum* Verr.

Several colonies were dredged in the approaches to Passamaquoddy Bay and one off Swallow-tail Light, Grand Manan.

*Holozoa clavata* (Sars)?

Soft, light yellow, encrusting colonies of *Holozoa* were obtained at low water mark and practically throughout in the dredgings, though never in large numbers. Dr. Van Name has referred all the colonies from along this coast, that were examined by him, to Sars' species. None of the colonies in my collection show even an approximation to the clavate condition.

*Ciona intestinalis* (L.)

As only a single small specimen was obtained (off Grand Manan), no detailed study of it was made. It doubtless is identical with the European species.

*Ascidiopsis prunum* (Müller).

Syn.—*Ascidia callosa* Stimpson, Proc. Bost. Soc. N.H., vol. IV, p. 228.

*Ascidiopsis complanata* Verrill, Amer. J. Sc., ser. III, vol. 3, p. 289.

Characteristic of this species is the small number of longitudinal bars (from 15 to 19 on the left side and from 18 to 20 on the right), the presence of intermediate papillæ and the crossing (slightly) of the last bend of the intestine by the genital ducts. Eggs and larvae were found in the peripharyngeal cavities of some of the breeding individuals. The large individuals seemed to be uniform in having undeveloped reproductive organs.

Found in large masses at low tide mark. It is generally distributed as shown by the dredgings. At Grand Manan it seems to be largely replaced by the next species.

Genus *Phallusioides* nov.

This genus is formed for the reception of *Ascidia* (*seu Phallusia*) *obliqua*, which differs from *Phallusia* in that the pharynx and dorsal lamina do not extend beyond the œsophageal aperture, in this respect

resembling *Ascidiella*. From the latter it differs in having papillæ on the bars and in not having renal vesicles. It is thus intermediate between *Phallusia* and *Ascidiella*. The ganglion is close to the dorsal tubercle and there are no intermediate papillæ. In the absence of renal vesicles, it resembles some *Phallusiæ*. As if to offset this lack of vesicles, there is a very great development of what appears to be the pyloric gland. This forms a thick layer of coarse branches, covering all parts of the intestinal canal

*P. obliqua* (Alder).

Syn. *Ascidia mollis* Verrill, Amer. J. Sc., ser. III, vol. 7, p. 409.

This can be distinguished from the preceding species by the thinner test (which is more collapsible), the more numerous (about 50) longitudinal bars, and the course of the genital ducts (not crossing last bend of intestine), as well as by the differing generic characters.

Large numbers were dredged at various points and depths near Grand Manan and occasional specimens were obtained in the approaches to Passamaquoddy Bay.

*Chelyosoma macleayanum* B. & S.

Syn. *Ascidia geometrica* Stimpson, Proc. Bost. Soc. N.H., vol. IV, p. 229.

A single specimen was obtained in the approaches. It is rather unusual in the asymmetry of the plates of the disk. Those of the left side are larger than those of the right and two additional plates are interposed between the middle and posterior marginal plates. In both these respects, it approaches *C. columbianum* of the West Coast.

*Caesira papillosa* (Verrill).

Syn. *Molgula papillosa* Verrill, Am. J. Sc., ser. 3, vol. 1, p. 57.

Surface with numerous radiceid filaments, those on the siphons being quite short. Siphons quite variable in length, frequently as long as the diameter of the body, nearly equal.

From 15 to 25 bipinnate tentacles. Aperture of dorsal tubercle horseshoe-shaped; opening between horns directed backwards. Dorsal lamina of medium width, not extending beyond œsophageal aperture; its margin is coarsely toothed. Six folds on each side of pharynx. Posterior end of each fold coarsely toothed along its free border. Bars on both sides of each fold, as many as 8 on a fold, the dorsal bars weak.

Intestine forming a double loop. Outer lip of anus with about a dozen rounded lobes. Gonads elongated, the right horizontal, the left oblique and filling the secondary loop of the intestine. Oviduct of medium length, projecting upward from posterior end of gonad and ending at base of atrial siphon. Each ovary with an upper and lower row of

pouches. From the outer side it has the appearance of a double row of rounded lobes. Testicular lobes scattered along upper and lower margins of each ovary; usually on the right side the lobes are above anteriorly and below posteriorly, whereas on the left they are more variable, the majority being below. From 1 to 4 *vasa deferentia* on each side (usually 2) opening not far from the centre of the inner side of the ovary; the free part of each *vas deferens* is extremely short and can be seen only with difficulty.

Specimens obtained at the roots of eel-grass have very short siphons and seemed to fit Verrill's description of *Molgula manhattensis* better than that of *M. papillosa*. In internal anatomy they agree with specimens obtained beneath stones at low tide and in the dredgings, which correspond with the description of the latter species. Some of these specimens have siphons as long as those figured by Verrill for *Eugyra pilularis*. Specimens of *M. manhattensis* from Connecticut and Rhode Island, kindly sent me by Dr. Van Name, are distinctly different from all northern individuals. They have, as Dr. Van Name stated to the writer in a letter, a narrow dorsal lamina with smooth margin. Other differences are—a smaller, more rounded dorsal tubercle; the testicular lobes are not scattered but massed, being confined to the lower side of the ovary and the inner side of its anterior tip (on the left side, seen from without, the testicular mass appears to curl around the anterior end of the ovary, as figured in 1847 by Van Beneden for his *Ascidia ampuloides*, a related species); and the free portions of the *vasa deferentia* are much longer than in *C. papillosa*.

The nearest allies of the latter are *Molgula simplex* Ald. & Hanc. and *M. siphonata* Alder of the coasts of England. In both of these the testes are in the form of one or two large masses, confined to the inner side of the ovary. It is interesting to note that the English forms are short- and long-siphoned respectively, corresponding with the extreme individuals of the series of specimens of *C. papillosa* taken at St. Andrews.

This appears to be the *Caesira* that is most abundant and most generally distributed near St. Andrews.

*C. canadensis* sp. n.

This is the North American representative of the group to which Lacaze-Duthiers gave the name *Ctenicella*.

Body nearly spherical or flattened against the object of attachment. Attached usually by the right side. Up to about 1 cm. in diameter. Apertures fringed, each oral lobe with 3 teeth, each atrial with from 6 to 8. Exposed surface always more or less dirty. Along the margin of the attached area are numerous irregular radicial filaments. If the

animal is sand-covered, these are present over the entire surface, including that of siphons. If not sand-covered, the free surface has numerous minute adhesive tubercles.

From 15 to 25 tentacles, pinnate or slightly bipinnate. Aperture of dorsal tubercle varying from a simple slit to the shape of an imperfect S, which Hartmeyer suggests is characteristic of the genus *Ctenicella*. Dorsal lamina with tapering distant teeth. Seven folds on each side of pharynx. Bars on both sides of each fold, as many as 4 (or occasionally 5) on a fold. Stigmata in infundibula (divided once), each stigma usually representing  $\frac{1}{4}$  of a circle and simulating the longitudinal stigmata of other groups.

Intestinal loop narrow, more or less bent. Anus with smooth margin. Gonads some distance above intestinal loop and renal organ respectively. Ovary short, bent with the concavity ventral; oviduct passing from its anteroventral angle; testicular lobes along the upper side of the posterior end of the ovary or in a semicircle around its posterior end; the single *vas deferens* projects from the centre of the inner side of the ovary.

The species to which this form is most nearly related, and the respects in which it differs from them are as follows:—

*Molgula complanata* Ald. & Hanc.—7 folds on left side instead of 6, smaller number of bars and larger infundibula with the stigmata in transverse rows.

*Ctenicella lanceplaini* Lac.-Duth.—more teeth on each atrial lobe, deeper infundibula, more regular transverse rows of stigmata, a larger number of bars.

*C. morgatae* Lac.-Duth.—the smaller number of bars, the tooting of the posterior ends of the folds and the position of the testicular lobes.

At first I referred this species to Verrill's *Molgula littoralis*, but Dr. Van Name has informed me by letter that the latter (from his preliminary study of Verrill's specimens) has the long bent oviduct of the next species. He also states that he has not yet found any *Ctenicella* among his material. He suggests that it is something new to the region. There is the probability that it has been introduced from Europe since the time that Verrill collected in the Bay of Fundy region. Its derivation from *C. tenax* (Traust.), a nearly related Arctic form (occurring in Greenland) with usually only 6 folds, and its subsequent extension down the coast is another possibility. It is possible that further study will make it necessary to unite this species with the three from Europe into a single species.

Hartmeyer has retained Lacaze-Duthier's *Ctenicella* with an alteration of the diagnosis. His group does not seem to be a more natural



one than that of the latter author. Savigny's *Cynthia dione*, the type of the genus *Cæsira*, doubtless belongs to this same group. His description of the oral aperture as being 4-lobed and of the dorsal lamina as being smooth-margined was probably due to faulty observation. In that case *Ctenicella* will be synonymous with *Cæsira*.

*C. littoralis* (Verrill).

Syn.—*Molgula littoralis* Verrill, Amer. J. Sc., ser. 3, vol. I, p. 56.

Surface usually clean, at least in the neighbourhood of the apertures. Few radicoid filaments on surface. Siphons quite variable in length, usually rather short. Rows of papillæ on the outer surface of the siphons, corresponding with the apertural lobes. The papillæ are usually small and few in each row. Nearly globular in shape, somewhat laterally compressed. Siphons on dorsal edge, nearer anterior end.

From 20 to 30 bipinnate tentacles. Aperture of dorsal tubercle curved, the horns usually approximated so as to form a circle; opening between horns directed toward the right side. Dorsal lamina narrow, not continued behind œsophageal aperture, its margin smooth. Seven folds on each side, their posterior ends with smooth margins. Bars on both sides of each fold, as many as 10 on a fold. Stigmata in the usual infundibula (once branched), each stigma forming from  $\frac{1}{4}$  to  $\frac{1}{2}$  a circle.

Intestinal loop rather narrow, bent with the concavity dorsal. Anus with smooth margin. Gonads in the usual positions close to intestine and renal organ. Ovary small, narrow; oviduct, which passes from its posteroventral angle, is long and bent so as to form a right angle, the terminal part passing up toward atrial siphon. Testicular lobes variously disposed, usually ranged along the upper and lower borders of ovary, sometimes forming a large mass covering the greater part of both inner and outer surfaces of the ovary; the free portion of the single *vas deferens* is of moderate length and projects from near the middle of the inner surface of the ovary.

A large number of specimens were obtained at low tide beneath rocks and in the dredgings from stony and shelly bottoms.

This form is very close to two European species, *Molgula citrina* Ald. & Hanc. and *M. echinosiphonica* Lac.-Duth. The former has fewer bars (6) and fewer tentacles (12 to 14). The latter has very conspicuous spines on the oral siphon whereas the atrial is smooth and the testicular lobes are placed at some distance from the ovary. It is doubtful whether these differences are important.

*C. pannosa* (Verrill).

Syn.—*Molgula pannosa* Verrill, Amer. J. Sc., ser. 3, vol. I, p. 55.

Surface, except that of siphons, with numerous fine, long filaments and entirely covered with shell-fragments, sand-grains &c. Siphons

short, rather close together near anterior end; when retracted they occupy depressions, which are surrounded by projecting ridges or collars. Apertures with the usual lobes; the oral lobes occasionally have more than the single tooth or process and the atrial appear to have regularly 4 or 5 teeth, just as in Lacaze-Duthier's genus *Ctenicella*. Body elongated, laterally compressed, up to  $2\frac{1}{2}$  cm. in length.

About 20 (?) bipinnate tentacles. Aperture of dorsal tubercle horseshoe-shaped; opening between horns directed backwards. Dorsal lamina narrow, its margin smooth. Seven folds on each side. Bars on both sides of each fold, as many as 12 on a fold. Stigmata rather short, each forming only about  $\frac{1}{8}$  of a circle at base of infundibulum. Infundibula branched dichotomously once or twice.

Intestinal loop narrow, horizontal. Each gonad a large oblong mass, with ovary central and testicular lobes chiefly above and below ovary. Oviduct directed upward from posterodorsal angle. There are as many as 7 *vasa deferentia* projecting from the inner side of the ovary in an irregular row.

This species was obtained at most points where dredgings were made in gravel, but never in quantity.

It resembles *C. pacifica* in the structure of the gonads and pharynx (7 folds, bars on both sides of folds, smooth dorsal lamina), but differs from it in having the surface covered with radicle filaments and the dorsal tubercle directed backwards. From *C. oculata* (Forbes) of Europe it differs in having a smaller number of bars on the folds and the horns of the dorsal tubercle not rolled in.

*C. retortiformis* (Verrill).

Syn.—*Molgula retortiformis* Verrill, Amer. J. Sc., ser. 3, vol. I, p. 56.

This species occurs sparingly at low tide beneath rocks near the station and was dredged at various points in the approaches to Passamaquoddy Bay on stony and shelly bottoms.

It is by far the largest Cæsirid occurring at St. Andrews, the majority of the specimens being about 3 cm. in diameter.

Characteristic of this form are—its thick test, long atrial siphon (when extended) and the separation of the testes from the ovary. The latter has the usual position—above the intestinal loop on the left and above the renal organ on the right. The testes are below the renal organ on the right side and rather extensively distributed below the ovary, on the inner side of the intestinal loop on the left side. The oviduct of each side is long, ending just beneath the atrial velum. The *vasa deferentia* are very numerous. In one specimen 12 were counted on the right side and 25 on the left. They are scattered over the inner surface of the testicular mass. Their free portions are extremely short.

*Eugyra (Bostrichobranchnus) pilularis* Verrill.

Syn.—*Bostrichobranchnus manhattensis* Traustedt, Vid. Meddel., ann. 1884, p. 22.

No specimens were found in the vicinity of Eastport (where Verrill obtained it). But in 10 fathoms sand at Grand Manan numerous specimens were obtained which seem to be referable to Verrill's species. The tubes are strongly retracted in all the specimens, but the 'collar' at the bases of the siphons is very distinct.

This is very evidently Traustedt's species as well. The only differences apparent are explicable as due to a difference in size. Traustedt having specimens with a diameter twice as great as that of the largest in my collection. There is one exception. He describes the margin of the anus as smooth. In two specimens examined, the margin is reflected, but distinctly lobed (about 16 lobes). Evidently he has overlooked this reflected margin.

In *E. glutinans* and *E. adriatica* the entire margin of the anus is lobed and free. In this species the inner margin or lip is fused with the pharyngeal wall and the line of fusion seems to be represented by an irregular row of about 16 papillæ, placed just in front of anus on the outside of the pharyngeal wall.

There are 15 tentacles, the largest bipinnate. The dorsal lamina is broad and continued back behind œsophageal aperture and downwards toward endostyle.

Infundibula as in typical *Eugyræ*, consisting each of two stigmata spirally coiled and not broken up into short stigmata. They are not in regular rows. In a very small specimen not more than one row can be made out between successive longitudinal bars. In one 8 mm. in diameter there are two irregular rows and Traustedt has figured a larger number for a much larger specimen.

The oviduct passes along the left side of the rectum and opens only a short distance from the anus. The testes are along the upper and lower margins of the ovary. The *vasa deferentia* are numerous (9 in one specimen) and their free portions short, opening at various points along the middle of the inner side of the ovary.

The irregularity in the arrangement of the infundibula is not of enough importance to warrant the formation of a genus for this species as Traustedt has done, especially when there are as many points of agreement between it and typical *Eugyræ* as the following:—

Musculature reduced to siphonal region, with the exception of short fibres arranged in one or two rows encircling the body in the median plane.

Dorsal tubercle horseshoe-shaped, opening between horns directed toward left side and slightly forwards.

Dorsal lamina with smooth margin, extending behind œsophageal aperture.

Pharyngeal folds represented by single longitudinal bars, which are very thin and broad. Infundibula as described above.

Margin of anus lobed.

Only one gonad and that placed on the inner side of intestinal loop; oviduct accompanying rectum; testes peripheral, their duct or ducts not accompanying oviduct.

It might be well to retain *Bostrichobranchus* as a subgenus, if there prove to be species more closely related to *E. pilularis* than to the typical members of the genus (*E. glutinans*, *E. translucida* and *E. adriatica*).

*Goniocarpa placenta* (Packard).

Syn.—*Cynthia placenta* Packard, Mem. Bost. Soc. N.H., vol. I, p. 277, part.

? “ *pulchella* Verrill, Amer. J. Sc., ser. 3, vol. I, p. 99.

Easily recognized by the small, rounded, granular elevations that thickly cover the test. Near the apertures they are almost papilliform. I have not yet determined the differences (if any exist) between this form and the nearly related European and Pacific forms. It is as variable in shape as they.

Verrill states that Packard's specimens belonged to two different species and the one which he does not name but describes appears to be this species. Verrill himself probably confused this with *Dendrodoa carnea*, if the latter was as abundant and widely distributed in the Bay of Fundy when he made his collections as it is now. His *Cynthia pulchella* appears to have been a rounded form of one of these species, probably *G. placenta*.

*Cnemidocarpa mollis* (Stimpson).

Syn.—*Glandula mollis* Stimpson, Proc. Bost. Soc. N. H., vol. IV, p. 230.

“ “ Traustedt, Vid. Meddel., ann. 1880, p. 422.

“ *arenicola* Verrill, Amer. J. Sc., ser. 3, vol. III, p. 288.

*Tethyum arenicolum* Hartmeyer, Zool. Anz., vol. 34, p. 147.

The two specimens obtained came from 10 fathoms sand not far from the locality from which Stimpson procured his specimens. They correspond with the descriptions given by the authors listed in the synonymy. I have placed this species in the genus *Cnemidocarpa*, as it agrees in the condition of the gonads and atrial tentacles with the type of the genus. It belongs to a group, consisting of forms with radicoïd processes of the test to which sand-grains adhere, including *Styela vestita* Alder and *S. villosa* (Kupffer).

*Dendrodoa (Styelopsis) carnea* (Agassiz)?

Many specimens were obtained at low tide near the station and by the dredge at nearly every point, but never in large numbers. I have identified this with the *Ascidia carnea* of Agassiz with some hesitation. Hartmeyer, after examining specimens of this genus from Casco Bay, Maine, has considered Agassiz' species to be synonymous with *D. aggregata* (Rathke). I have not been able to find in my material any specimens that would correspond with Hartmeyer's description of the latter species. They are all more nearly related to *D. (Styelopsis) grossularia* (Beneden). They differ from it in having a very small number of longitudinal bars. This form shows, in fact, a much greater reduction in the number of bars than any other member of the genus. In nearly every case the formula is,

Right side. o (4) o (1) o (1) o (1) o.

Left side. o (1) o (1) o (1) o (1) o.

In one specimen the formula for the left side is

o (2) o (1) o (1) o (1) o.

In another specimen, which may belong to another species, the formula is—

Right side. o (4) I (3) o (2) o (1) o.

Left side. o (2) I (2) I (2) o (2) o.

This specimen differs from other individuals of the same size in having an immature gonad and no eggs in the brood-chamber.

The shape varies greatly—from scale-like to elongated oval, occasionally attached by a small base. Shallow-water specimens are a bright red. Those from deeper water are paler. As in *Cnemidocarpa joannæ*, the test in the living animal is transparent and the pigment is confined to the 'mantle.'

In a specimen 8 mm. in diameter there are 35 oral tentacles and 34 small tapering atrial tentacles. From 16 to 25 stigmata in each mesh.

The single gonad is similar to that of *D. grossularia*, the ovary forming the inner part and the testicular lobes a layer on the outer side. There are several *vasa deferentia*. The eggs are retained in a posterior brood-chamber into which the oviduct opens. There is a distinct pyloric cæcum. The anus is two-lipped, its margin indistinctly lobed.

*Pandocia fibrosa* (Stimpson).

Syn. *Glandula fibrosa* Stimpson, Proc. Bost. N.H., vol. IV, p. 230.

Specimens agreeing with Stimpson's description and obtained from the same locality as his specimens (the Hake Bay, off Grand Manan), prove to be closely related to the *Cynthia comata* of Alder. According to Hartmeyer, *Pandocia conchilega* Fleming the type of Fleming's genus *Pandocia*, is the same as *Cynthia comata*. Heller has specified *Glandula*

*fibrosa* as the type of *Glandula*. The latter genus is consequently synonymous with *Pandocia*.

Two hauls of the dredge made at a point off Long Island in about 35 fathoms, mud, brought up numerous specimens of this species.

The shape is spherical, and there is a thick coating of mud, which adheres to long fibrous processes of the test. These cover the entire surface, with the exception of a small area near the siphons. They are of three kinds, which intergrade—(1) simple threads, most numerous ventrally, (2) numerous threads arising from small tubercles of the test and (3) long processes with threads arising from each at different levels in a verticillate manner. Siphons verrucose and rusty.

From 45 to 55 tentacles. Dorsal tubercle horseshoe-shaped, opening between horns directed backwards and slightly towards the left. Dorsal lamina narrow. Four folds on each side. From 9 to 15 bars on each fold and from 1 to 4 bars in a space. Intermediate transverse vessels. From 5 to 8 long narrow stigmata in each mesh.

Diameter of stomach scarcely greater than that of intestine. About 24 gastric folds. Intestinal loop narrow, horizontal. Margin of anus with about 20 rounded lobes. Gonads hermaphroditic, about 2 mm. in length and 1 mm. in width. The end of each, that bears the ducts, is directed in most cases toward the atrial siphon, but occasionally downwards. From 10 to 15 gonads on each side, more numerous on the right. Endocarps numerous, many with enlarged opaque summits.

Siphonal vela narrow, free from wall. Atrial tentacles small, filiform, irregular in size, placed in an irregular row near attached edge of velum.

This species differs from *P. comata* (Alder) in having larger, verticillate processes of the test, more numerous gonads and a habitat in mud instead of sand.

#### *Boltenia ovifera* (L.).

This well-known species occurs at nearly every point and frequently in large numbers.

#### *B. hirsuta* (Agassiz).

Syn.—*Ascidia hirsuta* Agassiz, Proc. Am. Assn., vol. 2, p. 157.

*Cynthia* (*seu Halocynthia*) *echinata* auct. americ.

Hartmeyer (Fauna Arctica, vol. 3) has queried whether or not the North American form that has gone by the name of *Cynthia* (*seu Halocynthia*) *echinata* is identical with the Arctic and European form for which the same name has been used. The study of a number of specimens from St. Andrews has shown that we have on this coast a distinct form which differs from European, Arctic and Pacific specimens in hav-

ing rudimentary tentacles and very short gonads. The spines of the test are somewhat similar to those described by Hartmeyer for sub-arctic European specimens, but in this case we have large individuals with spines of this character.

*Ascidia hirsuta* Agassiz appears to be the only name that has been given primarily to Eastern North American specimens and is, therefore, the valid one for this species.

Specimens of large size were obtained at low tide near the station. It occurs generally distributed as shown by the dredgings.

*Tethyum pyriforme* (Rathke) subsp. *americanum* nov.

Syn.—*Cynthia* (*seu Halocynthia*) *pyriformis* auct. americ.

In contrast with the great constancy in the number of the gonads in the Mediterranean *T. papillosum* and in the Pacific *T. aurantium*, the number in *T. pyriforme* of Arctic and European seas is stated to vary from 4 to 6 on the right side and to be constantly 4 on the left. An examination of a series of individuals from St. Andrews, shows a variation of from 3 to 10 on the right side and from 5 to 14 on the left, the number on the left being usually greater than that on the right. It seems best to consider this as a subspecies of the Arctic *T. pyriforme*.