KUNGL. SVENSKA VETENSKAPSAKADEMIENS HANDLINGAR. Band 63. N:o 2.

NORTHERN AND ARCTIC INVERTEBRATES IN THE COLLECTION OF THE SWEDISH STATE MUSEUM

(RIKSMUSEUM)

VIII.

TUNICATA

1. STYELIDAE AND POLYZOIDAE

BY

Dr. AUGUSTA ÄRNBÄCK-CHRISTIE-LINDE

WITH THREE PLATES AND SIX FIGURES IN THE TEXT

COMMUNICATED OCTOBER 12TH 1921 BY HJ. THÉEL AND E. LÖNNBERG

STOCKHOLM
ALMQVIST & WIKSELLS BOKTRYCKERI-A.-B.
1922

Introduction.

The Tunicates which are reported in the present paper belong to the collec- of the Swedish Riksmuseum. They have been brought back from the Scandi- and Arctic seas by Swedish naturalists in the course of many years. A of the Swedish scientific expeditions and voyages made before the year 1903 given by THÉEL in the first paper of this series (1905).

The present paper includes northern and Arctic species of the families *Styelidae* *Polyzoidae*, of the American forms in the main only those which have been ght back by Swedish expeditions. Those species which are not represented in collections of the Swedish Riksmuseum, are printed in brevier types.

Material for comparison has been received from Professor Dr. R. HARTMEYER, lin, to whom I am also obliged for information on several dubious forms, from Dr. ODHNER, Stockholm, Dr. TH. MORTENSEN, Copenhagen, Conservator Dr. CARL , Tromsö, Professor Dr. L. A. JÄGERSKIÖLD, Gothenburg.

The family *Polyzoidae* was established by MICHAELSEN in his work on these dians in 1900. Later on (1904), he, and even other authors (e. g. HARTMEYER 08), has subordinated the group as a sub-family to the *Styelidae*. In this report MICHAELSEN's previous proposal for classification is followed: the sub-family *Poly-* is separated from the *Styelidae* and looked upon as a separate family.

From a comparative anatomical study it undeniably appears that the three milies *Styelidae-Polyzoidae-Botryllidae* form a series of closely related groups and that the *Polyzoidae* includes intermediate forms between the *Styelidae* and the *Botryllidae*. However, it seems doubtful whether a subordination of the *Polyzoidae* to the first-mentioned family is fully justified by the reasons which have been hitherto given, especially when we consider that our knowledge of the anatomy of several forms of the *Polyzoidae* still is incomplete. Besides, the relation of the last-mentioned family to the *Botryllidae* (and to other families) has not yet been made out. The *Polyzoidae* form, as is well known, a heterogenous group which shows very great differences especially as regards the structure of the reproductive organs. It does not seem excluded that this organ system might offer points of agreement even to other families. It also remains to be decided whether some points of agreement between the *Styelidae* and the *Polyzoidae* might be due to convergence or not. The importance of the reproduction by budding — character which distinguishes the *Polyzoidae* from

the *Styelidae*, but unites the former family with the *Botryllidae* — has not yet been thoroughly investigated. And that is one more reason why I prefer to maintain, for the present, the separation of the three groups into three families.

A revision of the *Styelidae* especially a division of the genus *Styela* based on the relation of the testis to the ovary in the gonad has long been a desideratum. HUNTSMAN (1913) has made an attempt at it, dividing *Styela* into five genera: *Styela*, *Katatropa*, *Goniocarpa*, *Botryorchis*, which form one group, and *Cnemidocarpa* which forms the other group. The classification proposed by HUNTSMAN is accepted in as much as the genus *Cnemidocarpa* is adopted. With regard to the systematical position of *Pelonaia corrugata* I agree to the view of HUNTSMAN (1912 p. 157). This genus is thus included in the family and not placed in a separate sub-family.

With the above-mentioned exceptions the system as well as the nomenclature used by HARTMEYER in »BRONN's Klassen und Ordnungen des Tierreichs» with the changes proposed in »Ascidiarum nomina conservanda» (1915) is adopted in this paper.

In the following synopsis of genera and species an attempt has been made to group species related to each other. The synopsis is based on anatomical characters especially those which are exhibited by the branchial sac and the reproductive organs. In identifying the species those two organ systems have proved to present more valuable characters than the others. External features are only secondarily used.

A new genus, *Ypsilocarpa*, has been established for an Arctic form which seems to be allied to *Cnemidocarpa*. Four new species have been described viz., *Styela theeli*, *Cnemidocarpa mollispina*, *Cnemidocarpa cirrata*, *Ypsilocarpa clipeata*.

In the present paper, the reproductive organs of *Kükenthalia borealis* are described. They are of a structure which highly differs from that of the corresponding organs in other known Polyzoids. The development of a brood-pouch is especially noticeable. The organs in question have hitherto been unknown.

Special notes concerning the geographical and bathymetrical distribution have been made in the remarks on the different species.

The occurrence of such forms as *Styela theeli* in Samlenfjord and *Cnemidocarpa rhizopus* in Cattegat is remarkable, likewise the catch of *Pelonaia corrugata* in Gullmarn. *P. corrugata* has even been found on the west and south coasts of Norway. According to the investigations of Norwegian zoologists (M. SARS 1866, GRIEG 1913), it belongs to the Arctic relic fauna which has been observed in the Norwegian fjords, a view which is not unquestionable as will be shown in the following. Its occurrence off Bohuslän is probably accidental. It has no doubt been brought there by the cold water which, orginating from the North Atlantic, has been observed to fill Gullmarn in Spring.

In Gullmarn there exists an abundant Ascidian fauna. As the present paper is dealing with two Ascidian families only, it can but give a small idea of the richness of the Ascidian fauna in those waters.

As to synonyms only those names have been mentioned which are thought to be more commonly known. As complete lists of works have already been published,

only the papers referred to are here enumerated. The measures have been taken on preserved specimens.

To the eminent artist GEORG LILJEVALL I wish to express my most sincere thanks for his excellent and delicate drawings.

Revised species.

Some of the Ascidians collected by the Vega Expedition, 1878—1880, have been described by SWEDERUS in 1885. A re-examination of the material has given the following result:

The numerous specimens labelled and described by the above-mentioned author under the name of *Molgula ampulloides* VAN BEN. do not belong to this species. They have been identified partly as *Molgula chrystallina* MÖLLER, partly as *Rhizomolgula* sp.

Molgula ampulloides VAN BEN. is not represented among the material dredged by the Vega Expedition in the Arctic Sea of Siberia and in Bering Sea. Thus any report of the species from those localities is erroneous as far as it is based on the statement of the above-mentioned author.

Boltenia spec.? SWEDERUS is no *Boltenia* which evidently appears from the description. In all probability it is *Molgula retortiformis* VERRILL. Very large specimens of this form have been collected by the Vega Expedition in the Arctic Sea of Siberia.

Styela conica SWEDERUS is certainly no new form. The author describes a *Styelid* with one sinuous ovary on each side of the body and a pyramid-shaped process between the apertures. Judging from the description it should then be *Styela rustica;* but this species is not represented in the material of the Vega Expedition. The original has not been found again.

Styela arctica SWEDERUS is probably synonymous with some form of *Dendrodoa*. The two specimens described might belong to the species *D. aggregata* which has been collected in Bering Sea by the expedition in question. The originals have not been found again.

Styela pomaria SAV. = *Polycarpa pomaria* SAV. is not found among the Ascidians dredged by the Vega Expedition. The originals have not been found again.

Rightly identified species are the following:

Boltenia bolteni L. = *Boltenia ovifera* L. from the Bering Sea.

Cynthia echinata L. = *Boltenia echinata* L. from the Arctic Sea of Siberia.

Chelyosoma macleayanum BROD. a. SOW. from the Arctic Sea of Siberia.

Synoicum turgens PHIPPS from the Bering Sea.

NORDENSKIÖLD's Expeditions, 1875 and 1876, have brought back to us Ascidians from Novaja Zemlja and the Yenissej. A few species have been reported by LÜTKE (1878) in his paper on the marine *Mollusca* collected by the above-mentioned expeditions. From a re-examination it appears that the species labelled *Molgula*

arenosa? FORB. and HANL. is identical with *Cnemidocarpa rhizopus* RDKZW., the species labelled *Cynthia rustica* MÜLL. is identical partly with *Styela rustica* L. and partly with *Dendrodoa grossularia* VAN BEN.

In her paper on Ascidians from the Norwegian North Atlantic Expedition, 1876—1878, BONNEVIE (1896) has described a new *Styelid, Styela cylindriformis.* It is characterized by four branchial folds on each side, »the generative organs are developed on both sides in the shape of long, winding, tube-like glands; they are attached to the muscle stratum, and extend so far in a horizontal direction, that they form almost a complete circle. They are hermaphroditic, having ova and sperm developed in different bends.» The specimen was found at Reykjavik. From this description it is not possible to conclude anything for certain as to the structure of the gonad and the relation of the male glands to the ovary. It cannot be decided whether the specimen is to be referred to the genus *Styela* or to the genus *Cnemidocarpa.* A gonad having »ova and sperm developed in different bends» does not occur in any known Ascidian. BONNEVIE's description might be interpreted in different ways. It seems to me that the most probable interpretation is that the male glands are separated from the sinuous ovary and situated at both sides of it, in the same way as in *Styela loveni* with which it agrees in several other respects. Making inquiries about the specimen in the Museum of Christiania where the Ascidians from the North Atlantic Expedition are stored, I was informed that *Styela cylindriformis* is not to be found in the Museum. The same answer has been given from the Museum of Bergen. Every possibility of re-examining the species seems thus to be excluded. For that reason, and as the species seems to be dubious and there is an uncertainty as to its classification it is not included in the following synopsis of genera and species.

Ord. **Ptychobranchia.**

Fam. **Styelidae.**

Branchial sac with from 1 to 4 folds on each side, or without folds, (a rudimentary fifth fold in one species only). Stigmata usually straight, longitudinal. Internal longitudinal vessels numerous. Tentacles simple. Alimentary canal on the left side of the branchial sac, in one genus posterior to the branchial sac. Stomach distinctly marked off from the intestine, with longitudinal folds, no »liver». A small gastric coecum present in many species. Reproduction by generative organs only, not by budding. Reproductive organs short polycarps or elongated gonads, undivided or divided into branches, placed on one or on both sides, within the body. No genital pouch and no brood-pouch are developed. Apertures four-lobed. Test leathery. Body usually attached, of various form. Individuals solitary or aggregated into groups, not forming colonies.

Synopsis of genera and species.

I. Reproductive organs on both sides of the body. Vasa efferentia join to form a vas deferens, running on the inner free surface of the ovary.[1]
   A. Testis separated from the ovary and situated at the side of it.
      1. Branchial sac with four well developed folds. Gonads one or two on each side of the body. Alimentary canal on the left side of the branchial sac. *Styela* FLEMING 1822.
      2. Branchial sac without folds. One gonad on each side, consisting of an elongated U-shaped ovary bordered on either side by male glands.[2] The greater part of the alimentary canal posterior to the branchial sac. *Pelonaia* GOODSIR a. FORBES 1841.

[1] In the descriptions of *Styela gelatinosa* TRAUSTEDT, *Styela doliolum* BJERKAN, *Styela bathybia* BONNEVIE, nothing is mentioned as to the structure of the vas deferens. There is, however, reason for supposing that those species agree with other *Styelae* in this respect.

[2] VAN NAME, W. G., 1912, p. 546, text-fig. 29, has figured the gonads of *P. corrugata* as elongated, straight structures what probably may be a mistake. As far as I can see, no other author has observed this form of the gonad in that species.

B. Testis not separated from the ovary, both forming a cylindrical body, the testis being placed on its outer side, and the ovary on its inner side.

1. Gonad one on each side of the body, elongated, U-shaped. Atrial tentacles scattered over the velum. *Ypsilocarpa* n. gen.
2. Gonads few to many on each side of the body, elongated, straight or tortuous, generally arranged in a single row on the inner side of the mantle. Atrial tentacles in a single row at the base of the velum. *Cnemidocarpa* HUNTSMAN 1912.
3. Gonads many, small and short »polycarps», generally diffusely scattered on the inner side of the mantle. Atrial tentacles arranged in a single row. Branchial folds well developed. *Polycarpa* HELLER 1877.

II. Reproductive organs only on the right side of the body. Vasa efferentia typically opening by many very short ducts, placed on the inner free side of the gonad.[1] *Dendrodoa* MAC LEAY 1824.

Styela FLEMING 1822.

I. One gonad on each side of the body.

A. Stalked forms. Reproductive organs retort-shaped.[2]
1. Stomach vertically placed. Test gelatinous. *S. gelatinosa* TRAUSTEDT 1887.
2. Stomach horizontally placed. Test opaque, tough, warty. *S. doliolum* BJERKAN 1905.

B. Stalkless forms.

a. Dorsal lamina plain-edged.

1. Ovaries sinuously curved, the right one sometimes bent to form an angle. The male glands form compact, bean-shaped masses, placed along both sides of the ovary. Opening of the dorsal tubercle horse-shoe-shaped, one horn usually inrolled. Test usually strongly wrinkled; a pyramid-like projection — »the horn» — is often present between the apertures. Body usually elongated. *S. rustica* LINNÉ 1767. Pl. 1, figs. 1—2.
2. Both ovaries sharply bent to form an angle. Male glands in the form of clusters, arranged at the proximal end and usually along one side, sometimes along both sides, of the ovary. Opening of the dorsal tubercle almost ring-shaped. Test often provided with minute wart-like projections. Body usually dorsoventrally compressed. *S. loveni* SARS 1851. Pl. 1, figs. 3—4.

b. Dorsal lamina with long pointed teeth. A rudimentary fifth fold is present on the right side. *S. bathybia* BONNEVIE 1896.

[1] In the description of *Dendrodoa uniplicata* BONNEVIE nothing is mentioned about the structure of the ducts of the reproductive organs nor about their openings.

[2] It seems most probable that a re-examination of the species *gelatinosa* and *doliolum* will prove them to be identical forms.

II. One gonad on the left side, two on the right. Ovaries sharply bent, forming an angle. Male glands in the form of clusters at the proximal end of the ovary. Dorsal tubercle with two small semicircular openings. Test wrinkled. Body dorso-ventrally flattened.

S. theeli n. sp. Pl. 1, figs. 5—9.

III. Two gonads on each side of the body.[1]
Stalked forms. Gonads of the right side of greater length than those of the left side. Oesophagus short, opening on the dorsal side of the branchial sac. Apertures near together, at the anterior end. Test tough, leathery. Body elongated. *S. clavata* PALLAS 1774.

Pelonaia GOODSIR and FORBES 1841.

Internal longitudinal vessels usually placed at a quite regular distance from each other. Opening of the dorsal tubercle horse-shoe-shaped. Test thin, of brownish colour, often incrusted with small grains of sand. Form of body elongated, cylindrical, somewhat tapering towards the anterior end.

P. corrugata GOODSIR a. FORBES 1841. Pl. 1, figs. 10—13.

Ypsilocarpa n. gen.

Branchial sac with three well developed folds on each side, and one — the second — in a rudimentary state. One intermediate vessel between the folds. Opening of the dorsal tubercle elongated and somewhat curved. Intestine bent almost at right angles. Rectum short and marked off from the intestine. Apertures surrounded by elevations covered with minute, translucent tubercles. Test divided into polygons. Form of body ovoid. *Y. clipeata* n. sp. Pl. 1, figs. 14—17.

Cnemidocarpa HUNTSMAN 1912.

I. Branchial sac with four well developed folds on each side. Numerous intermediate longitudinal vessels present. Gonads many on each side, generally tortuous. Pyloric coecum absent. Margin of dorsal lamina raised into small regular teeth. Stomach short, rounded. Opening of the dorsal tubercle horse-shoe-shaped. Test thin and firm. Surface of test smooth, free from foreign material. *C. finmarkiensis* KIAER 1893.

II. Branchial folds more or less reduced. Pyloric coecum usually well developed.

A. Branchial sac with one well developed fold — the first one — on each side. Intermediate longitudinal vessels present only between the dorsal lamina and the (first) fold. Gonads one on the left side, two on the right. Test thin and smooth, free from incrusting material. Filiform processes for anchoring the animal are present on the ventral side.
C. mortenseni HARTMEYER 1912.

B. Branchial folds substituted by groups of longitudinal vessels. No longitudinal intermediate vessels.

[1] This group comprises a great number of stalkless forms. As they do not belong to the fauna which is the object of this report, they are not dealt with in this paper.

a. Few endocarps on the body wall.
Dorsal tubercle placed by the side of the dorsal ganglion. The opening is meniscoid, the concavity directed to the left. Only two endocarps on the body-wall. Gonads three on the left side, five on the right. Stomach short, horizontally placed, with longitudinal folds. The surface of the test provided with spines of soft consistence. Test covered with gravel and fragments of shells. One rootlike, elongated process from the ventral side.
C. mollispina n. sp. Pl. 2, figs. 23—26. Text-figs. 1—2.

b. Numerous endocarps on the body-wall.

1. Gonads elongated, four on the left side, five or six on the right. Test incrusted with fine sand grains. Several root-like processes, generally short, from the ventral side.
C. rhizopus REDIKORZEW 1907. Pl. 1, figs. 18—21. Pl. 2, fig. 22. Text-fig. 3.
a. Stomach elongated and bent forming an angle... forma *typica*.
b. Stomach short, horizontally placed var. *murmanensis*.

2. Gonads short, polycarp-like, two or three on the left side, sometimes four in which case one or two are rudimentary, three on the right. Stomach straight, short. Test incrusted with fine sand grains. Usually only one root-like processus from the ventral surface. *C. cirrata* n. sp. Pl. 2, figs. 27—32.

Polycarpa HELLER 1877.

I. Opening of the dorsal tubercle directed to the left, horse-shoe-shaped. Stomach short and well marked off from the intestine. Apertures near together on high conical siphons. Test covered with root-like processes with very long hairs to which sand grains adhere. Only the part of the dorsal surface which bears the siphons is free. Form of body globular or elliptical.

A. The upper horn of the opening of the dorsal tubercle incurved. Intermediate vessels three to eight.
P. libera KIAER 1893.[1] Pl. 2, fig. 33.

B. The horns of the opening of the dorsal tubercle not incurved. Intermediate vessels one to two. *P. pusilla* HERDMAN 1884.

II. Opening of the dorsal tubercle directed to the right, horse-shoe-shaped, the upper horn coiled up. Stomach elongated, not distinctly marked off from the intestine. Apertures apart, on prominent siphons. Test rugose, with

[1] Comparing the descriptions of the different species of *Polycarpa* it seems most probable that the four names *P. comata* ALDER, *P. libera* KIAER, *P. pusilla* HERDMAN, *P. fibrosa* STIMPSON represent one and the same species. If this will be verified, the name of the species must be *P. fibrosa*. As far as I can see the name *fibrosa* has priority having been used by STIMPSON 1852.

irregular, wart-like prominences. Form of body irregular, generally subconical, somewhat compressed from side to side.

P. pomaria SAVIGNY 1816.

Dendrodoa MAC LEAY 1824.

I. Testis not separated from the ovary, both forming one hermaphroditic gonad, testis being placed on the outer side, ovary on the inner side of the gonad. Vasa efferentia open by many very short ducts, placed on the inner free side of the gonad. Opening of the dorsal tubercle horse-shoe-shaped. Test minutely wrinkled or strongly tuberculate.

A. Gonad unbranched, cylindrical, straight.
Branchial sac usually with only one well developed fold on the right side. *D. grossularia* VAN BENEDEN 1846. Pl. 2, figs. 34—38.

B. Gonad divided into branches.

1. Branchial sac with intermediate longitudinal vessels. The four branchial folds are well developed or the second is rudimentary. Gonad typically five-branched or with from two to many branches. Test minutely or coarsely wrinkled, sometimes tuberculate.

D. aggregata RATHKE 1806.

a. Branchial folds well developed.
Gonad five-branched. Stomach elongated, bent to form almost a right angle, not distinctly marked off from the intestine, with longitudinal folds externally conspicuous. Intermediate vessels usually two to three. forma *typica*.
Pl. 2, figs. 39—40. Pl. 3, figs. 43—44.

Gonad three-branched. Stomach elongated vertically placed, straight, with longitudinal folds. Intermediate vessels about two in number.
var. *adolphi* KUPFFER 1874.

Gonad four-branched. Stomach short, horizontally placed, distinctly marked off from the intestine, with longitudinal folds. Only one intermediate vessel between the folds in the branchial sac. var. *cylindrica* BJERKAN 1911.

Gonad usually three-branched. Stomach elongated, curved, with externally smooth wall, not distinctly marked off from the intestine. Intermediate vessels about two or three.
var. *groenlandica* n. var. Pl. 2, fig. 42. Pl. 3, figs. 45—46.

Gonad with more than five branches. Stomach elongated, not distinctly marked off from the intestine, externally smooth-walled, curved. Intermediate vessels of varying number. Test characteristically tuberculate. var. *tuberculata* RITTER 1899.

b. Branchial folds more or less reduced.
The second fold on each side is rudimentary. One to two intermediate vessels. Gonad two- or three-branched. Stomach short, distinctly marked off from the intestine, longitudinally folded. var. *pulchella* VERRILL 1871.
(syn. *D. kükenthali* HARTMEYER 1899). Pl. 2, fig. 41.

The second fold of the left side is substituted by one to two longitudinal vessels. One, sometimes two, intermediate vessels. Gonad four- or five-branched. Stomach elongated, not distinctly marked off from the intestine, externally smooth-walled.
var. *subpedunculata* RITTER 1899.

2. Branchial sac without intermediate longitudinal vessels. The folds are reduced, the second fold being substituted by two or three longitudinal vessels. Gonad usually four-branched.
Test with characteristic longitudinal lists and wart-like processes.
D. lineata TRAUSTEDT 1880.

II. Testis separated from the ovary.
Branchial sac with one fold developed on each side. Test translucent and somewhat incrusted with sand. Fine attaching filaments, especially on the under surface. *D. uniplicata* BONNEVIE 1896.[1]
a. Opening of the dorsal tubercle semi-circular. forma *typica*.
b. Opening of the dorsal tubercle horse-shoe-shaped. var *minuta* BONNEVIE 1896.

Geographical and bathymetrical distribution and general observations.

Mus. G. = Museum of Gothenburg; sp(s) = specimen(s).

Styela gelatinosa TRAUSTEDT 1887.

Distribution: Kara Sea, 50—70 fms, Dijmphna Exp. 1882—1883 (TRAUSTEDT 1887). — Between the Faroe Islands and the Orkney Islands, 60° 37′ N—5° 42′ W, 588 m, Valdivia Exp. (MICHAELSEN 1904). — N. W. of the Faroe Islands, 480 m (BJERKAN 1905).

Styela doliolum BJERKAN 1905.

Syn.: *Styela rustica?* BONNEVIE 1896.
Distribution: Norway, Lofoten, off Røst, 827 m, North-Atlantic Exp. 1876—1878; W. of Aalesund, 62° 53′ N—4° 14′ E, 820 m; D:o 62° 58′ N—1° 56′ E, 1,100 m. — Between the Faroe Islands and the Shetland Islands, 1,130 m. (BJERKAN 1905, 1908).

Styela rustica LINNÉ 1767.

Pl. 1, figs. 1—2.

Syn.: *Ascidia monoceros*, MÖLLER 1842.
» » SARS 1851.
Cynthia rustica, ALDER 1848.
Cynthia aggregata, KUPFFER 1875.
Tethyum rusticum, HARTMEYER in BRONN's Tierreich.
» » VAN NAME 1912.

Habitat:

West coast of Sweden: Bohuslän, without definite locality, many sps. — Gullmarn, numerous sps (1871 LOVÉN, 1873 STUXBERG, 1882 THÉEL); Kristineberg, 8 sps (Zool. st.); D:o many sps (1854 Mus. G.); Löken, 6 sps (July 13, 1852 Mus. G.); Flatholmen, 1 sp (May 1890, AURIVILLIUS); Lysekil-Stångehufvud, 1 sp. (July 1876);

[1] This species is provisionally referred to the genus *Dendrodoa* from which it differs in many typical respects.

Strumpeskagen, 1 sp; off Gåsö, 24 fms, 4 sps (July 16, 1878 Mus. G.); Strömmarna, 1 sp (September 1915); Alsbäck-Skårbergen, 70—80 fms, 1 sp (August 1890); Bornö, 40 m, 2 sps (July 30, 1912 Mus. G.). — Byfjorden, 10—15 m, 1 sp (September 2, 1912). — Stigfjorden, 1 sp. — Lindö, 15—30 fms, 4 sps (July 13, 1869). — Styrsö, 8 fms, 4 sps (July 11, 1869, OLSSON). — Dyngö, 1—8 fms, rocks, 4 sps. — Strömsund, 3 sps (August 8, 1909, ÖSTERGREN). — Björnsundsfjord, 10—15 m, 1 sp (July 28, 1918, ÄRNBÄCK). — Kalvöfjorden, 4 sps (September 9, 1912). — Väderöarna, 20 fms, 1 sp (June 25, 1869). — Kosterfjorden, 4 sps (1890); D:o 25 fms, 2 sps (August 9, 1905 Mus. G.); Sydkoster, 2 sps (1871 EISEN & STUXBERG). — Andsöholmar, 30 fms, 5 sps (July 1869, OLSSON). — Öresund, 2 sps.

Cattegat: Anholt, 3 sps (May 1872, v. YHLEN, Mus. G.).

Norway: Hardanger, Samlenfjord, 80 fms, sand, 1 sp (BOVALLIUS 1880); Finmarken, 4 sps (LOVÉN).

Iceland: Berufjord, 15—30 fms, rocks, 1 sp.

Beeren Island—Hope Island: 75° 49′ N—24° 25′ E, 80 m, rocks, 1 sp (June 21, Spb. Exp. 1898).

Greenland: without definite locality, 2 sps. — Davis Strait, 63° 47′ N—52° 26′ W, 35 fms, shells, 2 sps (June 9,1871, Ingegerd & Gladan Exp., LINDAHL). — Julianehaab, 10—35 fms, stones and algae, 9 sps (June 20, 1883 Sofia Exp.). — Fredrikshaab, 30—40 fms, 1 sp (August 8, 1866, AMONDSEN). — Ikamiut, 15—20 fms, clay, 1 sp (ÖBERG). — East Greenland: S. E. of the Clavering Island (Greenland Exp. 1899), 74° 10′ N—20° 8′ W, 25—40 m, mud, shells and stones, 10 sps (July 27,1899); D:o 73° 20′ N—21° 20′ W, 70 m, mud, shells and stones, 1 sp (July 31,1899).

Kola Peninsula: Sandeberg's Exp.: Waideguba, 1 sp (July 26,1877); Lumbowski, 15—16 fms, stones and shells, 2 sps (August 10,1877); Semiostrova, 50—55 fms, sand, stones and shells, 8 sps (August 18,1877); Kola Fjord, 95—100 fms, clay with shells, 1 sp (August 29,1877).

Novaja Zemlja: Matotchkin Shar, Rossmyslow's winterquarter, 15 fms, clay, Lithothamnion, 1 sp (Nordenskiöld's Exp. 1876).

Spitzbergen: without definite locality, many sps (Spb. Exp. 1837, 1868). — West Spitzbergen: Spb. Exp. 1861 (I. A. MALMGREN): Hackluyts Headland, 12—30 fms, stones and algae, many sps (May 1861); Amsterdam Island, 25 fms, sand, 1 sp (May 1861); Danes Gat, 20 fms, sand and stones, many sps; Magdalena Bay, 20 fms, sand, 1 sp; Cross Bay, 30—50 fms, stones and clay, many sps; Hinlopen Strait, 80° N 17° 5′ E, 40 fms, stones, 1 sp (July 1861); Lomme Bay, 10 fms, 6 sps (August 1861); D:o 25—40 fms, 5 sps (September, Spb. Exp. 1868); Waigat Islands, 30 fms, rocks, D:o 60—80 fms, clay, many sps (August 1861); Fosters Islands, 40 fms, sand, 1 sp; Treurenburg Bay, 6—30 fms, stones and clay, many sps (June 1861); Kings Bay, 100 fms, clay, many sps; Ice Fjord, Advent Bay, 10—20 fms, clay, 2 sps (September 1861); D:o 25—30 fms, clay, 2 sps (Spb. Exp. 1868). — Spb. Exp. 1864 (I. A. MALMGREN): Ice Fjord, Safe Harbour, 20—25 fms, many sps (June—July 1864) stones and clay; Horn Sound, 20—60 fms, stones and clay, 7 sps (1864); Stor Fjord, 5—20

fms, stones and clay, 2 sps (August 23, 1864). — Spb. Exp. 1868: Liefde Bay, 10—30 fms, 1 sp; Ice Fjord, Green Harbour, 40—50 fms, clay, 1 sp; D:o 4 sps (February 31, 1872, Mus. G.). — Spb. Exp. 1872—1873: Spitzbergen, without definite locality, many sps; Norway Islands, 15—25 fms, clay, many sps; Foul Bay, 10—25 fms, 4 sps; Smeerenburg Bay, 25 fms, stones and clay, 6 sps; D:o sand, stones and algae, 1 sp, depth 1 fm.

Arctic North America: 76° 9′ N—68° 28′ W, 30—45 m, mud, 2 sps along with *Dendrodoa aggregata* (July 5, 1894, E. NILSON).

General Distribution.

Styela rustica is common along the whole coast of Norway, bottom various, depth down to about 110 m (KIAER 1896, BJERKAN 1908). It is met with off the coasts of the Danish Islands and Sleswig-Holstein to Travemünde, Iceland and the Faroe Islands (TRAUSTEDT 1880), Sweden, Gullmarn (CARLSSON 1918). In the Arctic Sea its occurrence is almost circumpolar. This species has not been hitherto recorded from the Bering Sea, as far as *Styela macrenteron* RITTER may not be a synonymous form or a variety (HARTMEYER 1903, 1919; REDIKORZEW 1910). Off the east coast of North America it is found to the north of the New England coast. (VAN NAME 1912.)

Remarks.

The examined specimens do not show great variation as regards the typical characters, though they vary in other respects especially as to the test and the form of the body. The form of the body is generally elongated, cylindrical, sometimes rounded, dorso-ventrally flattened. The latter form is not often met with among full-grown individuals. Therefore it will be worth mentioning that specimens collected off Kola Peninsula belong to that type. They are rounded and low, dorso-ventrally depressed and often covered with Hydroids. (Pl. 1 fig. 2.) From the east coast of N. America, the Gulf of St. Lawrence, specimens of the same peculiar form have been recorded. According to VAN NAME (1912) they are characterized by small a size and low, conical shape, two individuals were almost disk-like. The presence of the pointed process of the test between the apertures and above all the internal anatomy prove, however, that they are identical with *Styela rustica*.

The test is always of leathery consistency, more or less thick. In living specimens from Gullmarn it is of a light-reddish colour. The surface of the test is variable. Generally it is deeply wrinkled, sometimes the wrinkles are substituted by rather sharp processes. Not seldom the surface is transversally folded, or it is almost smooth. The presence of the pointed process between the apertures may be independent of the condition of the test surface; it occurs in individuals with a smooth test as well as in individuals with a wrinkled test. Its presence is not constant, as is known. Judging from the collections examined, it occurs in most cases.

Under the name of *Styela macrenteron* a new species apparently closely allied

to *S. rustica*, has been recorded by RITTER (1913) from the Bering Sea. If we compare the descriptions of the two species, it is evident that they differ in only two points: as to the intestine which is of great length, forming at least two convolutions in *S. macrenteron*, and the internal vessels which are of greater number in the last-mentioned species. In all other essential respects they agree. The question therefore arises whether *S. macrenteron* is to be regarded not as a distinct species but as a variety of *S. rustica*.

The largest individuals in the collection are dredged off Spitzbergen and measure about 80 mm in height (baso-apical). The specimens collected off the Swedish coast do not equal the Arctic ones in size; they are not beyond 50 mm in height. Those from the Norwegian coast are often larger. In Tromsösund specimens have been collected measuring 70 mm in height (BJERKAN 1908).

Styela rustica is most widely distributed in the Arctic region, where it is almost circumpolar. From the Arctic its distribution extends along the Norwegian coast into the eastern Boreal zone to Travemünde in the Baltic Sea on the south, being common off the Swedish west coast, especially in Gullmarfjorden, and the Danish Islands. As far as is known, it has not been recorded from the British Isles. On the east cost of N. America it has been collected in the northern part of the Boreoarctic mixture zone.

S. rustica inhabits various bottoms, generally rocks and gravel, but also clay and mud with stones. It has been dredged from 2 to 432 m.

Styela loveni SARS 1851.

Pl. 1, figs. 3—4.

Syn. *Cynthia coriacea*, ALDER a. HANCOCK 1848.
» *rustica*, KUPFFER 1875.
Styela aggregata, TRAUSTEDT 1880.
Tethyum loveni, HARTMEYER in BRONN's Tierreich.
» *coriaceum*, VAN NAME, 1912.

Habitat.

West coast of Sweden: Bohuslän, no definite locality, 1 sp (LOVÉN), 2 sps (OLSSON 1869). — Gullmarn, 3 sps (LOVÉN 1871); D:o many sps (ÄRNBÄCK, July 1918); Flatholmen, 1 sp (July 14, 1876, C. BOVALLIUS); Kristineberg, 1 sp (1893); Pittlehufvud, 30—35 m, mud, 3 sps; Humlesäcken, 60 fms, 2 sps; Gåsö, Fittebojen, 25 fms, 1 sp (July 4, 1876 Mus. G.); Gåsö skären, 14 fms, 3 sps (August 10, 1881 Mus. G.). — Väderöarna, 10—60 fms, rocks and corals, many sps (1862). — Koster, 1 sp (1869 BOVALLIUS); Kosterrännan, 25 fms, 1 sp (July 18, 1877); Kosterfjorden, 3 sp (June 1895, C. AURIVILLIUS). — Dyngö, 8 fms, 2 sps rocks. — Skåne: Kullen, 3 sps (LOVÉN); Landskrona—Malmö, 6—9 fms, blue-clay, stones and algae, 1 sp (July 22, 1878, Gunhild Exp. THÉEL & TRYBOM); Grytskärspricken — Skaudden, 10 fms, Zostera, 2 sps (July 19, 1902, E. LÖNNBERG).

Baltic sea: W. of Bornholm 55° 10′,5 N—14° 13′ E, 27 fms, sand with clay, 1 sp (July 31, 1878, Gunhild Exp. THÉEL & TRYBOM).

Cattegat: Torrboskär — Skagen, 22 fms, clay, 1 sp (Gunhild Exp. 1878, THÉEL & TRYBOM).

Norway: Hardanger, Samlenfjord, 280 fms, rocks, 7 sps (1880 BOVALLIUS).

Kola Peninsula: Sandeberg's Exp. August 1877: Ladigino, 70 fms, stony bottom, 1 sp; Semiostrowa, 50—55 fms, sand with stones and shells, 6 sps; Lumbowski, 15—16 fms, stones and shells, 1 sp; D:o 25 fms, 1 sp; Kola Fjord, 95—100 fms, clay and shells, 2 sps.

West Greenland: Pröven, 16—40 fms, rocks, 1 sp (TORELL); Illordlek, 5 sps (August 18, 1870, ÖBERG). East Greenland: S. E. of Clavering Island, 74° 10′ N—20° 8′ W, 25—40 m, mud with shells and stones, 1 sp (July 17, 1899, Greenl. Exp.).

West Spitzbergen: Spb. Exp. 1861 (I. A. MALMGREN): Danes Gat, 20 fms, sand and stones, 6 sps; Hackluyts Headland, 12—30 fms, stones and algae, 4 sps together with *S. rustica* (May 1861); Amsterdam Island, 20 fms, clay, 1 sp; D:o 25 fms, sand, 1 sp (May 23, 1861); Treurenburg Bay, 20 fms, sand with clay, 1 sp; Waigat Islands, 30 fms, rocks, D:o 60—80 fms, clay, many sps (August 1861). — Horn Sound, 40—100 fms, 1 sp. — Ice Fjord: Green Harbour, 40—45 fms, 1 sp (1868); Advent Bay, 10—15 fms, clay, 2 sps (August 10, 1868). — Spb. Exp. 1872—1873: Norway Islands, 15—25 fms, clay, 1 sp, D:o 10 fms, 1 sp (August 1872); Mossel Bay, 8—12 fms, open water, algae, Lithothamnion, 2 sps (December 3, 1873).

Arctic Sea of Siberia: Vega Exp. 1878—1880: 76° 8′ N—92° 20′ E, 40 fms, brown clay with stones, 1 sp (1878); Taimyr Sound, Actinia Bay, the north coast, 5—10 fms, stones with algae, 1 sp (August 16, 1878); New Siberian Islands: S. E. of Ljachow Island, 8 fms, clay, 1 sp (August 31, 1878).

General Distribution.

Styela loveni occurs off the coasts of the Danish Islands, where it has been dredged abundantly in the sounds, in the western part of the Baltic Sea: at Bornholm, off the coasts of Sleswig-Holstein, and northern Germany to Darsser Ort, it has here been dredged in shallow water, 5—55 m (TRAUSTEDT 1880); Sweden, Gullmarn (CARLSSON 1918). It is common along the whole coast of Norway, in the Norwegian fjords, to Sydvaranger on the north, depth 25—400 m (KIAER 1893, BJERKAN 1908). ALDER and HANCOCK report it from the Dogger Bank in the North Sea, from the English coast, Shetland; it occurs off the Faroe Islands (HARTMEYER 1912). In the Arctic Ocean it is widely distributed, though its occurence is not abundant (HARTMEYER 1903, REDIKORZEW 1906, 1908). It is also met with on the east coast of North America, from Labrador, the Gulf of St. Lawrence, and the Banks of Newfoundland to Massachusetts Bay, (VAN NAME 1912), and in Bering Sea, 350 fms (RITTER 1913).

Remarks.

As in *Styela rustica* two types are to be distinguished also in *Styela loveni:* a low, dorso-ventrally compressed one, attached by the expanded ventral surface of the test, and a tall, cylindrical one, attached by a narrow base. Between them there

a great many intermediate forms. Both types are represented in the collections examined, those belonging to the flattened one seem to be more numerous. A comparison between specimens dredged in the fjords of the Arctic Norway BJERKAN (1905) has expressed the view that the variation of the form of the body might depend on the locality, the tall form having been found in comparatively still water, the low one in strongly streaming water. From the material here examined nothing can be stated for certain as to that view. From the Kola Peninsula, for instance, there are small individuals of the flattened type and larger ones of the tall type (Pl. 1, fig. 3). Among the specimens collected off the Swedish coast both forms are represented. However, the observation has been made that specimens attached to the test of other individuals, e. g. *Polycarpa pomaria*, usually belong to the tall type, those attached to shell fragments or stones mostly belong to the low type.

In the collections from Spitzbergen there are specimens characterized in a special way. As appears from Pl. 1, fig. 4 representing a large individual in natural size from Danes Gat, the basal part of the test is inflated and the surface is covered with short, filiform processes incrusted with sand. The upper part is wrinkled and folded like a cap. According to HARTMEYER (1903, p. 211) this form is characteristic of the individuals from Spitzbergen and distinguishes them from Subarctic ones. The material here examined does not verify that statement. In animals from the Swedish coast the test shows the same differentiation though less developed. BJERKAN observed it in specimens dredged in the North Sea. From Actinia Bay there are specimens which show the same external character. To that may be added that the specimens from Spitzbergen vary; in the collection examined there are individuals which have a high cylindrical form, without the above-mentioned differentiation of the test. In some specimens from Greenland the lower part of the test is inflated and wide, but the surface is smooth, without filiform processes.

The surface of the test is usually covered with small tubercles, it is wrinkled, incrusted with sand, or smooth. In living specimens from Gullmarn the test is of a brown reddish colour.

As to the internal structure the examined individuals generally agree but for the internal longitudinal vessels which show a highly varying number both on the folds and on the interspaces between the folds. In large specimens they are often more numerous than in smaller ones. The intermediate vessels are typically three in number (cf. HARTMEYER l. c. p. 210). In an individual from Kola, height about 17 mm., I have found 7—8 intermediate vessels between the folds and 10 along every side of the endostyle. The usual form of the opening of the dorsal tubercle is ring-shaped, in the specimen from Kola it has the form of the inverted letter *S*. In the same animal the margin of anus shows only 5—6 lobes. The usual number is 12—14. Whether those differences fall within the range of individual variation or not can be decided only after the study of a more ample material.

Styela loveni occurs, like *S. rustica*, in both the Arctic and the Boreal regions. However, it seems to have its centre of distribution in the latter, being found there more abundantly than in the Arctic, where it is sparingly met with. Is is abundant

off the coasts of the Danish Islands, common along the whole west coast of Sweden, especially in Gullmarn, and Norway, and is also found in the Baltic Sea as far as Bornholm on the east. On the American Atlantic coast it is common in the southern Boreoarctic mixture zone about the Bay of Fundy region and even in Casco Bay.

S. loveni usually occurs on stony bottom on shells, or in mud with stones. Depth varying from a few metres to about 630 m.

Styela bathybia Bonnevie 1896.

Distribution: N. of Jan Mayen, 75° 12′ N—3° 20′ E, depth 2,195 m, temperature —1,57° C. (The Norwegian North Atlantic Exp. 1876—1878).

Styela theeli n. sp.[1]

Pl. 1, figs. 5—9.

Habitat:

Norway: Hardanger, Samlenfjord, 350 fms, rocks, 1 sp (July 23, 1880, Bovallius).

Description.[1]

External Appearance.

The specimen is of elliptical outline; the body is dorso-ventrally flattened and attached by the left side by an expanded base. The apertures are placed at the anterior end of the animal and not far apart. They are four-lobed and surrounded by small papillae and folds of light colour. Wrinkles in the test prevent them from being easily distinguished (Pl. 1, fig. 5). The test of the upper side, i. e. the right side, of the animal is of dark-brown colour, coriaceous and wrinkled. It is covered with retracted *Bryozoa*, whence the surface looks as if it were dotted with tiny whitish tubercles. Some shells of *Foraminifera* are also attached to it. The surface is free from other foreign matter. The left side by which the animal is attached is whitish and opaque. The specimen measures 34 mm in length and 19 mm in breadth. The expanded base measures 23 mm in breadth.

Internal Structure.

The right side of the test is thick and of leathery consistency. The inner surface is smooth and provided with a nacreous lining. The left side — by which the animal is attached — is thin.

The mantle musculature is powerfully developed on the right side and round the siphons as regards both the horizontal and longitudinal layers. On the left side it is thinner and not so well developed. The oral tentacles are short and conical

[1] In associating with the species the name of Professor Doctor Hj. Théel, I desire to express my appreciation of the interest he has taken in the study of the Swedish Tunicata.

[2] A preliminary note on this species has been published in Bergens Museums Aarbok, 1919—1920.

ual of different size. Their exact number could not be ascertained. Atrial tentacles are present in great number. They are slender and club-shaped, scattered over a broad velum. The dorsal lamina is broad and plain-edged. Transversally it is strongly folded, probably owing to contraction of the tissues. Its posterior part is apparently double. (Pl. 1, fig. 6.) As appears from the last-mentioned figure, the dorsal tubercle is of a very characteristic structure, differing from that of other Styelae. It is prominent and of rounded form with two small openings of semi-circular shape, the concavity of which is directed to the left. The ganglion situated behind the dorsal tubercle is rather long.

The branchial sac of the specimen at my disposal is highly contracted. It is provided with four well-marked longitudinal folds on each side; the longitudinal vessels of each fold are numerous, at least 12—15 in number. The stigmata are elongate and of the usual form. On the interspaces between the folds about 8—10 longitudinal vessels are visible. Transverse vessels of different size cross the branchial sac. Here and there the stigmata are crossed by slender vessels.

In examining the alimentary canal one is struck by the development and arrangement of the intestine, which is of great length and characteristically bent, forming a wide, rounded loop above the stomach. The oesophagus is rather long, projecting from the base of the branchial sac. The stomach is short and well marked with about 22 longitudinal folds in its wall. Only a very small rudiment of a pyloric caecum is present. (Pl. 1, fig. 7.) The condition of the rectum is noticeable; it is long and sinuous and placed close to and on the inner side of the descending part of the loop of the intestine. The margin of the anus has about 12 small lobes.

The reproductive organs consist of two gonads on the right side and one gonad on the left. Each gonad consists of an ovary, bordered proximally by clusters of male glands. The ovaries are tubes of great length which are bent along a sharp angle and sinuously curved. The oviducts are wide, almost inflated, the orifices are lobed, directed towards the atrial siphon. (Pl. 1, fig. 8.) The two ovaries on the right side differ in size, the one being shorter and narrower than the other. In other respects they exactly agree. The ovary of the left side is in its proximal part less sinuous than those of the right side. Moreover they are of the same structure and the characteristic bend along a sharp angle is common to the ovaries on both sides. (Pl. 1, fig. 9.)

The want of symmetry is manifested not only in the arrangement of the ovaries but also in that of the male organs. If we compare figs. 8 & 9 it will be seen that the testis of the left side is much more developed than that of the right. On the latter side, the clusters of male glands are few and are placed only at the proximal end of the oviduct, whereas on the left side they are numerous, forming a series of testicular masses, grouped along the ovary at one side and bordering the greater part of its length. The vasa efferentia embrace the proximal part of the ovary and unite in forming a common vas deferens, which lies on the inner free surface of the

ovary and ends close to the orifice of the oviduct. Both the oviduct and the vas deferens open at the end of the gonad near each other.

On the inner side of the mantle a large number of endocarps are visible.

Remarks.

In comparing *Styela theeli* with other *Styelids*, it appears that, while it agrees in some external and internal features with the members of the group *Goniocarpa*, it is distinctly marked off from other species. No known *Styela* has gonads which agree with those of *S. theeli*, nor a dorsal tubercle which resembles that of the latter; even the alimentary canal shows different characters. In some respects *S. theeli* resembles in appearence *S. loveni:* the leathery test, the expanded base and the depressed form are features which remind one of *S. loveni*. And as to the internal anatomy, it should be observed that the structure of the gonads offers several points of agreement with the last-mentioned species. In both, the ovary is a sinuously curved tube of considerable length and with the same characteristic bend, the testis and the vas deferens show the same general plan of arrangement and structure. The orifices of the gonads are in both species directed towards the atrial aperture.

There exist, however, more essential differences. With regard to the external aspect I would point out that *S. theeli* is of greater size, that it is attached by the left side. It also differs in the condition of the test: the wrinkles and the arrangement of the folds around the apertures are dissimilar. In the internal structure we find important differences. If we compare the gonads of the two species, it will be evident that, while agreeing in some general features, they differ in form and size, in the inflated oviducts and above all in the number, a character which is considered to be of great value in distinguishing the different groups of the family *Styelidae* from each other. In no other known *Styela* there are, normally, two gonads on the one side and only one on the other. In *Styela loveni* the presence of one gonad on each side is considered to be constant.

As far as concerns the number of the gonads, *S. theeli* might be regarded as an intermediate form between the *Goniocarpa* group which has one gonad on each side and the *canopus* group which has two gonads on each side. So far as one can judge from this single specimen of *S. theeli*, there does not seem to exist any greater resemblance between it and the latter group in any other respect.

In regard to the systematical position of *S. theeli* it should be observed that, though the species is no doubt nearly allied to the group *Goniocarpa*, it can not be referred to this group without further evidence. If forms like *S. theeli* are to be included, the definition of the group should be altered. Or a new genus must be established. Provisionally, however, it may conveniently be referred under the genus of *Styela* to the *Goniocarpa* group, until further specimens will have been found, the investigation of which will serve to complete the description of the species.

So far as I am aware, no further specimen of *S. theeli* has yet been found in the Norwegian fjords nor off the coast, and according to the literature on the subject,

no *Styelid* resembling it has been reported elsewhere. For those reasons one can not at present determine whether the species here described is to be regarded as an endemic or as a relic form, or whether possibly its occurrence there is accidental, the animal having been carried, as larva or adult, from other regions to Samlenfjord.

Styela clavata Pallas 1774.

Syn. *Styela greeleyi*, Ritter 1899.
Distribution: Kamtchatka (Pallas 1774). Bering Sea: Pribilof Islands (Ritter 1899).

Pelonaia corrugata Goodsir and Forbes 1841.

Pl. 1, figs. 10—13.

Syn. *Pelonaia villosa*, Sars 1858, 1866.
» *glabra*, Forbes a. Hanley 1853.
» » Herdman 1891.
» *arenifera*, Stimpson 1851.
» » Whiteaves 1901.

Habitat:

West coast of Sweden: Bohuslän, off the mouth of Gullmarn, E. of Grötön, 10—15 fms, 1 sp (July 2, 1887, C. Aurivillius).

Norway: Finmarken, Sörvaer, many sps (S. Lovén). — Trondhjemsfjord, Rissen Bay, 15—30 fms, clay with sand, 1 sp (Hj. Östergren).

Iceland: Berufjord, 25 m, clay, many sps.

Greenland: West Greenland, (Sofia Exp. 1883): Waigat Strait, Atanikerdluk, 20—25 fms, clay, 2 sps (July 7, 1883); D:o 25 fms, sand and stones with algae, 1 sp (July 17, 1883). — Ikamiut, 15—20 fms, clay, 1 sp (July 24, 1870, Öberg). — East Greenland: Scoresby Sound, Cape Stewart, 70° 27′ N—22° 35′ W, 13—18 m, clay, stones and algae, 2 sps (July 7, 1899, Greenland Exp. 1899).

Kola Peninsula: Lumbowski, 25 fms, sand with shells and stones, 3 sps (August 10, 1877, Sandeberg's Exp.).

Novaja Zemlja: Novaja Zemlja Exp. 1875 (Théel and Stuxberg): Besimannaja Bay, 4—10 fms, clay, many sps (July 3, 1875); Matotchkin Shar, 2—6 fms, sand and clay, many sps (July 10, 12, 1875). — Without definite locality, 2 sps (1891 Ekstam).

Kara Sea: Novaja Zemlja Exp. 1875 (Théel a. Stuxberg): 71° 6′ N—66° 23′ E, 8 sps; 71° 19′ N—66° 5′ E, 7 sps, 8—12 fms, sand (August 6, 1875); 71° 55′ N—67° 10, 32 fms, clay, 1 sp (August 7, 1875).

Jan Mayen: Drift-wood Bay, 70° 55′ N—8° 30′ W, 14—21 m, black sand, many sps (June 12, 1899, Greenland Exp. 1899).

Spitsbergen: Without definite locality, 1 sp; Spb. Exp. 1861 (I. A. Malmgren): Treuronburg Bay, 79° 55′ N—16° 5′ E, 14—25 fms, clay and stones, many sps (June 1861); D:o Hecla Cove, 6—20 fms, 1 sp (June 11, 1861); Shoal Point, 25—30 fms, clay, 1 sp (July 1861); Wijde Bay, east coast, 40 fms, clay, 1 sp (July 1861); Kobbe Bay, 7 sps; Kings Bay, 20 fms, fine, light-coloured clay, 1 sp (August 1861).

— Spb. Exp. 1864 (I. A. MALMGREN): Stor Fjord: Whales Point, 20—30 fms, clay, 1 sp (August 9, 1864); Stor Fjord, 78° 31′ N—19° E, 5—20 fms, clay and stones, 8 sps (August 23, 1864). — Spb. Exp. 1872—1873: Bel Sound, 4—12 fms, clay, 10 sps (July 1872). — Spb. Exp. 1898: Bel Sound, Recherche Bay, 0—20 m, stones, 1 sp (July 13, 1898).

General Distribution.

Pelonaia corrugata occurs, though sparingly, along the whole Norwegian coast. In the northern Norway it has been collected in Ramfjord, 45 m; Kjöllefjord, 50—60 m; off Tromsö; Vadsö, 12—55 m; on the west and south coasts: off Molde; in Hardangerfjord, 10—50 m (GRIEG 1913); Arendal, about 24 m; in the mouth of Christianiafjord at Bollaerene, 20—30 m (SARS 1866, KIAER 1896, BJERKAN 1908). It has also been dredged in Cattegat, in the North Sea, off the coasts of Denmark, Holland and the British Isles, the Faroe Islands, Iceland, Greenland (TRAUSTEDT 1880). In the Arctic Ocean this species is widely distributed; it is nearly circumpolar (HARTMEYER 1903, 1909; REDIKORZEW 1906). Moreover it has been reported from the American Atlantic coast: Labrador, the Gulf of St. Lawrence, Massachusetts (VAN NAME 1912), from the south-eastern Bering Sea (RITTER 1913), the western coast of Canada: British Columbia, Rose Spit, 22 sps, in a few fathoms (HUNTSMAN 1912).

Remarks.

The form of body of *Pelonaia corrugata* is usually elongated, flask-shaped, the broader posterior part tapering into an obtuse point. The test is usually of a dark-brown colour, coriaceous and transversally corrugated, covered with sand grains. In no specimen well-developed attaching filaments have been observed. (Pl. 1, figs. 10—12.) In the collections examined there are, however, individuals of an other type, more elongated and slender, almost worm-like; the test is thin, of a light-grey colour and incrusted with very fine sand grains. They have been brought back from Finmarken, Norway. No doubt they represent the form which has been described as a different species under the name of *P. glabra*. There is also a small collection of specimens from Jan Mayen which agree with the above-mentioned ones as to the form of the body; they are quite black being incrusted with black grains, only a small area around the apertures is white. As regards the internal structure the worm-like forms do not differ in any essential points from that of the common type. The only noticeable difference observed is that the gonads are small and very little developed. I therefore agree to the view of HARTMEYER that specimens of that type are young ones of the species *corrugata*.

According to VAN NAME (1912, p. 546, text-fig. 29) the gonads of *Pelonaia corrugata* are represented by one straight structure on each side. In all specimens examined by me, even in young ones, the gonads are U-shaped. As far as I can see, other authors agree in that respect. (Pl. I, fig. 13).

The largest individual in the collection has been collected in Berufjord, Iceland,

and measures about 85 mm. in length. The length of the specimens from Spitzbergen do not exceed 45 mm., and the single specimen from the Swedish coast measures 22 mm. Off Spitzbergen, in Stor Fjord, gigantic individuals have been dredged, measuring 137 mm. in preserved state (REDIKORZEW 1906, p. 132). Like the specimen from the Swedish coast those from the Norwegian coasts are of small a size; BJERKAN has stated that, in a collection from Finmarken, the largest specimen did not exceed 32 mm. in length.

Pelonaia corrugata occurs in the Artic and Boreal regions and is widely distributed in both. It is generally maintained that it is an Arctic form which has wandered southward. In the Arctic region this species attains its largest size, but it ought to be observed that specimens from the Boreoarcic mixture zone almost equal the first-mentioned ones, individuals measuring at least 110 mm. having been collected on the east coast of Iceland.

As appears from the above, *P. corrugata* inhabits the fjords of northen Norway, but has also been found along the west and south coasts of this country. Its occurrence in the last-mentioned localities has been explained by the theory of an Arctic relic fauna living in those fjords (SARS 1866). J. A. GRIEG who has investigated the matter in later time and published the results of those investiagtions as recently as the year 1913, has accepted the same view that *Pelonaia corrugata* is a relic form: »De fleste arter kan dock ikke betragtes som 'arktiske utliggere' da de har forstaat at tillempe sig efter de forandrede livsvilkaar. — Der er dog nogen arter hos hvem öiensynlig denne evne har vaeret litet utviklet. De optraer spredt og faatallige og meget ofte kun i forkröblede eksemplarer. Av saadanne arter kan naevnes *Pelonaia corrugata.* — Disse arter kan derfor med rette betragtes som relikter. Det er sandsynlig at det arktiske element i fjordfaunen stammer fra istiden» (1. c. p. 30). This view of GRIEG does not, however, seem to be supported by what is known about the distribution of this species. *P. corrugata* is not an exclusively Arctic form, on the contrary, it has been collected in the eastern Boreal region in several localities: off the Brittish coasts in many places, in the North Sea between Borkum and Helgoland, off the coasts of Denmark east of Hjelmen, between Anholt and Kullen in Cattegat, and, as has been mentioned above, off the Swedish coast in Gullmarn. And if we consider the numerous localities and especially the depth in which *P. corrugata* has been dredged on the west and south coasts of Norway the theory that this species belongs to the relic fauna does not become more probable. In Hardangerfjord it has been collected at Saetveit, depth 10—50 m, only one specimen, at Arendal in a depth of 24 m, in Christianiafjord it has been found in the mouth, at Bollaerene, in a depth of about 20—30 m. Thus the local conditions do not appear in any way remarkable. Why may we not then suppose that the presence of this species in the last-mentioned localities is due to the same powers which brought it to other places in the Boreal region? Judging from the facts mentioned above, this supposition is no doubt closer at hand. The occurrence of *P. corrugata* in Gullmarfjorden on the Swedish west coast is probably purely accidental; only a single specimen has been collected at a depth of 10—15 fms off the

mouth of the fjord. It has been observed that water coming from the North Atlantic streams into this fjord in Spring. Many an animal, adult or as larva, is supposed to have been brought there with that water from other regions. Thus there is reason for the supposition that the occurrence of *P. corrugata* in Gullmarn is due to the same fact.

P. corrugata generally occurs on sandy a bottom, sometimes on muddy bottoms with stones. Depth down to 200 m.

Ypsilocarpa clipeata[1], gen. et sp. n.

Pl. 1, figs. 14—17.

Habitat:

N. W. Spitzbergen: Smeerenburg Bay, 25 fms, stones and clay, 1 sp, along with *Styela rustica* (August 27, 1872, Spb. Exp. 1872—1873).

Description.

External Appearance.

The body is ovoid and somewhat compressed baso-apically; the test is spread out over the object to which the animal is attached. The apertures are situated on the dorsal surface, about 2 1/2 mm. apart, and, in this preserved specimen, scarcely raised over the surface, and not easily detected. They are surrounded by elevations of the test, which are covered with numerous minute tubercles (Pl. 1, fig. 14). The test of this preserved example is of a yellowish-grey colour and very firm. Its surface is divided all over into irregular polygons. In the middle of each polygon is a minute, translucent, vesicle-like elevation. On larger polygons there are two such structures, and here and there, especially in the vicinity of the siphons, they are more closely scattered, and are of a somewhat smaller size, though more prominent. The surface is free from adherent foreign material. The specimen measures 6 mm. in length (baso-apical) and 8 mm. in breadth (dorso-ventral).

Internal Structure.

The test is moderately thick and of a tough consistency. Its outer layer consists apparently of a very thin transparent membrane of a chitin-like aspect and of somewhat greater thickness around the vesicle-shaped elevations on the polygons. The inner surface of the test is smooth and whitish.

The mantle musculature is not very strongly developed. The tentacles are simple and of differing size, the largest numbering about seven or eight.

The atrial tentacles are numerous and slender; they are scattered over the narrow velum and arranged in two or three rows. The dorsal lamina is plain-

[1] A preliminary note on this species has been published in »the Annals and Magazine of Natural History», Ser. 9. Vol. 7. London 1921.

edged and rather broad. The dorsal tubercle is rounded and small, though prominent. The aperture is elongate and feebly curved (Pl. 1, fig. 17).

The branchial sac is provided with four folds on each side; three are well developed, and one — the second — is in a rudimentary state. It is represented by three longitudinal vessels, a number which is reduced to two in the bottom of the branchial sac. On the interspaces between the folds there is one wide longitudinal vessel. The following scheme shows the approximate number and the distribution of the vessels:

Dorsal lamina, 1(9) 1(3) 1(7) 1(5) 1, endostyle.

The stigmata are elongated and of the usual form.

The alimentary canal is not of great length. The stomach is short and has a horizontal position. Numerous longitudinal plications are visible in its wall. No pyloric coecum has been observed. The intestine forms a short loop and afterwards bends upwards almost at right angles (Pl. 1, fig. 16). As appears from the figure, the rectum is short and distinctly marked off from the intestine, from which it rises at right angles. The margin of the anus is provided with seven small lobes.

Te reproductive organs consist of one hermaphrodite gonad on each side of the body. The gonad is of great length and characteristically bent into the shape of the letter *U* (Pl. 1, fig. 15). In this individual it is well distended with eggs at different stages of development. Macroscopically no male glands could be observed, but from sections it appears that the gonad contains very small glands — in all probability, male glands, though no spermatozoa were observed there, — with ducts, hidden by the mass of large eggs. So far as one can judge from this single specimen, the eggs and the spermatozoa are thus produced at different times. The ovary and testis each open at the end of the gonad by an elongated duct dorsally directed. Owing to the *U*-shaped form of the gonad, its distal end with the opening ducts almost touches its proximal end. The main sperm-duct lies upon the inner free surface of the gonad, and ends at some distance from the oviduct. Macroscopically the vasa efferentia were scarcely visible.

Endocarps are present on the inner side of the mantle and in the loop of the intestine.

Remarks.

In discussing the systematic position of *Ypsilocarpa* the characters of the gonads and the atrial tentacles should above all be considered. As far as one can judge from this single specimen it agrees with the genus *Cnemidocarpa* as regards the general structure of the reproductive organs, the ovary and testis not being separated. In other respects, even as to the reproductive organs, it differs from that genus. *Cnemidocarpa* has from few to many gonads, which are usually straight or tortuous. *Ypsilocarpa* has, on each side, one gonad only, which is of considerable length and bent in the shape of the letter *U*.

In *Cnemidocarpa* the atrial tentacles are arranged in a single row at the base of the velum. In *Ypsilocarpa* they are scattered over the velum. In *Y. clipeata*

the velum is narrow and only two or three rows of tentacles could be observed at its base. *Ypsilocarpa* thus agrees with *Styela* as to the arrangement of the atrial tentacles.

A revision of the *Styelae* is still wanting; it would be highly desirable. Many a *Cnemidocarpa* has been described under the name of *Styela*. Perhaps that will prove to be the case also with the *Ypsilocarpa*-forms. Hitherto known *Styelids*, collected in the Arctic, present no species comparable with the above-mentioned one. However, there are forms dredged in other waters which seem to agree with it as regards the generic characters. In *Styela nordenskiöldi* MICHAELSEN, caught in the Magellanic region, the reproductive organs consist of one cylindrical gonad on each side; it is of great length and irregularly curved, the ovary and the testis are not separated. From a re-examination it also appears that the atrial tentacles are scattered over the surface of the velum.

In *Styela curtzei* MICHAELSEN (1900), another Magellanic form, the structure of the gonad seems to be in principal the same as in *Styela nordenskiöldi*, there is only one gonad on each side. The arrangement of the atrial tentacles is also the same: they are scattered over the velum.

Styela squamosa, dredged to the south of Australia, and described by HERDMAN (1882), resembles *Ypsilocarpa* in several respects.[1] In both species a reduction of the branchial folds has taken place; in the former three distinct folds lie on each side, the fourth is in a rudimentary state. In the latter three folds are well-developed on each side, the second is rudimentary, In both, the dorsal lamina is plain and the larger tentacles are short and stout. In both, the surface of the test is peculiarly differentiated. In *Styela squamosa* it is provided with soft, regular tubercles — it is, however, impossible to get any clear idea of the last-mentioned character from the figure illustrating it (l. c. pl. xviii, fig. 1). — In *Ypsilocarpa* the surface of the test is divided into polygons. Even in *Styela squamosa* the reproductive organs consist of one hermaphrodite gonad on each side, elongated and curved, the ovary and the testis are not separated. The condition of the specimen did not allow any observation of the atrial tentacles, nor has HERDMAN given any description of their arrangement. Consequently, no decisive conclusion can, for the present, be drawn from a comparison between the two species.

If one considers the above-mentioned facts, three groups of *Styelids* nearly allied to each other may be distinguished.

1. *Cnemidocarpae:* gonads from few to many, straight or somewhat tortuous, regularly arranged in a single row on each side. Atrial tentacles sparingly placed in a single row at the margin of the velum.

2. *Polycarpae:* gonads numerous short polycarps, diffusely scattered on each side of the mantle. Atrial tentacles in a single row at the base of the velum.

3. *Ypsilocarpae:* one gonad on each side, of great length, more or less *U*-shaped. Atrial tentacles scattered over the surface of the velum.

[1] During my stay in London this summer (1921) I had opportunity of re-examining *Styela squamosa* in British Museum, Nat. Hist.; the comparison here made is based on this re-examination.

Cnemidocarpa finmarkiensis KIAER 1893.

Syn. *Cynthia gutta*, SARS 1858.
Polycarpa finmarkiensis, KIAER 1893, 1896.
Styela finmarkiensis, HARTMEYER 1903; BJERKAN 1908.
Tethyum finmarkiense, HARTMEYER in BRONN's Tierreich.
» » VAN NAME 1912.

Habitat:

West Greenland: Pröven, 16—40 fms, rocks, 2 sps (1861 TORELL); Upernivik, 130 fms, 1 sp (1870 ÖBERG).

General Distribution.

Cnemidocarpa finmarkiensis has been reported from a few localities only: the northern coast of Norway: from Hammerfest; Tromsö, 2 sps (KIAER 1893); Tromsösund, 20—30 m, 1 sp; Kongsfjord, 70—90 m, many sps (BJERKAN 1908); the Murman coast (REDIKORZEW 1908); the east coast of N. America 45° 29′ N—55° 24′ W, 1 sp (VAN NAME 1912).

Remarks.

Cnemidocarpa finmarkiensis is a rare form; only a small number of specimens has hitherto been collected. Many of them have been dredged in Kongsfjord, Norway (cf. BJERKAN l. c.). It is found in the Arctic region but chiefly in the Boreo-arctic mixture zone. As appears from the above, its range of distribution comprises West Greenland, the Murman coast, northern Norway, and the east coast of N. America.

Styela joannae HERDMAN and *Styela stimpsoni* RITTER, which have been reported from the west coast of North America, Puget Sound, are no doubt closely allied to *C. finmarkiensis*. If we compare the descriptions of the three species the differences between them do not seem to be of great importance. HUNTSMAN (1912) is of opinion that *S. joannae* HERDMAN is synonymous with *S. stimpsoni* RITTER and according to BJERKAN (l. c.) there are reasons for supposing that even *C. finmarkiensis* would be synonymous with *S. stimpsoni*. If further comparative studies should confirm the supposition that the three forms are identical, which appears most probable, the range of the species would comprise even the north-eastern part of the Pacific Ocean, where *C. joannae* is common off the coast of British Columbia and occurs abundantly in Puget Sound (HUNTSMAN 1912). Further investigations of the synonomy and distribution of this interesting species will surely be of the highest importance.

The three preserved specimens at my disposition are of a yellowish-white colour; when alive, the species is said to be blood-red.

C. finmarkiensis occurs on hard bottoms, even corals; it is attached to stones or shells. It has been dredged at a depth varying from 20 m to 234 m.

Cnemidocarpa mortenseni HARTMEYER 1912.

Syn. *Tethyum (Styela) mortenseni,* HARTMEYER 1912, VAN NAME 1912.

Distribution: Skagerrack, between Norway and Denmark, 58° 06′ N—9° E. Depth 660—420 m, 1 sp. — East coast of North America, 42° 30′ 15″ N—70° 38′ W. Depth 45 fms, muddy bottom, 1 sp; D:o 44° 26′ N—62° 10′ W. Depth 127 fms, dark brown mud, 2 sps.

Cnemidocarpa mollispina n. sp.

Pl. 2, figs. 23—26. Text-figs. 1—2.

Habitat:

Kola Peninsula: Litza, 35 fms, sand, 1 sp (August 5, 1877, Sandeberg's Exp.). The unique specimen was collected along with a Molguloid, a form of *Eugyrioides.*

Description.

External Appearance.

The single specimen of the collection is of almost globular form. The upper side, i. e. the dorsal side, is somewhat flattened. The *apertures* are placed on the dorsal side, not far apart. They are four-lobed, small, and cannot be easily distinguished; the lobes of the atrial aperture are more distinct than those of the branchial one. The surface of the test is provided with irregularly formed processes or spines of soft consistence. It is incrusted with large sand grains and shell fragments, between which the pointed processes are discernible. From the ventral side a root-like stalk of great length arises (Pl. 2, fig. 23).

The specimen measures 6 mm. in length (baso-apical) and 7 mm. in breadth (dorso-ventral).

Internal Structure.

The test consists of a thin and very tough tissue which sends forth pointed processes covering the whole surface. It is penetrated by a system of large blood-vessels ending in rather wide bulbs as appears from text-fig. 1 drawn from a horizontal section. The mantle adheres to the inner side of the test and the mantle-musculature is well developed. The superficial layer consisting of transverse muscles, and the deeper layer consisting of longitudinal muscles form fairly continuous sheets. The oral tentacles are about 15 in number; they are simple and of three sizes. The atrial tentacles are placed in one row at the base of the velum. The dorsal lamina is plain-edged. The dorsal tubercle is situated by the side of the ganglion (cf. Pl. 2, fig. 25). Its opening is elongated and curved, not quite semicircular, the open interval is directed to the left. The ganglion is strongly developed; it is placed to the left of the dorsal tubercle.

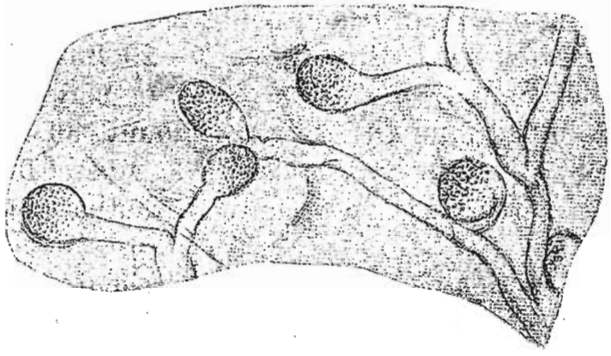
The folds of the branchial sac are all rudimentary. They are represented

by a few internal longitudinal vessels; the second fold is reduced to one single vessel. On the interspaces between the folds there are no longitudinal vessels. The distribution of the vessels is as follows:

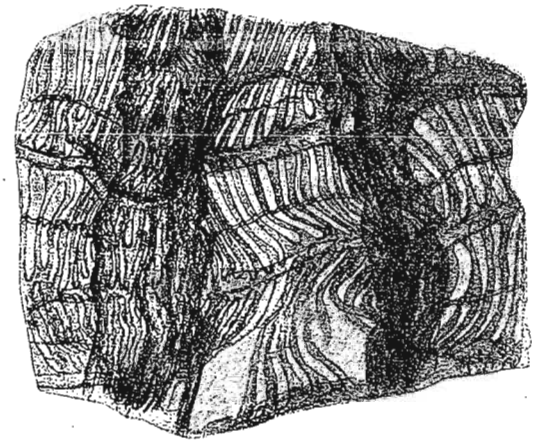
Dorsal lamina—4—1—4—3—endostyle.

Transverse vessels of three orders are present. Numerous straight stigmata are visible on the interspaces between the longitudinal vessels. (Cf. text-fig. 2.)

The position and external structure of the alimentary canal is clearly shown from fig. 24. The stomach is short and sharply marked off from the oesophagus and from the intestine. It has about 18 longitudinal folds which issue from a rather distinct raphe. It has a horizontal position. The osophagus is of remarkable length.



Text-fig. 1. *Cnemidocarpa mollispina* n. sp. Part of the test showing the blood-vessels; magnified.



Text-fig. 2. *Cnemidocarpa mollispina* n. sp. Part of the branchial sac. ×32.

The intestine forms a short rounded loop. The rectum is short and arises along a sharp angle. The margin of the anus is lobed; about 8 small rounded lobes were visible.

The reproductive organs consist of 3 gonads on the left side and 5 on the right. (Cf. Pl. 2, fig. 24.) They are elongated and straight; their openings are directed towards the atrial aperture. The male glands are situated on the outer side of the gonad; they are simple or of a lobed form. They communicate by the tiny vasa efferentia, visible on either side of the gonad, with the common vas deferens which accompanies the ovary and ends beside the opening of the oviduct. In the individual at my disposal the ovary is well distended with eggs; the male glands are rather reduced. From this fact one might conclude that the sexual products do not attain maturity at the same time. (Pl. 2, fig. 26.)

Endocarps are present in the loop of the intestine and on the inner side of the mantle. Those attached to the inner side of the mantle are only two in number, one is in the vicinity of the atrial aperture, the other on the opposite side. (Pl 2, fig. 24.)

Cnemidocarpa rhizopus Redikorzew 1907.

Pl. 1, figs. 18—20. Pl. 2, fig. 22. Text-fig. 3.

Syn. *Styela rhizopus*, Redikorzew 1907, 1910.
Tethyum rhizopus, Hartmeyer 1909.

Habitat.

Cattegat: Kummelbanken, 3 sps (1900, T. Tullberg).

East Greenland: Greenland Exp. 1899: S. of the Pendulum Island, 74° 35′ N—18° 23′ W, 18—21 m, mud with sand and algae, 3 sps (July 6, 1899); S. E. of the Clavering Island, 74° 10′ N—20° 8′ W, 25—40 m, mud with shells and stones, 3 sps (July 17, 1899).

West Spitzbergen: Spb. Exp. 1861 (I. A. Malmgren): Hakluyts Headland, 12—30 fms, stones and algae, 1 sp (May 1861); Danes Gat, 20 fms, sand and stones, many sps; Treurenburg Bay, 20 fms, 2 sps; Waigat Islands, 60 fms, clay, 3 sps (August 1861). — Spb. Exp. 1864 (I. A. Malmgren): Stor Fjord, 5—20 fms, clay and stones, 1 sp (August 23, 1864). — Bel Sound, 5—20 fms, clay or clay with stones, many sps. — Spb. Exp. 1868 (A. I. Malmgren): Lovén's Mount, 36 fms, clay with stones, 2 sps (September 11, 1868). — Spb. Exp. 1872—1873: Mossel Bay, 8—15 fms, various bottoms: sand, clay with algae, especially Lithothamnion, many sps.

Novaja Zemlja: N. Zemlja Exp. 1875: Waigatch Island, Cape Grebeni, 8—10 fms, clay or clay with sand, a great number of specimens (July 25—31, 1875, Théel a. Stuxberg).

General Distribution.

The species has been reported from the Arctic Sea of Siberia, W. of West Taimyr; depth, 9 m; bottom, mud and sand (cf. Redikorzew 1910).

Remarks.

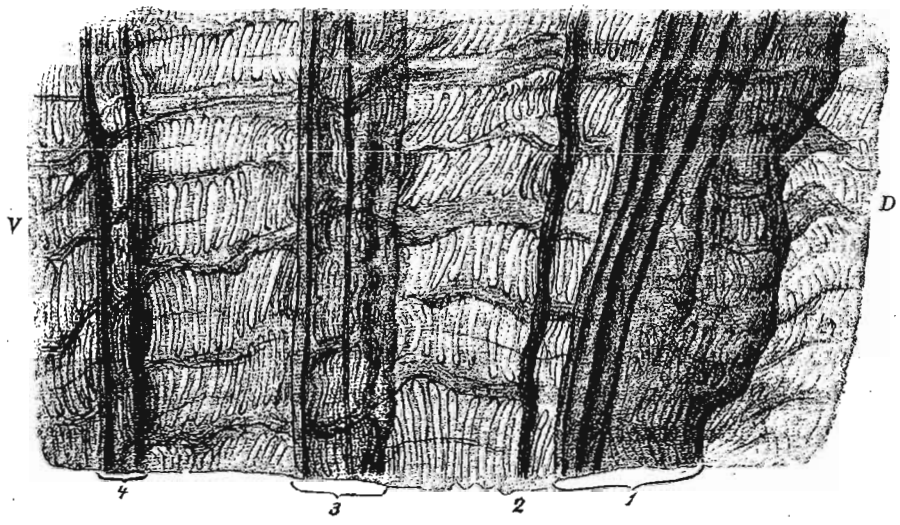
To the description given by Redikorzew the following notes should be added.

As is shown from figs. 18—20, the body is of various form, it is generally cylindrical with a tapering posterior part, or conical with a bulb-shaped base; sometimes it is almost spherical. The anterior end, where the apertures are placed, is somewhat flattened. The apertures are near together and easily distinguished; they are surrounded by circular folds of the test. The test is thin and incrusted with very fine sand grains. From its ventral side numerous rhizoid-like processes arise. The atrial tentacles are arranged in a single row. The dorsal tubercle is almost circular, its opening is directed to the left. According to Redikorzew (1910) the opening is turned to the right, a statement which probably is due to a mistake, since such an arrangement has been observed in no specimen among the numerous collection here examined.

The folds of the branchial sac are rudimentary — but more or less as to the first one — and are substituted by groups of longitudinal vessels. (Cf. text-fig. 3.) The number of the vessels is not constant, nor quite the same on each side. The average number might be as follows:

right side: dorsal lamina—6 to 7—2—3—2—endostyle,
left » » » 5—2—3—2— »

The above-mentioned number is met with in the upper part of the branchial sac; towards its bottom the longitudinal vessels are often less numerous, one vessel in each group being reduced.



Text-fig. 3. *Cnemidocarpa rhizopus* REDIKORZEW. Part of the branchial sac showing the groups of longitudinal vessels. ×32.

According to REDIKORZEW all folds are rudimentary and the vessels are distributed as follows:

dorsal lamina—3—1—2—1—endostyle.

No intermediate longitudinal folds have been observed.

As appears from fig. 22 the alimentary canal is of great length and characteristical structure. The stomach is elongate and curved almost along a right angle. Numerous longitudinal folds — about 20 in number — are visible in its wall. The pyloric coecum is well developed and curved. The intestine forms a U-shaped loop. Its proximal part is provided with longitudinal folds (cf. fig. 22); in some individuals examined these folds are externally less conspicuous than in the specimen figured. The rectum is long and sinuous; a deep plication accompanies it along its whole length. The margin of the anus is two-lipped and densely lobed.

The reproductive organs consist of four gonads on the left side of the body

and from five to six on the right. The testis and the ovary are not separated; they form one cylindrical body, the male glands being placed on the outer side and the ovary on the inner side of the gonad. The testis opens beside the ovarian aperture at the end of the gonad. The openings are directed towards the atrial siphon. (Cf. Pl. 2, fig. 22.)

REDIKORZEW has given the following description of the reproductive organs in *C. rhizopus:* »Die Gonade ist beiderseits entwickelt; das Ovarium und der Hoden sind getrennt. Das Ovarium hat die Gestalt von langen cylindrischen Schläuchen; — an einigen davon bemerkt man deutlich einen kurzen Ausführungsgang — den Oviduct. Die Hodenbläschen sind sehr zahlreich, auf der Bauchseite ziehen sie in zwei Reihen längs der Mittellinie hin.» »Die Hodenbläschen» of which the author speaks, are endocarps, which are present in a great number; that is clearly shown from the above-mentioned figure.

C. rhizopus (incl. var.) is found in the Arctic region, occurs also in the Boreoarctic mixture zone, and has been collected once and in three specimens in the Boreal region. Its range of distribution comprises the western Arctic Sea of Siberia, West Spitzbergen, East Greenland, Novaja Zemlja, the Murman coast and Cattegat. The last-mentioned locality is noticeable and further investigations should be of interest to make out whether its occurrence there is accidental or it may be a relic form, no locality being known, yet at least, between the Murman coast and Kummelbanken in Cattegat. Two closely allied forms are known before from the North Sea region viz. *Styela vestita* STANGER (syn. *Cnemidocarpa mollis* STIMPSON) reported from the north-eastern British coast (Northumberland and Durham) and *Cnemidocarpa mortenseni* HARTMEYER of which one specimen has been dredged in Skagerrack 58° 6′ N—9° E, 660—420 m (»Norska rännan»). The three specimens of *C. rhizopus* collected in Cattegat are of small a size, the largest one measuring 12 mm in length. Two are mature, in the third the gonads are thin and only a little developed. The branchial sac and the alimentary canal are of typical structure. As to the external appearance they are elongated, the test is rather thick, incrusted with sand grains and with numerous rhizoid-like processes arising from the posterior part of the body.

C. rhizopus has been dredged from 5 to 60 fms. Ordinary bottom, mud with sand or stones.

Cnemidocarpa rhizopus var. **murmanensis** REDIKORZEW 1911.

Pl. 1, fig. 21.

Syn. *Tethyum rhizopus* var. *murmanense,* REDIKORZEW 1911.

Habitat:

Kara Sea: 73° 53′ N— 69° 20′ E, 10 fms, sand, 3 sps (August 10, 1875, N. Zemlja Exp. 1875, THÉEL & STUXBERG).

General Distribution.

This variety of the species *C. rhizopus* has been reported from the Murman Biological Station. Three specimens have been dredged at three different localities. Bottom, sand and shells. Depth, 28—90,5 m. (Cf. REDIKORZEW 1911.)

Remarks.

It appears most probable that the specimens described under the name of *Cnemidocarpa rhizopus* var. *murmanensis* may represent young ones of *C. rhizopus*. As the material at my disposal is not ample enough to make out the question, the variety is provisionally maintained.

Two of the specimens of the Riksmuseum collection dredged in Kara Sea seem to agree, as to principal features, with the form described under the above-mentioned name. However, I will point out that the opening of the dorsal tubercle is directed to the left. The reproductive organs consist of many gonads on each side; the gonads are of the same structure as those of the other *Cnemidocarpae*: the testis and the ovary are not separated. Judging from the figures (1911, p. 62), the individuals reported by REDIKORZEW do not show any difference with regard to the above-mentioned organs. The above-mentioned author, however, has described them as follows: »Das Flimmerorgan ist ungemein gross, kreisförmig; die Öffnung nach rechts gewandt; —». »— die Ovarien sind schlauchförmig, je 5 auf jeder Seite; die drei oberen Schläuche sind sehr nahe an einander gestellt, die zwei unteren etwas kürzer und unter einem gewissen Winkel zu den ersteren. Beide unteren Ovarien rechts und links sind allseitig mit zahlreichen Hodenbläschen umgeben.» In the description of the variety the above-mentioned author seems thus to have made the same mistakes as in that of the species (cf. p. 32).

The third specimen dredged in Kara Sea has been referred, with some hesitation, to *Cnemidocarpa rhizopus* var. *murmanensis*. No complete description can be made from the individuaal in question, only the following notes, from which one might conclude that it is a form nearly related to *C. rhizopus*. The specimen is a young one. The body is elongated, cylindrical and covered with sand grains. The apertures are easily detected and situated near together on small elevations. At the posterior end the test tapers abruptly into a long root-like stalk. (Pl. 1, fig. 21.) Length, baso-apical, 4 mm, breadth, dorso-ventral, 2 mm.

With regard to the internal structure it should be noticed that the dorsal lamina is plain-edged, transversally folded — what might possibly depend on contraction of the tissues. The opening of the dorsal tubercle is C-shaped; the open interval is turned to the left. The stomach is short, with longitudinal folds in its wall. The margin of the anus has about 15 lobes. The folds of the branchial sac are in a rudimentary state. In the individual in question they are more reduced than in any other known *Cnemidocarpa*. They are substituted by longitudinal vessels which are distributed as follows:

right side: dorsal lamina—3—1—1—1—endostyle;
left side: » » —2—1—1—1— »

There is no intermediate vessel on the interspaces between the folds.

The gonads are only a little developed; their number could not be exactly stated. Numerous endocarps are scattered over the body-wall.

Cnemidocarpa cirrata n. sp.

Pl. 2, figs. 27—32.

Habitat:

West Greenland: Jacobshavn, 120 fms, clay with sand, a great number of specimens (August 14, 1870, ÖBERG).

East Greenland: Franz Joseph Fjord, at a distance of 1 km from the shore, 73° 16′ N—23° 15′ W, 28—36 m, clay with gravel and shells, 2 sps (August 29, 1899, Greenland Exp. 1899).

Spitzbergen: Wijde Bay, 40 fms, fine clay, 1 sp (July 1861); between Waigat Islands and Lovén's Mount, 100 fms, fine clay, 1 sp (August 15, 1861, MALMGREN).

Arctic North America: 72° 8′ N—74° 20′ W, 30—80 m, hard bottom and mud, 1 sp.

Description.

External Appearance.

The form of the body varies, being in some specimens nearly spherical in others ovate. (Pl. 2, figs. 27—28.) The apertures are situated near together, the atrial one is somewhat turned over to the dorsal side. In preserved specimens they are level with the surface of the test and small, but easily detected. The test is smooth, sometimes with faint, transverse folds. It is covered with firmly adhering small sand grains. From the posterior end of the body a rhizoid-like process with numerous fine threads projects; in but few individuals two such tuft-like processes were present. The colour of the test is grey, like grey clay.

It should be mentioned that, in an individual from Spitzbergen, the test is of brown colour, thick and provided with dense, fine wrinkles. On the inside a thin nacreous lining was observed.

The individuals are all of a small size; the largest specimens measure about 9 mm in length, baso-apical, and 6 mm in breadth, dorso-ventral.

Internal Structure.

The test is usually thin, not transparent. The mantle musculature is well developed. The oral tentacles are slender, of great length and different size. The

tentacles are sparingly arranged in one row. The dorsal lamina is plain- and not very broad. The dorsal tubercle is large; the opening is C-shaped the open interval is directed to the left. (Cf. Pl. 2, fig. 31.)

The branchial sac has rudimentary folds with a varying number of internal ngitudinal vessels. The average number may be as follows:

right side: dorsal lamina —4 to 7—1 to 2—3 to 5—1 to 2—endostyle;
left side: » » —3 to 5—1 to 2—3 to 5—1 to 2— »

In the interspaces between the folds, no well-developed intermediate vessels ve been observed; only rudiments of two such vessels have been found in the upper rt of the branchial sac of a few specimens.

The external structure of the alimentary canal is shown from fig. 30. The sophagus is rather long. The stomach is short and straight, well marked off from sophagus and the intestine. It is provided with about 15 longitudinal folds sh tissue from a raphe. The intestine forms rather a short, rounded loop. The um arises along almost right angle and the margin of the anus has 18—20 small

The gonads are few in number; they are usually 3 on the right side, and 2 on the left. On the left side they are sometimes 4 in number, in which case or two are rudimentary (Pl. 2, fig. 29). They are short and polycarp-like, ar- d in a row on each side of the body-wall. The ovary is situated on the inner of the gonad and the testis on the outer side. When well-developed, part of testis might be visible even on the inner free side of the gonad. (Cf. Pl. 2, 30.) As appears from fig. 32 the male glands are only six in number; they ht be more or less lobed. The vasa efferentia are as many. The vas deferens ns beside the aperture of the oviduct. Like the sperm-duct the oviduct is very rt. The openings of the gonads are directed towards the atrial siphon.

Remarks on the Genus Cnemidocarpa.

The species included in this genus are characterized by a few to many elon- ted, hermaphrodite gonads, regularly arranged on each side of the body. The al tentacles are placed in a single row at the base of the velum. As regards the nature of the branchial sac two groups are to be distinguished: one is distinguished well developed branchial folds, in the other the branchial folds are more or reduced and substituted by groups of longitudinal vessels. In the collections amined only one species is to be referred to the first-mentioned group: *C. finmarkiensis*. The second group comprises *C. mortenseni*, *C. rhizopus*, *C. mollispina*, *C. serrata* and *C. mollis* STIMPSON. The latter has been reported from the east coast of North America under different names (*Glandula mollis*, *G. arenicola*, *Tethyum arenicolum*) and is probably synonymous with *Styela vestita* STANGER of the British ast. This group may conveniently be named the rhizopus group, the forms here nted of agreeing as to principal characters with the species *rhizopus*. If we com-

pare those species it is evident that they are closely allied to each other and not sharply distinct. It seems possible that further investigations based on a more ample material might prove some of them to be local species only.

According to VAN NAME and HARTMEYER *C. mollis* STIMPSON is no doubt identical with *Styela vestita*, re-described by ALDER a. HANCOCK and occurring off the British coast. Judging from the descriptions of the species, *C. mollis* and *C. mortenseni* are both distinguished by the presence of intermediate longitudinal vessels; in the former there are, on each side, three well-developed branchial folds, in the latter there is only one. In the other species the branchial folds are all more or less rudimentary and the intermediate vessels are reduced. In *C. cirrata* rudiments of intermediate vessels have been observed. The number of the gonads is reduced in both *C. cirrata* and *C. mortenseni;* but the alimentary canal of the former agrees with that of *C. mollis* and *C. mollispina*, the stomach being short and straight and the intestine of moderate length. In C. *mortenseni* the alimentary canal, characterized by an elongated stomach and intestine of great length, shows resemblance to that of *C. rhizopus.* It should be noticed that the last-mentioned species has not hitherto been reported from West Greenland where *C. cirrata* seems to be abundant.

As to the external aspect *C. mollispina* resembles certain Molguloid Ascidians being of almost globular form and covered with sand (cf. Pl. 2, fig. 23). The test of that single specimen of the collection shows a peculiar structure, being provided with soft spine-like processes which are clearly shown from fig. 23. As regards the internal anatomy the reduction of the number of the endocarps is noticeable. In all other members of the group here examined there are a great number of endocarps scattered over the inner surface of the body-wall. In *C. mollispina* there are only two, one on each side. (Pl. 2, fig. 24.) Even the dorsal tubercle of the species in question differs from that of the other *Cnemidocarpae;* in the former it is elongated and narrow, the opening is somewhat curved, in the latter it is large, of a rounded form and the opening is more or less circular. (Pl. 2, fig. 25.) From a comparison between figs. 22 & 24 it appears that the alimentary canal of *C. mollispina* is of quite another structure than that of *C. rhizopus;* its resemblance to that of *C. cirrata* is evident.

The gonads of the three last-mentioned species show different details in their structure, though they agree in principal.

The polycarp-like aspect of the gonads of *C. cirrata* should be noticed. (Pl. 2, fig. 29 & 32.)

Cynthia villosa, described by KUPFFER (1874) and re-described by HARTMEYER 1903 (1. c.) under the name of *Styela villosa*, belongs to the rhizopus group. Whether it is synonymous with *C. rhizopus* — which seems most probable — cannot be decided without a re-examination of the specimen in question. If this would prove to be the case, the name of *C. rhizopus* must perhaps be changed.

Styela sabulifera RITTER (1913) from the Bering Sea should be included in the genus *Cnemidocarpa;* it is closely related to *C. rhizopus.* Judging from the description, there are no principal differences between the two species. The branchial folds

seem to be less rudimentary and the longitudinal vessels of the folds are more numerous in the form from the Bering Sea, but, as has been pointed out above, the number of the vessels is not constant in *C. rhizopus*.

The *rhizopus* group is of wide distribution in the Arctic region and the eastern and western Boreoarctic mixture zones, and its range even extends into the Boreal region comprising, eastward, the North Sea waters and, westward on the American Atlantic coast, the Long Island Sound. In the Arctic region species of this group are found from the Arctic N. America in the west to the Arctic Sea of Siberia in the east, or, if *Styela sabulifera* from the Bering Sea is included, it is circumpolar.

The different species are distributed as follows: *C. rhizopus* occurs abundantly off Novaja Zemlja and is also reported from the Arctic Sea of Siberia, West Spitzbergen, East Greenland, the Murman coast and Cattegat, where it has been dredged once and in only three specimens. This species has not been reported from West Greenland, where the group is represented by *C. cirrata* of which a few individuals have been collected also off East Greenland, West Spitzbergen and the Arctic North America. On the east coast of N. America the species *C. mollis* and *C. mortenseni* occur. The former has been dredged from the Gulf of St. Lawrence to Long Island Sound and, moreover, off the British coast: Northumberland and Durham, *Styela vestita* having proved to be an identical form. Of the latter, i. e. *C. mortenseni*, only four specimens have yet been collected, viz. three specimens from the east coast of N. America 42° 30′ 15″ N—70° 38′ W and 44° 26′ N—62° 10′ W, and one specimen from Skagerrack 58° 6′ N—9° E (»Norska rännan»). Of *C. mollispina* a single specimen is known from the Kola Peninsula.

Polycarpa libera KIAER 1893.

Pl. 2, fig. 33.

Syn. *Glandula tubularis*, M. SARS 1858.
Polycarpa comata, BONNEVIE 1896.
Pandocia libera, HARTMEYER 1909.

Habitat:

West coast of Sweden: Bohuslän, Gullmarn (July-August, 1918—1919, ÄRNBÄCK): Spättan, 30 m, 7 sps, bottom, clay; Smedjan-Flatholmen, 30—40 m, many sps; Smedjan, 8 sps. — Sörgrundsberget, S. W. of Hållö, depth, about 10 m, 3 sps (August 1, 1913). — N. of Vinga fyr, 16—42 m, 2 sps (August 1, 1906, T. LAGERBERG). — Styrsö, 20 fms, 1 sp (July 6, 1869, OLSSON). — Väderöarna, 10 fms, sand and rocks, 1 sp (1862). — W. of Nord-Koster, 12—18 fms, rocks, 1 sp (August 4, 1865). — Kosterrännan, E. of Ramsholmen clay, depth, about 100 fms, 1 sp (July 24, 1919, M. AURIVILLIUS).

Cattegat: Kummelbanken, 1 sp. (1900, T. TULLBERG).

East Greenland: Off Murray's Island, 71° 33′ N—21° 30′ W, 200 m, mud and sand, 1 sp (July 28, 1899, Greenland Exp. 1899).

General Distribution.

P. libera has been collected, though a few specimens only, on the coast of Norway: in Komagefjord, Öxfjord, off Vadsö (cf. KIAER 1893); at Gaasvaer off Tromsö, 300 m; in Porsangerfjord; in Vestfjord off Bodö, 105—160 m; W. of Aalesund; in the North Sea; N. of the Faroe Islands (BJERKAN 1905, 1908); in the North Atlantic, depth, 836 m (BONNEVIE 1896). One specimen has been reported from Spitzbergen: King Charles Land (HARTMEYER 1903), and 10 specimens have been dredged off West Taimyr, Nansen Island, 18—30 m (REDIKORZEW 1910).

Remarks.

If we compare the descriptions of the following four species of *Polycarpa: P. libera* KIAER, *P. comata* ALDER, *P. pusilla* HERDMAN, *P. fibrosa* STIMPSON, it is evident that they are closely allied forms and it seems dubious whether they are distinct species.

According to HARTMEYER (1903, p. 228), *P. comata* and *P. libera* cannot be regarded as synonymous species, owing to differences in the internal structure: the number of tentacles, the dorsal tubercle, the branchial sac, and the alimentary canal do not agree. The geographical distribution, too, is different, *P. comata* being confined to the coasts of western Europe. MICHAELSEN, however, who has found an intermediate individual from the coast of Portugal, has united the two species under the name of *P. comata* (1911). Later (1912) the first-mentioned author has discussed the difficult question again without answering it definitively. VAN NAME (1912) is of opinion that it is not unlikely that *P. libera* KIAER is identical with *P. fibrosa* which occurs on the north-eastern coast of N. America from the Gulf of St. Lawrence to Nantucket.

As I have not had any opportunity of re-examining and comparing the species, the question must be left open. It should only be pointed out that, if the three species in question would prove to be identical, which seems most probable, the name should be *P. fibrosa* which, as far as I can see, has priority, having been used by STIMPSON in 1852.

Only a few specimens of *Polycarpa libera* are at present known from the Arctic region and they have been dredged at three localities: West Taimyr, King Charles Land and East Greenland. Its distribution extends, along the north-western coast of Norway, into the Boreal region where it is not rarely met with off the coast of Bohuslän especially in Gullmarfjorden. If it would prove to be identical with *P. fibrosa* and *P. comata* its range within those southern zones should be wider, comprising the coasts of western Europe, where *P. comata* occurs, and the north-eastern coast of N. America where *P. fibrosa* is abundant.

Polycarpa libera is generally found on bottoms of clay or on muddy bottom with sand and stones. In Norway and the N. Atlantic it has been dredged from considerable depth, from 60 down to 836 m, in the Arctic Sea of Siberia from more

shallow water, 18—30 m (Cf. REDIKORZEW, l. c.), *P. fibrosa* of the American Atlantic coast from 30 fms. or less to at least 134 fms (VAN NAME 1912).

In Bohuslän, this species has been collected along with *Eugyra arenosa*, bottom, clay (Gullmarn). Depth various, from a few fathoms to 100 fathoms. The largest individuals from Gullmarn measure 14 mm in height (baso-apical), and 12 mm in broadth (dorso-ventral).

Polycarpa pusilla HERDMAN 1884.

Syn. *Pandocia pusilla* HARTMEYER 1909, 1912.

Distribution: The Atlantic, 35° 56′ N—7° 6′ W, 477 fms, 1 sp; D:o off Valentia, 110 fms, a great number of sps (Cf. HERDMAN 1884). — Norway, Trondhjemsfjord, Rödberg, 830—1,000 m (KIAER 1896). — D:o off Tautra, ca. 200 m (HARTMEYER 1912).

Polycarpa pomaria SAVIGNY 1816.

Syn. *Cynthia pomaria*, SAVIGNY 1816.
» *tuberosa*, SARS 1870.
Polycarpa varians, TRAUSTEDT 1883.
Pandocia pomaria, HARTMEYER in BRONN's Tierreich.

Habitat:

West coast of Sweden: Bohuslän, Gullmarn, where a great number of specimens has been dredged at various localities: Humlesäcken, Kristineberg, Alsbäck, Skårbergen (1879 THÉEL, 1882 THÉEL, 1885, 1893 FLODERUS, 1894, 1897). — Koster-fjorden, 20—200 fms, many sps (1865, 1879, 1890, 1895). — D:o 12—40 fms, clay and stones, 5 sps (Gunhild Exp. 1877, BOVALLIUS a. THÉEL). — Koster, E. of Hamnholmen, about 100 m, 4 sps (September 22—27, 1910). — Väderöarna, 60 fms, many sps (1862, 1869). — D:o 40—50 fms, corals 4 sps (July 25, 1877, BOVALLIUS a. THÉEL).

Cattegat: many sps.

North Sea: Jutland Reef, 50—200 fms, numerous clusters of specimens (1874—1878, 1881—1882).

Norway: Svinesund, 30—70 fms, stones, 2 sps. — N. W. of Egersund, 50—60 fms, 1 sp (October 22, 1872). — Jaederen, 100—170 fms, numerous clusters of specimens (1874, 1877). — N. W. of Bergen, 60—200 fms, numerous clusters of specimens (1874—1878, 1880, 1882). — Trondhjemsfjord, 20—400 m, many sps (June, 1917, E. PETERSON, Mus. G.).

Spitzbergen: Ice Fjord, Advent Bay, clay, 4 sps (Spb. Exp. 1861).

General Distribution.

Polycarpa pomaria is common along the south and west coasts of Norway to Lofoten, often in great masses along with *Ascidia obliqua*, on rocky bottom, depth from 100—200 m (KIAER 1893). It has been collected in several places: Dröbak,

50—120 fms; Moster, 9—15 fms; Hardangerfjord; Bergen, 55—200 m; Trondhjemsfjord, etc. (cf. HARTMEYER 1903, GRIEG 1913). It is rare on the Norwegian north coast, where it has been collected at Risö off Tromsö, 10—12 m; Helgeland, Traenenhavet, 260 m (BJERKAN 1908), in the Atlantic, 70° 55′ N—18° 38′ E, 196 m (BONNEVIE 1896). It is also sparingly met with in the White Sea, off the Murman coast and Spitzbergen (REDIKORZEW 1906). In southern zones *P. pomaria* has a wider distribution and occurs abundantly. It has been reported from the Faroe Islands, Ireland, the British coasts, Denmark, Sweden, the coast of France and the Mediterranean (TRAUSTEDT 1880, HARTMEYER 1903, 1912, CARLSSON 1918).

Remarks.

P. pomaria is widely distributed and has its centre of distribution in southern regions, being common in the Mediterranean and along the coasts of northwestern Europe. In the eastern Boreal region it is abundant in the North Sea, along the south and west coasts of Norway, occurring in clusters with masses of specimens, and common in adjacent waters, off the coast of Bohuslän in Gullmarfjorden. It ought to be noticed that it is rather sparingly met with off the Danish Islands. In the Boreoarctic mixture zone this species is not common, rather rare, and in the Arctic region only two localities off Spitzbergen are known for certain yet.[1] It is remarkable that *P. pomaria* is unknown from the American coast.

This species often occurs in clusters, on rocky bottom or on bottom of stones with gravel, sometimes clay with stones. It is often found in deep water, down to 450 m.

Dendrodoa grossularia VAN BENEDEN 1846.

Pl. 2, figs. 34—38.

Syn. *Cynthia grossularia*, SARS 1870.
Styela » HERDMAN 1884.
» » KIAER 1893, 1896.
Styelopsis » TRAUSTEDT 1882.
» » HARTMEYER 1903.

Habitat:

West coast of Sweden: Bohuslän, Gullmarn, without definite locality, a great number of specimens (1871 LOVÉN, 1885, 1893 FLODERUS, 1894 C. AURIVILLIUS); Humlesäcken, 60 fms, many sps; Strumpeskagen, 3 sps (July 17, 1876, BOVALLIUS); Strömmarna, many sps (July, 1894, FLODERUS); Skårberget 100 fms, clay, 8 sps; D:o 60—70 fms, many sps (August 1884, July 1890, C. AURIVILLIUS); Alsbäck-Skårberget, 70—80 fms, many sps (August 1890, CARLGREN). — Saltkällefjord, 8 sps

[1] SWEDERUS (l. c. p. 106) has reported 3 specimens from the Bering Sea, Cape Nunamo, depth 4—6 fms, a statement which cannot be verified, the species not being represented in the collections of the Vega Expedition in the Swedish Riksmuseum.

(August, 1894, C. AURIVILLIUS). — Kalvöfjord, Vindö, 1 sps (September 2, 1912, Zool. Stat.). — Styrsö, 20 fms, 2 sps (July 6, 1869, OLSSON). — Lindö, 15—30 fms, 1 sp (July 13, 1869, OLSSON). — Väderöarna, 10—80 fms, various bottoms: rocks, sand, clay, many sps (1869 OLSSON; Gunhild Exp. 1877, BOVALLIUS a. THÉEL; 1892 FLODERUS). — Kosterfjord, many sps, generally attached to *Polycarpa pomaria*, bottom, clay, depth, 40—125 fms (1865, 1877, 1890, 1895, 1910). — Halland, Laholmsbukten, 11 fms, shells and algae, 3 sps (June 13, 1903, E. LÖNNBERG); Kungsbackafjorden, 15—25 m, 1 sp (1911, Zool. Stat.). — Skåne, Landskrona—Malmö, 6—9 fms, clay and stones with algae, many sps (July 22, 1878, Gunhild Exp. 1878, THÉEL a. TRYBOM). — Torekov—Halland's Väderö, 8 fms, many small specimens, attached to *Fucus* (July 7, 1902, E. LÖNNBERG); Väderö fyr — Höghalla udde, 8—10 fms, algae, many sps (July 7, 16, 1902, E. LÖNNBERG).

Norway: Jaederen, 100—170 fms, Svinesund, 30—70 fms, many specimens, attached to *Polycarpa pomaria*.

Kara Sea: 74° 6′ N—58° 34′ E, 5 fms, algae, 1 sp; D:o 73° 34′ N—57° 56′ E, 40—50 fms, clay, 1 sp (August 1875, STUXBERG a. THÉEL).

Novaja Zemlja: Matotchkin Shar, at Rossmyslow's winter quarter, 15 fms, clay, Lithothamnion, many sps (Nordenskiöld's Exp. 1876).

Spitzbergen: without definite locality, 4 sps (Spb. Exp. 1868). — Kobbe Bay, 5 sps. — Danes Gat, 20 fms, sand and stones, 3 sps (1861, I. A. MALMGREN). — Rocherche Bay, 90 m, stones, 1 sp (July 4, 1898, Spb. Exp. 1898).

Beeren Island—Hope Island: 75° 49′ N—24° 25′ E, 80 m, rocks, 1 sp (June 1898, Spb. Exp. 1898).

Banks of Newfoundland: 45° 53′ N—51° 56′ W, 50 fms, stones and shells, 1 sp (August 16, 1871, Ingegerd a. Gladan Exp. J. LINDAHL).

Davis Strait: 63° 35′ N—52° 57′ W., 43 fms, sand and shells, 1 sp (June 9, 1871, Ingegerd a. Gladan Exp. J. LINDAHL).

General Distribution.

Dendrodoa grossularia is a widely distributed species. In Norway it is common on the south and west coasts, on shells, stones and sea weed, depth about 60 m (KJAER 1893); on the north coast it has been collected in Tromsösund, 20—95 m, Ramfjord, 55—130 m, Kongsfjord, 25—80 m (BJERKAN 1908). It has been reported from the west coast of Sweden (CARLSSON 1918), Skagerrack (HARTMEYER 1912); the coasts of Denmark, where it is abundant; the western part of the Baltic Sea: along the coast of Sleswig—Holstein and northern Germany to Warnemünde eastward, depth 2—30 m; Great Britain and Ireland, Belgium and France, Iceland and the Faroe Islands (TRAUSTEDT 1880). In the Arctic Sea it has been sparingly found off W. Greenland, Jan Mayen; off the Murman coast (REDIKORZEW 1906), in the White Sea and at Spitzbergen. (Cf. HARTMEYER 1903, 1912.) The species also occurs on the east coast of North America (VAN NAME 1912), and, according to RITTER (1913), it has been dredged in Bering Sea, according to BJERKAN (1911) in Arctic N. America.

Remarks.

The genus *Dendrodoa* has been divided into two groups, the one comprises species having an unbranched gonad, the other includes species having a branched gonad. Only two species belong to the first-mentioned group, *D. uniplicata* BONNEVIE and *D. grossularia* VAN BENEDEN. *D. uniplicata* is a highly interesting form which essentially differs from the other members of that genus. It is not represented in the collections of the Swedish Riksmuseum.

As to the species *D. carnea* AGASSIZ which has been re-described by VAN NAME (1912), it seems most probable that it is a form occurring within the range of variation of *D. grossularia*. This supposition seems to be supported by the author's own words, according to which specimens of *D. grossularia* »agree in practically all characters, external and internal, with the species last described (*D. carnea*), but differ in having a much greater number of internal longitudinal vessels in the branchial sac» (l. c. p. 588). From previous literature on the subject it appears that the number of the internal longitudinal vessels is liable to variation; it often depends on the age of the individual, on the occurrence as solitary or aggregated form, or on other circumstances, why it is not to be considered as a valuable character in distinguishing species from each other.

Dendrodoa grossularia has long been known under the name of *Styelopsis*, a name which has lately been changed (1912). It represents a well defined group. Many authors are of opinion that it may be regarded as a sub-genus and the name *Styelopsis* retained for it. Between *D. grossularia* and the other *Dendrodoae* — *D. uniplicata* excepted — there are, however, several points of agreement making the limitations almost seeming. The features peculiar to the genus *Dendrodoa* and distinguishing it from the other *Styelids* are present also in *D. grossularia*. The gonad is only one in number, placed on the right side, the oviduct is directed ventrally. — Branched or unbranched gonad can hardly be regarded as a character of value. — The male glands lie between the ovary and the body-wall; when well-developed they form, in *D. grossularia*, irregular masses (Pl. 2, fig. 38). The vasa efferentia pass around on the free side of the ovary and unite there, forming numerous short ducts or openings (cf. Pl. 3, fig. 44). In other *Styelids* they usually form a vas deferens running along the ovary and opening at the end of the gonad.

Like many *Dendrodoae* the species *grossularia* is distinguished by the reduction of the folds and vessels of the branchial sac. In this respect it proves to be a highly variable form. The individuals described as *D. carnea* (l. c.) having only one fold on the right side and none on the left and resp. 4 and 7 vessels on each side, seem to represent one extreme, specimens like those described by SELYS-LONGCHAMPS (1916—1917) represent the other; between them there are many intermediates. The last-mentioned author has observed that, in well-developed specimens of the aggregated type, collected off Roscoff, 2 symmetrical, real folds, one on each side, often occur; that on the right side is always more developed than that on

the left. Moreover, rudiments of one or two other folds have been observed in some individuals, on one side or on both sides. According to him, the development of the branchial folds has a relation to the age of the individual: »On trouverait donc chez *Styelopsis*, suivant l'âge des individus, suivant les variations des individus ou des variétés, toutes les transitions entre le manque total des replis et la présence d'au moins un repli vrai de chaque côté» (l. c. p. 187).

In well-developed specimens from Gullmarn, Bohuslän, one fold is present on the right side, none on the left, and the longitudinal vessels are arranged in groups, each group comprising 3—5 longitudinal vessels.

Even as regards the external appearance *D. grossularia* proves to be a highly variable species. This is clearly shown from figs. 34—37, illustrating 4 specimens, dredged at the same time and at the same locality, Kobbe Bay, Spitzbergen. Fig. 34 shows an individual of a high and rounded, almost globular body-form, having the test almost smooth and the apertures level with the surface. Fig. 37 shows an individual of quite another type, having the body greatly flattened, dorso-ventrally, and the test coarsely wrinkled. On figs. 35—36 specimens with a more or less wrinkled test and prominent apertures are shown.

D. grossularia has its centre of distribution in the Boreal region and is common along the coasts of north-western Europe, especially on the coasts of the North Sea waters; it is abundant in the Danish sounds and on the Swedish west coast in Gullmarfjorden; it also occurs in the south-western part of the Baltic Sea. In the eastern Boreoarctic mixture zone it is sparingly met with, but it is common on the American Atlantic coast in many places. In the Arctic region it has been recorded from several localities, but in few specimens.

D. grossularia occurs both solitary and aggregated into groups. It inhabits bottoms of clay or sand with stones, shells and algae. It is often attached to stones and shells and other Ascidians especially *Polycarpa pomaria*. It occurs in shallow water as well as in water of considerable depth, down to 660 m.

Dendrodoa aggregata Rathke 1806.

Pl. 2, figs. 39—40. Pl. 3, figs. 43—44.

Syn. *Cynthia aggregata*, Sars 1858.
Dendrodoa glandaria, Herdman 1891.
Styela aggregata, Kiaer 1893, 1896.

Habitat.

Norway: Finmarken, without definite locality, 4 sps (Lovén). — D:o Hammerfest, 30 fms, sandy bottom, 8 sps. — D:o, Grötsund, 30—70 fms, clay and stones, a great number of specimens; in the neighbourhood of Tromsö, 1 sp; D:o off Karlsö 50 fms, 5 sps (October 1861, Goës a. Malmgren). — D:o Karlsö, 30—40 fms, many sps (June 13, 1864, I. A. Malmgren).

Iceland: Berufjord, 15—30 fms, a great number of specimens (Torell).

Greenland: no definite locality, 4 sps. West Greenland: Pröven, 16—40 fms, rocks, 4 sps (TORELL). — Egedesminde, 80—100 fms, stony bottom, many sps (July 16, 1870, ÖBERG). — D:o 65° 15′ N—53° 30′ W, 75 fms, stones, 8 sps; Baffins Bay, 75° 26′ N—67° 27′ W, 260 fms, hard clay, 1 sp (Sofia Exp. 1883). — The Ingegerd & Gladan Expedition (June—August, 1871, J. LINDAHL): Disco, Nordfjord, 27 fms, hard dark-grey clay, 5 sps; Davis Strait, 63° 35′ N—52° 57′ W, 43 fms, sand and shells, many sps; D:o 65° 11′ N—53° 33′ W, 48 fms, green clay 4 sps; D:o 63° 47′ N—52° 26′ W, 35 fms, shells, 4 sps; Baffins Bay, 69° 16′ N—58° 8′ W, 183 fms, clay and stones, 1 sp; D:o 68° 8′ N—58° 47′ W, 169 fms, clay and stones, 1 sp; D:o 68° 14′ N—54° 7′ W, 131 fms, clay with sand and stones, 8 sps.

Arctic North America: 76° 9′ N—68° 28′ W, 30—45 m, mud, many sps (July 5, 1894); 72° 8′ N—74° 20′ W, 30—80 m, muddy bottom, 1 sp (September 11, 1894); 71° 57′ N—73° 56′ W, 9—36 m, muddy bottom, 1 sp (September 14—15, 1894, E. NILSON).

Spitzbergen: without definite locality, a great many clusters of specimens, along with *Boltenia echinata* and *Styela rustica*, brought back by LOVÉN and the Spitzbergen Expedition 1868. — Bel Sound, 30—40 fms, stones and zoophytes, 1 sp. — Spb. Exp. 1861 (I. A. MALMGREN): Hakluyts Headland, 12—30 fms, stones and algae, 1 sp (May, 1861); Danes Gat, 20 fms, sand and stones, many sps (1861); Verlegen Hook, 80° 10′ N—17° E, 70—80 fms, stones, 1 sp (June, 1861); D:o 80° N—17°,5 E, 8—20 fms, stones, 2 sps; Treurenburg Bay, 6—30 fms, stones and clay, 1 sp (June, 1861); Waigat Islands, 79° 20′ N—19° E, 30 fms, rocks, 6 sps; D:o 60 fms, clay, 4 sps (August, 1861); Smeerenburg Bay, 0—1 fms, stones and sand with algae, 4 sps (August, 1861). — Sbp. Exp. 1872—73: without definite locality, a great many specimens along with *Boltenia echinata* and other *Styelids;* Hinlopen Strait, Duym Point, 36 fms, rocks, 7 sps (July 6, 1873); Foul Bay, 10—25 fms, 5 sps (August 23, 1872); Norway Islands, 10—25 fms, clay, a great many species (August, 1872).

Beeren Island: 74° 21′ N—19° 15′ E, 14—20 m, stones and algae, many sps. along with *Synoicum turgens* (June 15—17, 1898, Spb. Exp.). — Beeren Island—Hope Island, 75° 49′ N—24° 25′ E, 80 m, rocks, 1 sp (June 21, 1898).

Bering Sea: 66° 10′ N—169° 45′ W, 24 fms, sand and shells, 2 sps (July 20, 1879, Vega Exp.).

General Distribution.

Dendrodoa aggregata f. *typica* is common in Norway at Lofoten and along the whole Finmarken, but has not been found south of Lofoten; it occurs in clusters from 20—30 full-grown individuals, stony bottom, depth 40—80 m (KIAER 1893). According to BJERKAN it has been collected in Tromsösund, 75—95 m; Gjesvaer; Kjöllefjord, 50—70 m; Kongsfjord, 60—90 m; Nordkap, 250 m; Baadsfjord, 65 m. HARTMEYER (1912) reports it from the Faroe Islands, Nolsö, about 100 fms. It is most widely distributed in the Arctic Ocean; it is met with off the

Murman coast, Novaja Zemlja, in Kara Sea and Barents Sea; it is abundant off Spitzbergen and common off Iceland and Greenland. Westward it has been reported from the Arctic American Archipelago and from the east coast of N. America from Labrador to Vineyard Sound, 10 fms (HARTMEYER 1903, REDIKORZEW 1906, VAN NAME 1912).

This species occurs both solitary and aggregated into clusters, consisting of numerous individuals, often covered with young ones. Usual bottom, stones, but also clay and gravel, sometimes sand. Depth, down to 550 m.

Dendrodoa aggregata var. adolphi KUPFFER 1874.

Distribution: East Greenland, Shannon Island (KUPFFER 1874). — North-eastern Pacific: Cape Etolin, Nunivak, Alaska, 8 fms, 150 sps (RITTER 1913).

Dendrodoa aggregata var. cylindrica BJERKAN 1911.

Distribution: Arctic North America, Ellesmere Land, Landsend Bay, depth about 35 m, 2 sps (BJERKAN 1911).

Dendrodoa aggregata var. groenlandica n. var.

Pl. 2, fig. 42. Pl. 3, figs. 45—46.

Habitat:

West Greenland: Sukkertoppen, 60 fms, clay, 8 sps (September 24, 1870).

Dendrodoa aggregata var. tuberculata RITTER 1899.

Distribution: North-eastern Pacific (RITTER 1899, 1913).

Dendrodoa aggregata var. pulchella VERRILL 1871.

Pl. 2, fig. 41.

Syn. *Cynthia pulchella,* VERRILL 1871.
Dendrodoa kükenthali, HARTMEYER 1899.

Habitat:

Spitzbergen: Horn Sound, 40—100 fms, 2 sps. — Spb. Exp. 1861 (I. A. MALMGREN): Kings Bay, 25 fms, clay with red sand, 2 sps; Danes Gat, 20 fms, sand and stones, 1 sp; Hakluyts Headland, 12—30 fms, stones and algae, 3 sps (May, 1861); Fosters Islands, 40 fms, sand, 5 sps (August 3, 1861); Waigat Islands, 30 fms, rocks, 10 sps, D:o 60—80 fms, clay, many sps (August, 1861). — Spb. Exp. 1868: Lomme Bay, 25—40 fms, stones and clay, 1 sp (September 10, 1868); Lovén's Mount, 36 fms, stones and clay, 1 sp (September 11, 1868). — Norway Island, 10 fms, clay, 1 sp (Spb. Exp. 1872—73).

Banks of Newfoundland, 45° 53′ N—51° 56′ W, 50 fms, stones and shells, 1 sp, D:o 46° 6′ N—52° 3′ W, 46 fms, sand, stones and shells, 1 sp (August 16, 1871, Ingegerd and Gladan Exp.).

General Distribution.

As the variety *pulchella*, described by VAN NAME (l. c.), seems to be identical with *Dendrodoa kükenthali*, the range of this variety should comprise the Arctic Ocean from Spitzbergen and the Murman coast to the New Siberian Islands (HARTMEYER 1903, REDIKORZEW 1910), and the east coast of North America (VAN NAME 1912).

It prefers a stony or shelly bottom, but is also found on clay with stones and sand. Depth from 12—100 fms.

Dendrodoa aggregata var. subpedunculata RITTER 1899.

Distribution: North-eastern Pacific (RITTER 1899, 1913).

Dendrodoa lineata TRAUSTEDT 1880.

Syn. *Styela lineata*, TRAUSTEDT 1880.

Habitat:

Greenland: without definite locality, 7 sps.

Spitzbergen: Horn Sound, 40—100 fms, 1 sp; D:o without definite locality, 3 sps. — Spb. Exp. 1861 (May—September, I. A. MALMGREN): Hakluyts Headland, 12—30 fms, stones and algae, 2 sps; Amsterdam Island, 16—25 fms, sand and clay, 2 sps; Law Island, 16 fms, stones. 1 sp; Waigat Islands, 60 fms, clay, 1 sp. — Stor Fjord, 5—20 fms, stones and clay (August 23, 1864, I. A. MALMGREN). — Lomme Bay, 25—30 fms, clay (September 9, 1868).

Arctic Sea of Siberia: N. of the winter harbour of the Vega, Pitlekaj, 10—14 fms, sand and stones, 1 sp (July 5, 1879, Vega Exp.).

General Distribution.

Dendrodoa lineata has been dredged off West Spitzbergen, between Beeren Island and Hope Island and at the Murman coast. (TRAUSTEDT 1880, HARTMEYER 1903, REDIKORZEW 1906, 1908).

It prefers stony bottom, but has also been found on clay. Depth, from 5 to 100 fms.

Dendrodoa uniplicata BONNEVIE 1896.

Syn. *Styela uniplicata*, BONNEVIE 1896.
Distribution: West Spitzbergen, 78° 2′ N—9° 25′ E, depth 761 m.

Dendrodoa uniplicata var. minuta BONNEVIE 1896.

Syn. *Styela uniplicata* var. *minuta*, BONNEVIE 1896.

Distribution: West Spitzbergen, 78° 2′ N—9° 25′ E (BONNEVIE 1896). — Novaja Zemlja, Murman coast (METSCHNIKOWSKY 1906).

Remarks.

The subgroup of *Dendrodoa* characterized by a branched gonad has, by previous authors, been divided into several species: *aggregata*, *lineata*, *adolphi*, *cylindrica*, *hakenthali*, *tuberculata*, *subpedunculata*. Of late the validity of the characters distinguishing them, has been questioned, however, owing to the great variability of the individuals. »The genus Dendrodoa is one of those groups of organisms which the more it is studied . . . the more dubious become the boundary lines of the subgroups into which it may be divided.» (RITTER, 1913, p. 480.) In the present paper only two forms have been considered as distinct species: *D. aggregata* and *D. lineata*, the other forms have been treated as varieties of the species *aggregata*, comparative studies having proved that the characters used in distinguishing the species cannot be regarded as constant.

The divisions have, in most cases, been based on the number of the ovarian branches, the number of the intermediate longitudinal vessels of the branchial sac and the development of the branchial folds, the number of the tentacles, the condition of the external surface of the stomach, the external aspect of the test. With regard to the number of the ovarian branches it should be noticed that, in well developed specimens of *D. aggregata* forma *typica*, the usual number is five (Pl. 3, fig. 43), in young ones it is very often three. But there are also large individuals, typical in other respects, which have three or four ovarian branches and even from seven to nine.

RITTER has based the formation of the species *tuberculata* on the characters exhibited by the gonad having more than five branches, the stomach wall having longitudinal folds externally invisible, the surface of the test being regularly tuberculated and hard. Later (1913), having examined an extensive material of this form, this author has observed that the variation of the number of the ovarian branches »is so great as to deprive them of much classificatory value» (l. c. p. 483). If we compare the test of the two specimens of *D. aggregata* forma *typica*, illustrated by figs. 39 & 40, it will be evident that the test cannot offer any valuable species character, the tuberculation occurring also in the typical form. Though the surface of the test of *D. aggregata* usually is faintly wrinkled in longitudinal and transversal directions, or sometimes quite smooth, it is very often provided with rather coarse folds or wrinkles and even, as appears from fig. 40, with tubercles.

Having had occasion of examining specimens of *tuberculata* and *subpedunculata*, kindly lent me by Professor Dr. R. HARTMEYER, I can confirm the observation that, as seen from the external side, the longitudinal folds of the stomach-wall are invisible, at least in *tuberculata*. This difference is probably due to some differentiation

of the external layers of the stomach-wall and should be subject to a histological investigation. In most *Styelids*, at least in preserved specimens, the longitudinal folds are well visible, the external layers being thin and transparent; in *tuberculata* they seem to be of a greater thickness. Nevertheless this difference can hardly be regarded as a valuable species character, especially as — which will be shown in the following description of the variety *groenlandica* — an externally smooth stomach-wall occurs in other forms also.

RITTER's species *subpedunculata* was distinguished also by characters exhibited by the branchial sac, characters which, in all *Styelids*, generally seem to be of a relative value only. Even in individuals belonging to the typical form the number of the internal longitudinal vessels and the branchial folds show a very high degree of variability (cf. HARTMEYER l. c.). In young ones I have often found one single intermediate vessel, sometimes no such vessel, between some pair of folds.

In well-developed specimens the second and the fourth folds are very often reduced as compared with the two others; in young ones the difference is striking: I have observed, in a few cases, only three branchial folds on the left side, the second having been reduced. The retaining of *tuberculata* and *subpedunculata* as species is thus impossible, the internal features used in distinguishing them occurring within the range of variations of the forma *typica*.

HARTMEYER's species *kükenthali* should be characterized by a two- or three-branched gonad, the reduced number of vessels and folds of the branchial sac, the globular form of the body, thus, features of dubious value as far as this species is concerned. Moreover, those characters are often found in young ones of *aggregata*, why one might suppose that forms described under the name of *kükenthali* are young ones of the last-mentioned species. Or they might represent the solitary type of that species. *D. aggregata* occurs, as is known, both solitary and aggregated into groups and it is most probable that the two forms may differ in certain respects.

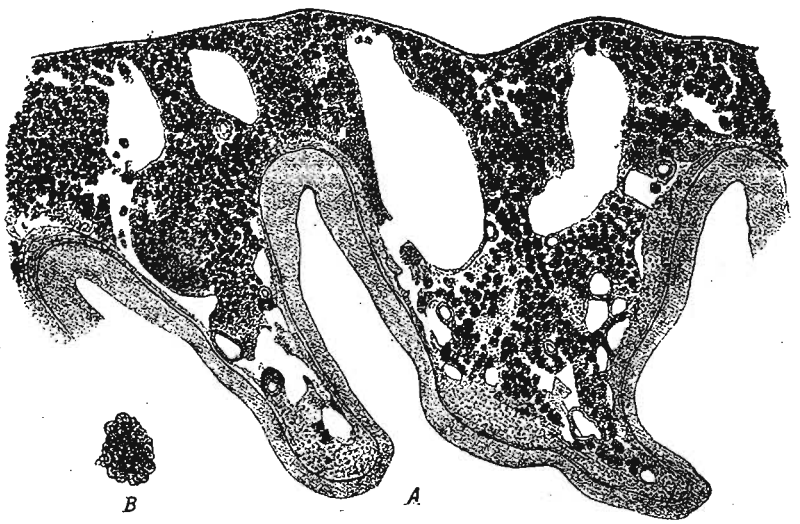
The variety *pulchella*, re-described by VAN NAME (l. c.), is no doubt identical with *D. kükenthali*, the different number of the intermediate vessels being the only known difference. As the name *pulchella* has priority, this name is used in the present paper.

According to RITTER (l. c. p. 485) the species *adolphi* is distinguished from *aggregata* by the greater number of tentacles, »a difference too great to be due to fluctuating variation». As is well known, the number of tentacles is subject to individual variation, and it has often been observed that they are of a less number in young individuals than in full-grown ones. It is thus evident that one cannot give much weight to this character for distinguishing a species. Other features regarded by the above-mentioned author as peculiar to this form, have been found again in the variable typical *aggregata*.

Judging from the description given by BJERKAN the species *cylindrica* seems to represent a young one of *aggregata*. The four-branched gonad, the condition of the branchial sac, the small number of the tentacles seem to support this view.

The form described in the present paper under the name of *groenlandica* re-

presents an interesting variety of *aggregata*. Already its external aspect is noticeable, the test being provided with strong, coarse wrinkles, preventing the apertures from being easily distinguished. (Pl. 2, fig. 42.) The branchial sac is of typical structure. The gonad is three-branched, the branches being long and irregularly curved (fig. 45). The structure of the *alimentary canal* is characteristic to that variety. As is shown from fig. 46 the intestine forms a wide S-shaped loop, the rectum is long and sinuous. The stomach is of considerable length, spindle-shaped, of liver-brown colour. Its external surface is quite smooth, numerous vessels are visible, ramifying



Text-fig. 4. *Dendrodoa aggregata* var. *groenlandica*.
A. Transverse section through the stomach-wall showing the crystals. ×80.
B. Group of crystals. ×450.

in its wall. (Cf. fig. 46.) Externally no longitudinal folds are visible, internally they are well-developed.

Text-fig. 4 represents a transverse section of the wall of the stomach, showing the folds internally and the smooth surface externally. When studying the section, one is struck by the presence of masses of small round structures of light-brown colour, crowded together and forming a thick layer around the whole stomach. As far as one can judge from this material, they seem to be spherical crystals of radial structure. They have not been observed in other forms of the species, but occur in all eight individuals representing the var. *groenlandica*. The individuals agree also in other respects.

They have been collected at Sukkertoppen, West Greenland, bottom, clay; depth, 60 fms.

Dendrodoa lineata has been distinguished by the absence of longitudinal vessels between the folds, four ovarian branches and wart-like processes of the test. The characters of both the internal and external structure having proved to be constant, the form *lineata* has been regarded, in the present paper, as a good species.

The forms of *Dendrodoa aggregata* here treated of inhabit almost exclusively

the Arctic and Boreoarctic zones of the Old and New worlds, only on the American east coast its range of distribution exceeds the southern boundary of the latter zone, specimens having been found as far southward as 41° N. lat. Eastward it has been collected as far as the Faroe Islands on the south, on the Norwegian coast not south of Lofoten. In the Arctic region this species is circumpolar being represented even in Bering Sea, and the American Archipelago; it is also represented on both the eastern and north-western coasts of N. America.

Fam. **Polyzoidae.**

Branchial sac with folds more or less developed, never more than 4, or without folds. Stigmata straight. Internal longitudinal vessels numerous or few. Tentacles simple. Alimentary canal placed alongside the branchial sac. Stomach distinctly marked off from the intestine, with longitudinal folds. A pyloric coecum usually present, well-developed. Reproduction by generative organs as well as by palleal budding. Reproductive organs of the most varying structure and shape, placed on one side or on both sides, within the body or on the external side of the body enclosed in a genital pouch projecting from the body-wall. A brood-pouch is sometimes present (known hitherto in one genus only). Apertures four-lobed, or without lobes, slit-like. Both apertures opening independently on the surface. Test cartilaginous or internally gelatinous with a cartilaginous or leathery external layer. Individuals forming colonies without systems and without common cloacal apertures.

Synopsis of genera and species.

Branchial sac without folds, with 4 internal longitudinal vessels on each side. Reproductive organs on one side, the left one, forming a hermaphroditic structure enclosed in an outgrowth of the body-wall and situated on the external side of the body. A brood-pouch develops to receive the embryos:

Kükenthalia HARTMEYER 1903.

Dorsal tubercle cup-chaped. Stomach short, rounded, with 11 longitudinal folds. Pyloric coecum elongated, curved. Margin of anus plain. Apertures four-lobed. The zooids form one layer. Test internally gelatinous, externally leathery. Colonies small, rounded and massive, attached by a narrow base.

K. borealis GOTTSCHALDT 1894.
Pl. 3, figs. 47—56.

Geographical and bathymetrical distribution and general observations.

Kükenthalia borealis GOTTSCHALDT 1894.

Pl. 3, figs. 47—56. Text-figs. 5—6.

Syn. *Goodsiria borealis*, GOTTSCHALDT 1894.
» *coccinia*, BONNEVIE 1896.

Habitat:

West Greenland: Davis Strait, 65° 11′ N—53° 33′ W, 48 fms, green clay, 4 colonies (June 13, 1871); Baffins Bay, 68° 14′ N—54° 7′ W, 131 fms, clay with sand and stones, 1 colony (July 27, 1871, Ingegerd & Gladan Exp., J. LINDAHL). — D:o 65° 16′ N—53° 30′ W, 75 fms, stones, 1 colony (June 25, 1883, Sofia Exp.).

Spitzbergen: Without definite locality, many colonies (LOVÉN 1837; Spb. Exp. 1872—1873). — Spb. Exp. 1861 (I. A. MALMGREN): Amsterdam Island, 12 fms, stones, 1 colony (May 23, 1861); Bel Sound, 30—40 fms, stones, zoophytes, many colonies; Fosters Islands, 40 fms, sand, many colonies (August 7, 1861); Waigat Islands, 60—80 fms, clay, a great number of colonies (August, 1861). — Spb. Exp. 1864 (I. A. MALMGREN): Ice Fjord, Safe Harbour, 30—50 fms, stones and clay, many colonies (June 28, 30, 1864); D:o many colonies (July 16, 1864). — Spb. Exp. 1868 (A. I. MALMGREN): Off Spitzbergen, 76° 40′ N—18° E, 100—120 fms, stones and clay, 1 colony (July 29, 1868); Lovén's Mount, 36 fms, clay with stones, 1 colony (September 11, 1868). — Spb. Exp. 1872—1873: Wijde Bay, 105 fms, many colonies (1873); D:o 100 fms, stones and clay, 6 colonies (July 1, 1873); Off Spitzbergen 79° 50′ N—15° E, 60 fms, sand and stones, 5 colonies (July 3. 1873); D:o 79° 55′ N—14° 13′ E, 80 fms, gravel and stones, 3 colonies (July 10, 1873); D:o 79° 34′ N—10° 25′ E, 35 fms, shells, 1 colony (July 11, 1873); D:o 78° 37′ N—10° 12′ E, 94 fms, stones, 2 colonies (July 13, 1873). — Spb. Exp. 1898: White Island, 80° 15′ N—33° 10′ E, 40—50 m, rocks, 1 colony (August 18, 1898); Beeren Island—Norway, 73° 3′ N—18° 30′ E, 410 m, gray clay, many colonies (September 4, 1898); King Charles Land, 78° 50′ N—27° 39′ E, 60—70 fms, clay, 1 colony (August 17, 1898).

General Distribution.

Kükenthalia borealis is widely distributed in the Arctic Ocean, though not circumpolar, not having been found, as far as is known, in the Arctic Sea of Siberia, nor off the north coasts of N. America. It has been reported from West Greenland, Spitzbergen, Beeren Island, Barents Sea, the Murman coast, Iceland and the Faroe Islands (cf. HARTMEYER 1903, 1919, REDIKORZEW 1906). It even occurs in northern Norway and has been collected in Kongsfjord, where masses of this species have been dredged, depth 80—90 m, Sydvaranger, 80 m. Probably this species has been dredged also north of Nordkap by HERDMAN, depth 150 fms (BJERKAN 1905, 1908).

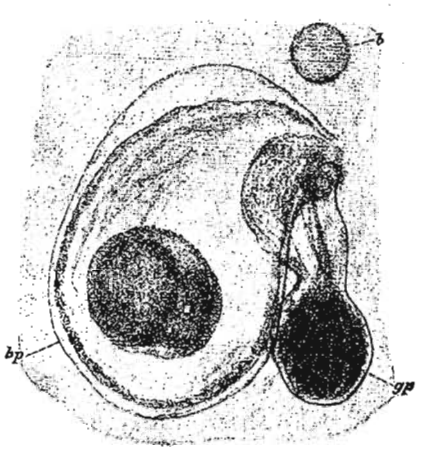
Remarks.

To the descriptions of *Kükenthalia borealis* given before by MICHAELSEN (1904) and HARTMEYER (1903) the following notes on the reproductive organs and the test should be added.

Testes as well as ovaries have been unknown hitherto, though the species has been thoroughly investigated on that point by several eminent scientists.

Reproductive Organs.[1]

The reproductive organs are in the form of a hermaphrodite structure, the male glands as well as the ovary and the ducts being enclosed in a long, sac-like outgrowth of the mantle which extends into the common test. This outgrowth is here named the genital pouch.



Text-fig. 5. *Kükenthalia borealis* GOTTSCHALDT. ×23. The reproductive organs, seen from the outside.
b. Bud. *bp*. Brood-pouch. *gp*. Genital pouch with testis and ovary.

In some individuals another sac-like structure, generally of greater size, has been observed. It is situated at the upper side of the above-mentioned one, and projects like the latter into the common test. When an individual contained developing embryos, they were enclosed in this sac. No doubt it develops to receive the embryos, and it is consequently to be regarded as a brood-pouch (text-fig. 5). In the zooids most advanced in development there are thus two pouches which are to be referred to the reproductive organs (Pl. 3, fig. 48).

In the individuals examined, reproductive organs have been observed only on the left side of the body; they are placed ventrally, on the outer side of the mantle, and are embedded in the test.

Only one genital pouch—consequently only one brood-pouch — has been observed in each zooid. If the individuals are seen from the inside of the colony, the position as well as the number of the organs in question is easily determined. The members of the colony are arranged in one layer and are placed close to each other side by side; only the ventral part is free. From here the reproductive organs extend between the individuals, and only one genital pouch is visible between them, projecting from the left side of each zooid. In the different zooids of the samy colony the reproductive organs show various degrees of development. In some zooids the genital pouch was very large and of considerable length, in others it was hardly distinguishable (cf. Pl. 3, fig. 49). A brood-pouch was developed only in few individuals.

[1] A preliminary note on the reproductive organs of *Kükenthalia borealis* has been published in Proc. Zool. Soc., London, 1921.

From the above-mentioned facts one might conclude that the members of the colony do not attain sexual maturity at the same time, probably owing to different age. As appears from figs. 48—49 the part of the genital pouch which contains the genital organs is of a bulb-shaped form. On one side a large swelling, enclosing the distal part of the oviduct, is visible, and its form varies, owing to the degree of development of the brood-pouch, as will be described in the following.

The male organ. The testis is composed of numerous spermatic vesicles and a long vas deferens. As has been mentioned above, the testis is placed on the outside of the body-wall, invested by an outgrowth of the mantle, projecting into the common test. The vas deferens, which is a duct of considerable length, extends into the peribranchial cavity and opens into it. The spermatic vesicles are pyriform glands which are arranged in two bundles, on account of which the testis appears to be bipartite. The male glands open into two sperm-ducts, each bundle having its duct, and these unite as a rule into a main sperm-duct, the vas deferens (cf. Pl. 3, figs. 50 & 54).

In one individual examined another arrangement was observed. Here the two ducts did not join, but entered separately into the peribranchial cavity, thus forming two vasa deferentia (cf. Pl. 3, figs. 51—52).

After its entrance into the peribranchial cavity, the sperm-duct generally bends somewhat to the side, extending along the inner wall of the cavity. This arrangement was observed in all specimens but one. In the latter, a rather large individual with a strongly developed testis, the distal part of the vas deferens was coiled up, and its opening lies close to that of the brood-pouch (cf. Pl. 3, fig. 56). As this arrangement has been found in a single individual only, I do not venture to draw any conclusions from it. The possibility seems, however, not excluded, that it might be of some importance for the fertilization, in this case probably the self-fertilization of the individual. The fact that ova and spermatozoa are not seldom found mature at the same time in the same individual appears also to support the view that self-fertilization can take place; whether it is usual is another question.

From sections it appears that, in zooids belonging to colonies caught in June, masses of spermatozoa fill up the sperm-ducts. Other cells are macerated, but the spermatozoa are in good condition — a fact which confirms the observation made many times before that the spermatozoa are more resistant than other cells, and that they are highly resistent, even to maceration.

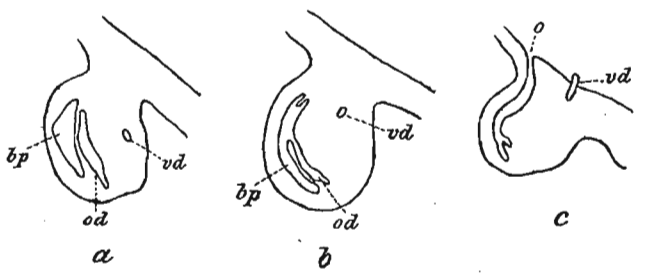
The female organ. In zooids most advanced in development the female organ consists of a small ovary with a wide oviduct and a very large brood-pouch. As is shown by fig. 53, a small rounded vesicle with a wide duct is situated at the side of the male glands in the genital pouch. Sections through it did not show much of its structure, the tissues being rather macerated. The presence of eggs makes it, however, evident that this structure is to be regarded as an ovary. (Pl. 3, fig. 54.) Whether it is an ovary in the proper sense of the word, is another question which will be discussed in an article on the *Botryllids* which will soon be published.

As mentioned above, the ovary is placed at the side of the male glands and

is quite separated from them. Seen from the left side of the zooid, the one bundle of male glands is partly covered by the other, and the ovary has its position opposite their middle line. If one imagines the gonads spread out, the ovary would thus have its position between the two bundles of male glands.

The oviduct extends from the above-described ovary between the two sperm-ducts towards the brood-pouch, and opens into the distal part of the latter with a very wide aperture (Pl. 3, fig. 53). The lumina of the brood-pouch and the oviduct become thus distally confluent, and they communicate with the peribranchial cavity by a short, narrow aperture which is well observable near the vas deferens (cf. text-fig. 6). These facts are of a special interest; then, owing to the above-mentioned arrangement, the passage of the egg is secured: the oviduct opening widely into the brood-pouch, the egg, having left the oviduct, must be laid into the brood-pouch, where it probably remains until it is fully developed.

The oviduct is of considerable width, especially the distal part, which is rather



Text-fig. 6. *Kükenthalia borealis* GOTTSCHALDT. Sections through the genital pouch, showing the distal part of the oviduct and the rudimentary brood-pouch; cut obliquely. ×50.
bp. Brood-pouch. *od.* Oviduct. *o.* Opening into the peribranchial cavity. *vd.* Vas deferens.

sac-like, and the wall is deeply folded on one side. Fig. 55 represents a transverse section of the genital pouch on a level with the bifurcation of the vas deferens. The latter is on the point of forking, on account of which it appears somewhat broad. The last-mentioned figure shows how the oviduct is somewhat compressed from side to side; it is lined with a low epithelium. As appears from the same figure, the ciliated epithelium of the vas deferens is well-developed.

The brood-pouch has the form of a large double-walled sac with a constricted neck. It generally contained one embryo. In some individuals it is of considerable length and width, projecting beyond the genital pouch (text-fig. 5). Fig. 53 represents it at a stage somewhat less developed.

In individuals containing no embryos a brood-pouch has also been observed, though highly reduced with regard to form and size. Such an interesting stage is shown by fig. 54, where the brood-pouch is represented by a short blind sac or an appendix in connection with the oviduct; and in zooids with a rudimentary genital pouch, as for instance in that represented by fig. 49, the presence of such a blind sac can also be stated. Text-fig. 6 shows three transverse sections of the genital pouch with the ducts, which are cut obliquely. The brood-pouch is represented by

a short blind sac; like the oviduct, it is compressed from side to side. In text-fig. 6 *a*, the oviduct and the brood-pouch are still separated; fig. *b* shows how the oviduct opens into the brood-pouch, and in fig. *c* the opening into the peribranchial cavity is visible. Whether this blind sac is to be regarded as a vestigial trace or possibly as a rudiment of the brood-pouch, is a question which ought to be examined in connection with that of the origin and formation of the whole complicated female organ. As it is difficult to state anything for certain about the age of the individuals examined, we cannot draw any conclusions from the above-mentioned facts as to the presence of a rudimentary brood-pouch, even before the first egg has been laid.

Another matter of interest is the question of the homology of the brood-pouch in *Kükenthalia*. Before deciding it, it ought to be investigated whether the brood-pouch of the species in question arises as a direct projection from the peribranchial cavity, or whether it is possibly formed in connection with the oviduct with which it, when fully formed, is so intimately connected. In other *Ascidians* in which a brood-pouch develops to receive the embryos, it is generally a diverticulum of the peribranchial cavity.

Test.

Kükenthalia borealis forms colonies which are massive, usually rounded, and not very large; they are attached by a narrow base (Pl. 3, fig. 47). The zooids are not arranged in systems, and the atrial as well as the branchial aperture of each zooid opens independently on the surface. They form one layer and are placed close to each other. The test of the colony is well-developed. Internally and at the base it is soft and gelatinous, externally it is leathery. To that may be added also that the capsules which surround the individuals are firm and tough.

In my preliminary paper (1921) the occurrence of spicules in the test has been mentioned. They seem to consist of calcareous matter. If put in some decalcifying liquid — hydrochloric acid has been used — the crystals are dissolved. According to the literature, spicules of various size and shape have been found in different groups of *Ascidians*. However, the structures described under that name have not been thoroughly investigated and their origin and chemical nature have not been made out hitherto. According to HERDMAN they might be due to postmortem changes, at least in certain cases (1882, p. 226). Modern men of science seem to be of a contrary opinion. (Cf. Bronn's Kl. u. Ordn. d. Tierreichs pp. 230—234.) Before further investigations of fresh material have been made, nothing can thus be decided as to the importance of the spicules found in *Kükenthalia borealis*.

The species in question was re-described by HARTMEYER (1903) under the new generic name *Kükenthalia*. As the structure of the reproductive organs has been made one of the chief characters in distinguishing the genera of the family Polyzoidae, the facts which have been ascertained by this investigation justify the formation of a new genus. A comparative study shows that the above-mentioned organs

of *Kükenthalia* are quite different to those of the other members of the group. The most striking difference is the presence of a brood-pouch in *Kükenthalia,* a structure which, according to MICHAELSEN's investigations (1904), has not been found in the other genera. Thus one might conclude that it occurs in the Arctic form only.

As regards the genital pouch, the beginning of analogous structures may possibly be found in other genera, though they have not attained the same development as in *Kükenthalia.* For instance, in *Chorizocarpa sydneyensis* and *Chorizocarpa michaelseni* the reproductive organs are placed in cavities of the test. The description of those species is, however, too incomplete to allow of a satisfactory comparison.

In certain respects *Kükenthalia* agrees with *Gynandrocarpa.* In both, the reproductive organs consist of one single hermaphrodite structure. In *Gynandrocarpa* it is placed on the right side, in *Kükenthalia* on the left. The structure of the testis seems to be the same in principal. In both, it is composed of pyriform vesicles with delicate ducts opening into sperm-ducts which generally unite into a single vas deferens (cf. HERDMAN 1886, p. 332; Pl. 44, fig. 4).

With regard to the branchial sac *Kükenthalia* shows a resemblance to *Chorizocarpa* and *Diandrocarpa* having no branchial folds, only a few longitudinal bars.

If we compare *Kükenthalia* with the other *Polyzoidae* it is evident that it does not belong to the forms pointing to a close relationship to the family *Styelidae.* On the contrary, it seems to have more in common with the *Botryllidae,* even if such common characters as the reproduction by budding and the formation of colonies should be left out of consideration. This view is based on the morphological characters exhibited by the branchial sac, the dorsal tubercle, the alimentary canal and, judging from a preliminary investigation of mine of the *Botryllidae,* the reproductive organs.

K. borealis is an Arctic species widely distributed in the Arctic region, it even occurs in the eastern Boreoarctic mixture zone — especially on the northern coast of Norway — and the Faroe Islands form the southern boundary. But it has not been recorded from the American Atlantic coast. It usually inhabits stony bottoms; depth down to 550 m.

List of works referred to.

ALDER, J., and HANCOCK, A., Tunicata in: ALDER, J., A catalogue of the Mollusca of Northumberland and Durham. Tr. Tyneside Club. Vol. 1. Newcastle-upon-Tyne 1848.

ALDER, J., Additions to the Mollusca of Northumberland and Durham. Tr. Tyneside Club. Vol. 1. Newcastle-upon-Tyne 1848.

ARNBÄCK-CHRISTIE-LINDE, A., A remarkable Styelid Tunicate from Spitzbergen. Ann. a. Mag. of Nat. Hist. Ser. 9. Vol. 7. London 1921.

, A new Styelid Tunicate from Norway. Bergens Mus. Aarb. 1919—1920. Christiania 1921.

, On the reproductive Organs of the Ascidian *Kükenthalia borealis* GOTTSCHALDT. Proc. Zool. Soc. London 1921.

BENEDEN, P. J. VAN, Recherches sur l'embryogénie, l'anatomie et la physiologie des Ascidies simples. Mém. Ac. Belgique. Tom. 20. Bruxelles 1847.

BJERKAN, P., Ascidien von dem norwegischen Fischereidampfer »MICHAEL SARS» in den Jahren 1900—1904 gesammelt. Bergens Mus. Aarb. 1905. Bergen 1905.

, Die Ascidien des nördlichen Norwegens. Tromsö Mus. Aarsh. 25. Tromsö 1908.

, Ascidien in: Report of the second Norwegian Arctic Expedition in the »Fram», 1898—1902. Christiania 1911.

BONNEVIE, K., Ascidiae simplices and Ascidiae compositae. From the North Atlantic Expedition. The Norwegian North Atlantic Expedition 1876—1878. Christiania 1896.

CARLSSON, J. G., Tunicater ifrån Sveriges västkust. Monascidier. Ark. f. zoologi. Bd. 11. Stockholm 1918.

FLEMING, J., The Philosophy of Zoology. Vol. 2. Edinburgh 1822.

FORBES, E., and HANLEY, S., A History of the British Mollusca. Vol. 1. London 1848—53.

GOODSIR, J., and FORBES, E., On Pelonaia, a new genus of Ascidian Mollusca. Rep. Brit. Ass. Vol. 10. London 1841.

GOTTSCHALDT, R., Die Synascidien der Bremer Expedition nach Spitzbergen im Jahre 1889. Jen. Z. Vol. 28. Jena 1894.

GRIEG, J. A., Bidrag till kundskapen om Hardangerfjordens fauna. Bergens Mus. Aarb. 1913. Bergen 1913.

HARTMEYER, R., Die Monascidien der Bremer Expedition nach Ostspitzbergen im Jahre 1899. Zool. Jahrb. Syst. Bd. 12. Jena 1899.

, Die Ascidien der Arktis in: Römer u. Schaudinn, Fauna arctica. Bd. 3. Jena 1903.

, Tunicata in: Bronn's Klassen und Ordnungen des Tierreichs. Leipzig 1893—1911.

, Ascidien aus dem Skagerrack, dem Trondhjemsfjord und den Fär Öer. Vidensk. Meddel. Naturh. Foren. Bd. 63. Kjöbenhavn 1912.

, Ascidiarum nomina conservanda. Sitzungsber. Ges. naturf. Fr. Berlin 1915.

, Ascidien aus dem Barentsmeer in: Wiss. Meeresunters. d. deutschen Meere in Kiel u. d. Biol. Anstalt auf Helgoland. N. F. Bd. 13. Abth. Helgoland. Oldenburg i. O. 1919.

HELLER, C., Untersuchungen über die Tunicaten des Adriatischen Meeres. 3. Abt. Denk. Ak. Wien. Bd. 37. Wien 1877.

HERDMAN, W. A., »Challenger». Report 6. Ascidiae simplices. Edinburgh 1882.

, Report upon the Tunicata dredged during the cruises of H. M. SS. »Porcupine» and »Lightning». Tr. R. Soc. Edinburgh. Vol. 32. Edinburgh 1884.

, »Challenger». Report 14. Ascidiae compositae. Edinburgh 1886.

, A revised classification of the Tunicata. J. Linn. Soc. Vol. 23. London 1891.

HUNTSMAN, A. G., Holosomatous Ascidians from the coast of Western Canada in: Contributions to Canadian Biology. Ottawa 1912.

, The classification of the Styelidae. Zool. Anz. Bd. 41. Leipzig 1913.

KJAER, J., Oversigt over Norges Ascidiae simplices. Vidensk. Selsk. Forhandl. Christiania 1893.

KIAER, J., A list of Norwegian Ascidiae simplices. The Norwegian North Atlantic Expedition 1876—1878. Christiania 1896.
KUPFFER, C. v., Tunicata. Die zweite deutsche Nordpolfahrt. Bd. 2. Leipzig 1874.
——, Tunicata. Ber. Komm. D. Meere 1872—1873. Kiel 1875.
LECHE, W., Öfversigt öfver de af Svenska expeditionerna till Novaja Semlja och Jenissei 1875 och 1876 insamlade Hafs-Mollusker. Sv. Ak. Handl. Vol. 16, Stockholm 1878.
LINNÉ, C. v., Systema Naturae, ed. 12, Tom. 1, Vol. 2. Holmiae 1767.
MAC LEAY, W. S., Anatomical observations on the natural group of Tunicata with the description of three species collected in Fox Channel during the late Northern Expedition. Tr. Linn. Soc. London. Vol. 14. London 1824.
MICHAELSEN, W., Die holosomen Ascidien des magalhaensisch-südgeorgischen Gebietes. Zoologica. Bd. 12. Stuttgart 1900.
——, Revision der kompositen Styeliden oder Polyzoinen. Mit. Mus. Hamburg. Jahrg. 21. Hamburg 1904.
——, Die stolidobranchiaten Ascidien der deutschen Tiefsee-Expedition. Ergeb. D. Tiefsee-Exp. Bd. 7. Jena 1904.
——, Die Tethyiden (Styeliden) des Naturhistorischen Museums zu Hamburg. Mit. Mus. Hamburg. Jahrg. 28. Hamburg 1911.
MÖLLER, H. P. C., Index Molluscorum Grönlandiae. Naturh. Tidskr. Vol. 4. Kopenhagen 1842.
PALLAS, P. S., Spicilegia zoologica quibus novae imprimis obscura animalium species iconibus, descriptionibus, atque commentariis illustrantur, fasc. 10. Berlin 1774.
RATHKE, J. Zoologica danica. Vol. 4. Havniae 1806.
REDIKORZEW, W., Ein Beitrag zur Ascidienfauna der Arctis. Ann. Mus. St. Pétersbourg. T. 11. St. Pétersbourg 1906.
——, Die Ascidien der russischen Polarexpedition 1900—1903. Zool. Anz. Bd. 31. Leipzig 1907.
——, Die Ascidien der Murmanküste. Trav. Soc. Nat. St. Pétersbourg. Vol. 39. St. Pétersbourg 1908.
——, Die Ascidien des Sibirischen Eismeeres. Mém. Acad. imp. des sciences de St. Pétersbourg. T. 18. St. Pétersbourg 1910.
——, Tethyum rhizopus var. murmanense — eine neue Ascidie von der Murmanküste. Ann. Mus. St. Pétersbourg. T. 16. St. Pétersbourg 1911.
RITTER, W. E., A contribution to the knowledge of the Tunicata of the Pribilof-Islands. The Fur Seals and Fur Seal Islands of the North Pacific Ocean. P. 3. Washington 1899.
——, The simple Ascidians from the Northeastern Pacific in the collection of the United States National Museum. Proc. U. S. Nat. Mus. Vol. 45. Washington 1913.
SARS, M., Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken. Nyt Mag. Naturv. Vol. 6. Christiania 1851.
——, Bidrag til en Skildring af den arktiske Molluskfauna ved Norges nordlige Kyster. Forhandl. Vidensk. Selsk. Christiania 1858. Christiania 1859.
——, Om arktiske Dyreformer i Christianiafjorden, ibidem 1865. Christiania 1866.
——, Bidrag til Kundskapen om Christianiafjordens Fauna. Nyt Mag. Naturv. Vol. 17. Christiania 1870.
SAVIGNY, J. C., Mémoires sur les animaux sans vertèbres. Vol. 2. Paris 1816.
SELYS-LONGCHAMPS, M. de, Sur le bourgeonnement des Polystyélinés. Bull. sc. de la France et de la Belgique. T. 50. Paris 1916—1917.
STIMPSON, W., Several new Ascidians from the coast of the U. S. Proc. Boston Soc. Vol. 4. Boston 1852.
SWEDERUS, M. B., Tunicater från Sibiriens Ishaf och Berings Haf. Vega Exp. Bd. 4. Stockholm 1885.
THÉEL, H., Northern and Arctic Invertebrates in the collection of the Swedish State Museum. I. Sipunculids. K. V. Akad. Handl. Bd. 39. Uppsala 1905.
TRAUSTEDT, M. P. A., Oversigt over de fra Danmark og dets nordlige Bilande kjendte Ascidiae simplices. Vid. Meddel. 1879—1880. Kopenhagen 1880.
——, Vestindiske Ascidiae Simplices, ibidem 1881. Kopenhagen 1882.
——. Die einfachen Ascidien des Golfes von Neapel. Mit. Stat. Neapel. Bd. 4. Berlin 1883.
——, Kara-Havets Söpunge (Ascidiae simplices). Dijmphna Udb. Kopenhagen 1887.
VAN NAME, W. G., Simple Ascidians of the coasts of New England and neighbouring British Provinces. Proc. Boston Soc. Nat. Hist. Vol. 34. Boston 1907—1912.
VERRILL, A. E., Descriptions of some imperfectly known and new Ascidians from New England. Amer. J. Sc. ser. 3 Vol. 1. New Haven 1871.
WHITEAVES, J. F., Catalogue of the Marine Invertebrata of eastern Canada. Geol. Survey Canada. Vol. 4. Ottawa 1901.

Index.

Species with an asterisk(*) are figured.

Explanation of plates.

Plate 1.

Fig. 1. *Styela rustica* LINNÉ, from Spitzbergen, somewhat magnified.
" 2. The same, from the Kola Peninsula, natural size.
" 3. *Styela loveni* SARS, from the Kola Peninsula, × 1½.
" 4. The same, from Spitzbergen, natural size.
" 5. *Styela theeli* n. sp. × 1½.
" 6. The same. Dorsal tubercle and part of dorsal lamina. × 10.
" 7. The same. Left side of body. × 2.
at. Atrial aperture; *br.* Branchial aperture; *i.* Intestine; *r.* Rectum; *s.* Stomach.
" 8. The same. Right gonads. × 6.
e. Endocarp; *od.* Oviduct; *ov.* Ovary; *t.* Testis; *vd.* Vas deferens.
" 9. The same. Part of left gonad. × 6.
ov. Ovary; *t.* Testis; *vd.* Vas deferens.
" 10. *Pelonaia corrugata* GOODSIR a. FORBES, from Iceland, natural size.
" 11. The same, from Spitzbergen, natural size.
" 12. The same, from Gullmarn, natural size.
" 13. The same. Gonad. × 1½.
t. Testis; *o.* Ovary.
" 14. *Ypsilocarpa clipeata* gen. et sp. n. × 6.
" 15. The same. Gonad. × 6.
od. Oviduct; *vd.* Vas deferens.
" 16. The same. Part of the intestine with rectum. × 6.
r. Rectum
" 17. The same. Dorsal tubercle. × 33.
" 18. *Cnemidocarpa rhizopus* Redikorzew, from Cape Grebeni. × 2.
" 19. The same. × 2.
" 20. The same. × 2.
" 21. *Cnemidocarpa rhizopus* var. *murmanensis* REDIKORZEW. × 4.

Plate 2.

Fig. 22. *Cnemidocarpa rhizopus* REDIKORZEW. Left side of body. The test is cut open and turned back to show the internal structure. × 4.
bs. Branchial sac; *c.* Coecum; *e.* Endocarp; *g.* Gonad; *r.* Rectum; *s.* Stomach.
" 23. *Cnemidocarpa mollispina* n. sp. × 4.
" 24. The same. The test is cut open and turned back to show the internal structure. × 6.
bs. Branchial sac; *c.* Coecum; *e.* Endocarp; *g.* Gonad; *r.* Rectum; *s.* Stomach.
" 25. The same. Dorsal tubercle. × 35.
" 26. The same. Gonad. × 10.
o. Ovary; *t.* Testis.
" 27. *Cnemidocarpa cirrata* n. sp., from Spitzbergen. × 3.
" 28. The same, from Greenland. × 3.
" 29. The same. The animal is cut open to show the gonads. × 5.
a. Right side; *b.* Left side; *g.* Gonad.
" 30. The same. The alimentary canal. × 5.
c. Coecum; *r.* Rectum; *s.* Stomach.

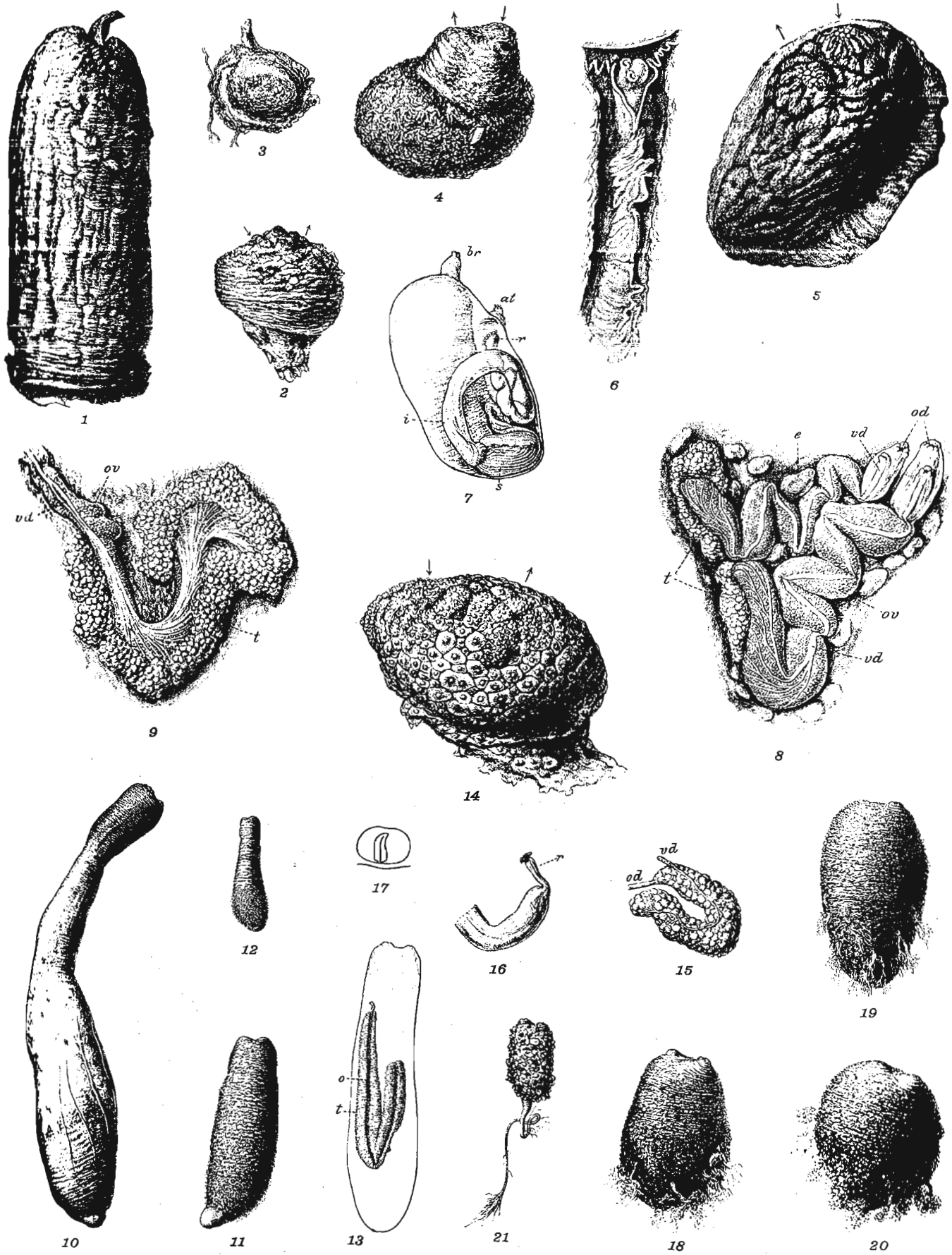
Fig. 31. The same. Dorsal tubercle. × 35.
» 32. The same. Gonad. × 10.
a from outer side; *b* from inner side. *o.* Ovary; *t.* Testis.
» 33. *Polycarpa libera* KIAER. × 4.
» 34. *Dendrodoa grossularia* VAN BENEDEN. × 2.
» 35. The same. × 2.
» 36. The same. × 2.
» 37. The same. × 2.
» 38. The same. Gonad. × 8.
o. Ovary; *od.* Oviduct; *t.* Testis; *vd.* Vas deferens.
» 39. *Dendrodoa aggregata* Rathke, forma *typica*, from Davis Strait, natural size.
» 40. The same, from Disco, natural size.
» 41. *Dendrodoa aggregata* var. *pulchella* VERRILL, from Banks of Newfoundland, natural size.
» 42. *Dendrodoa aggregata* var. *groenlandica* n. var., natural size.

Plate 3.

Fig. 43. *Dendrodoa aggregata* RATHKE, forma *typica*. Gonad. × 1½.
e. Endocarp; *od.* Oviduct; *vd.* Vas deferens.
» 44. The same. Part of gonad. × 10.
o. Ovary; *t.* Testis; *vd.* Vas deferens; *ve.* Vas efferens.
» 45. *Dendrodoa aggregata* var. *groenlandica* n. var. Gonad. × 2.
od. Oviduct.
» 46. The same. Alimentary canal. × 2.
r. Rectum; *s.* Stomach.
» 47. *Kükenthalia borealis* GOTTSCHALDT. Colony from Spitzbergen. × 2.
» 48. The same. Zooid seen from the left side, test partly removed. × 8.
at. Atrial aperture; *br.* Branchial aperture; *b.* Bud; *bp.* Brood-pouch; *gp.* Genital pouch with testis and ovary; *oe.* Oesophagus; *r.* Rectum; *s.* Stomach.
» 49. The same. Zooid seen from the left side, test partly removed. × 7.
at. Atrial aperture; *br.* Branchial aperture; *b.* Bud; *gp.* Genital pouch with testis and ovary; *oe.* Oesophagus; *r.* Rectum; *s.* Stomach.
» 50. The same. Testis, from the inside. × 33.
t. Testis; *vd.* Vas deferens.
» 51. The same, showing the testis and the rudimentary brood-pouch, from the outside. × 33.
b. Bud; *bp.* Brood-pouch; vd^1., vd^2. Vasa deferentia.
» 52. The same. Testis, from the inside. × 33.
t. Testis; vd^1., vd^2. Vasa deferentia.
» 53. The same. The reproductive organs, from the outside. × 23.
bp. Brood-pouch; *o.* Ovary; *od.* Oviduct; *t.* Testis; *vd.* Vas deferens.
» 54. The same. The reproductive organs, from the outside. × 23.
bp. Brood-pouch; *o.* Ovary; *od.* Oviduct; *t.* Testis; *vd.* Vas deferens.
» 55. The same. Transverse section of the genital pouch. × 110.
od. Oviduct; *vd.* Vas deferens.
» 56. The same. The reproductive organs, seen from the inside. × 33.
b. Bud; *bp.* Brood-pouch; *gp.* Genital pouch with testis and ovary; *vd.* Vas deferens.

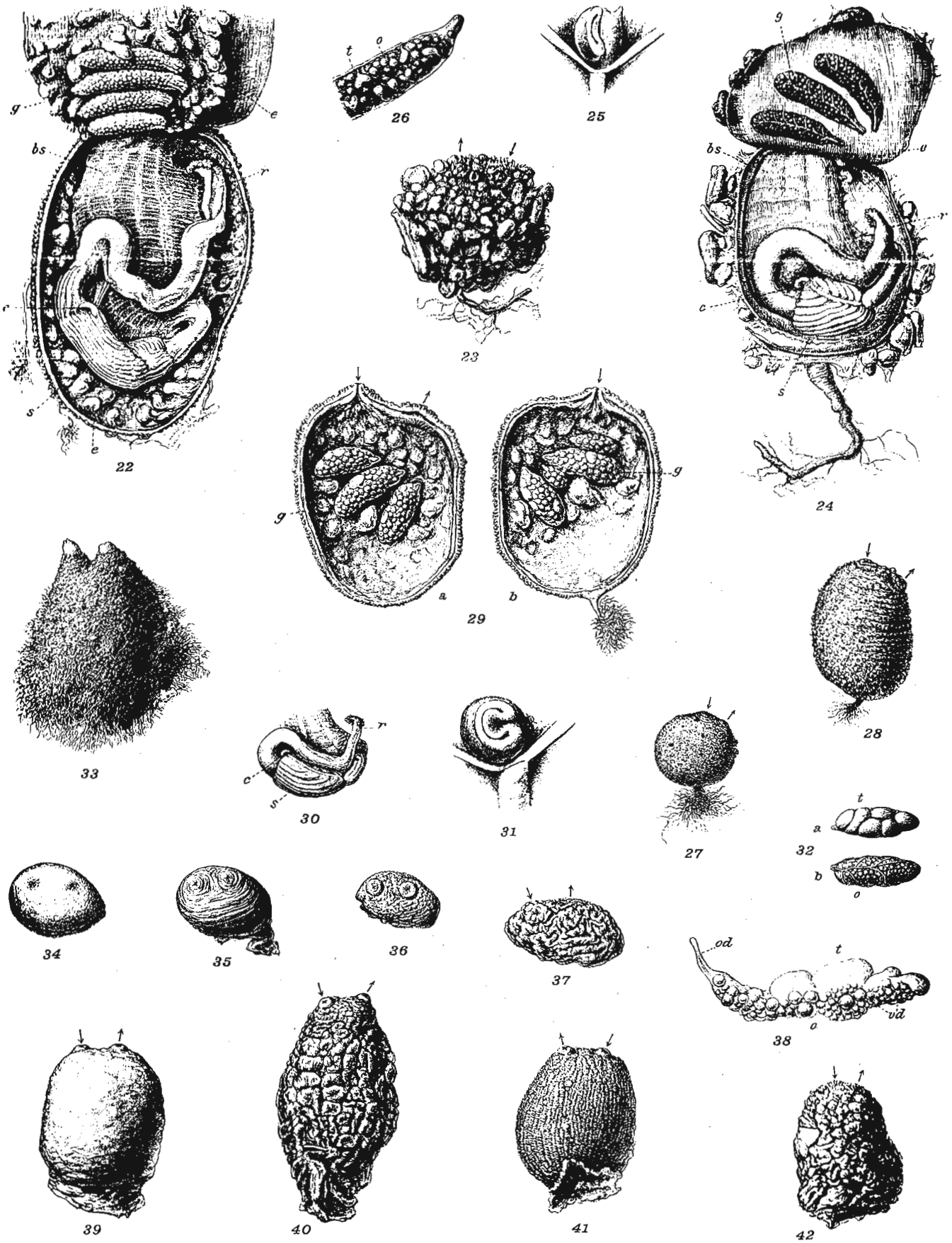
Tryckt den 19 april 1922.

Uppsala 1922. Almqvist & Wiksells Boktryckeri-A.-B.



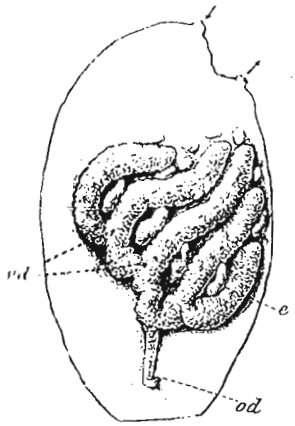
O. Ohlevall del.

Ljustr. A. B. Lagrelius & Westphal, Stockholm



G. Liljevall del.
A. Arnbäck - Christie - Linde foto.

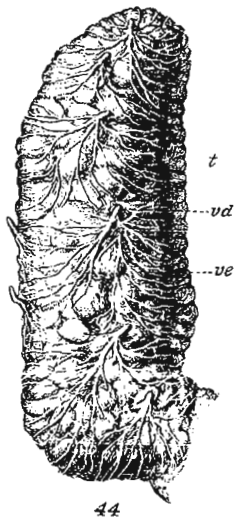
Ljustr. A. B. Lagrelius & Westphal, Stockholm



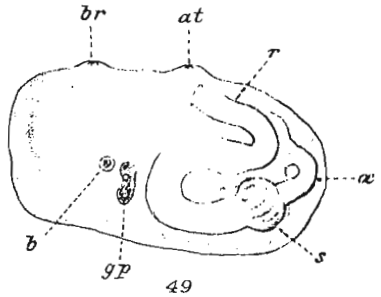
43

46

45

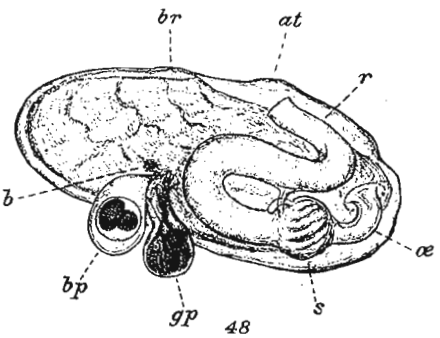


44

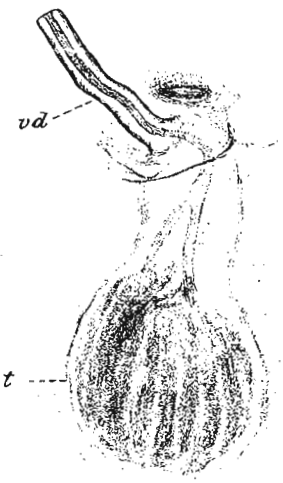


49

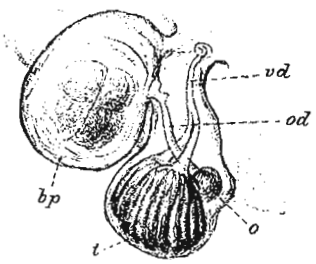

47



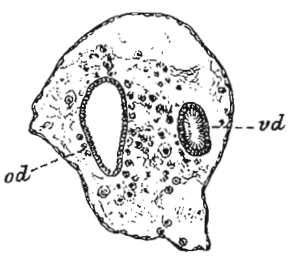
48



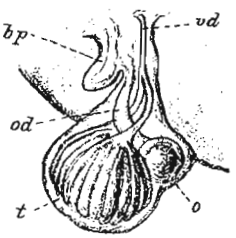
50



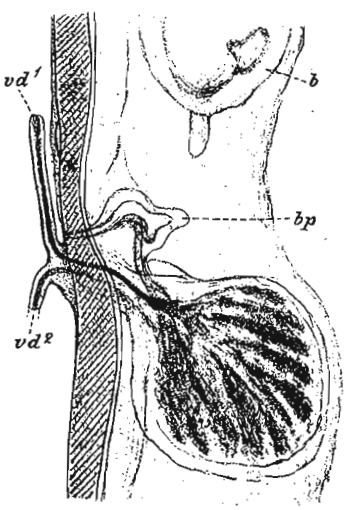
53



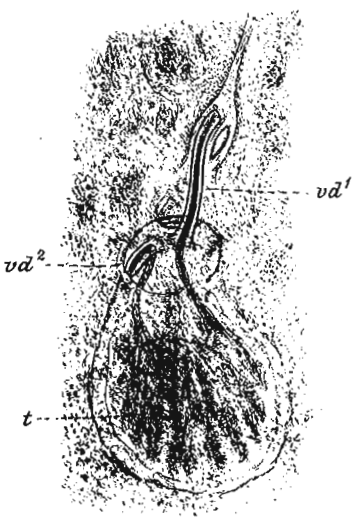
55



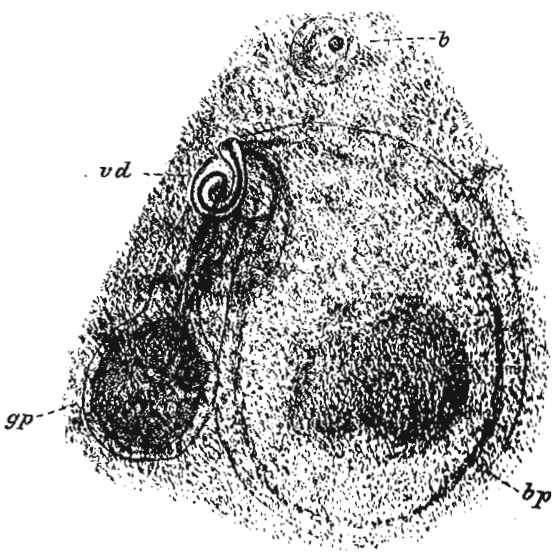
54



51



52



56

Ljustr. A. B. Lagrelius & Westphal, Stockholm