AUSTRALIAN MUSEUM, SYDNEY.

Catalogue No. XVII.

DESCRIPTIVE CATALOGUE

OF THE

TUNICATA

IN THE

AUSTRALIAN MUSEUM,

SYDNEY, N.S.W.

BY

W. A. HERDMAN, D.Sc., F.R.S.,

F.L.S., F.R.S.E., ETC.; PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

WITH FORTY-FIVE PLATES

PRINTED BY ORDER OF THE TRUSTEES,

R. ETHERIDGE, JUNR.,

CURATOR.

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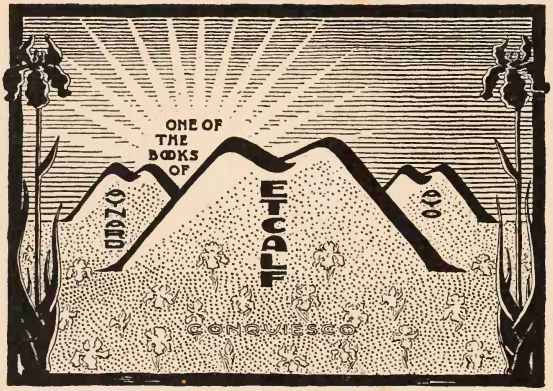
ONE OF
THE
BOOKS
OF
ETCALF
CONQUISTADORES

first structure simplified. Later the lens and especially the vitreous body degenerated more rapidly than the retina. The muscles in Typhlichthys have disappeared. The scleral cartilages have not failed to the same extent as the active structures of the eye. The degeneration is in no case due to arrested development. D. S. J.

Abbott on the Marine Fishes of Peru. — An excellent piece of faunal work is "The Marine Fishes of Peru," by James Francis Abbott, published in the *Proceedings of the Academy of Natural Sciences of Philadelphia* for June, 1899.

The paper is based on the collections made by Rear-Admiral L. A. Beardslee, U. S. N., at Callao, while in command of the *Philadelphia*. This accomplished officer has long taken a deep interest in natural history matters, and this collection presented by him to Stanford University is a proof of such interest.

Mr. Abbott notes 102 species as recorded thus far from Peru, and thirty of them are included in the Beardslee collection. Mr. Abbott describes as new the following species from Callao: *Basilichthys octavius*, *Basilichthys regillus*, *Basilichthys jordani*, *Pisciregia beardsleei*, and *Sciæna gilberti*. The new genus Pisciregia is allied to the California genus Atherinopsis, having a similar non-protractile premaxillary, but the vomer is armed with recurved teeth; the outer teeth in the jaws are enlarged, and the first dorsal is very small. The abundance of species of large-sized Atherinidæ (Pez del Rey), constituting the genera Chirostoma, Atherinopsis, Atherinops, Basilichthys, and Pisciregia, excellent food fishes all, is one of the notable features of the fish fauna of the eastern Pacific. D. S. J.

Fishes of French Guiana. — Dr. Léon Vaillant has published in the *Bulletin* of the Museum at Paris a paper on fishes collected in French Guiana, mostly from fresh waters.

Two new species are described: *Arius physacanthus*, from Rio Mahury; and *Rivulus geayi*, from Rio Cachipour. The Arius is allied to *emphysetus* and should be placed with it in Sciadeichthys if the modern genera of Bleeker are adopted. D. S. J.

Australian Tunicata. — Students of the Tunicata have known for some years that Professor W. A. Herdman has been occupied with the investigation of the collections of this group belonging to the Australian Museum at Sydney, New South Wales, and his report has

been looked forward to with interest. After a considerable delay, due to the late financial depression in Australia, the work has now been published as *Catalogue No. XVII* of the Museum. That it is of the highest order of scientific excellence hardly needs to be said, particularly for those who are familiar with Professor Herdman's distinguished work in the past on this group of animals.

The author has entitled his report a "Descriptive Catalogue of the Tunicata in the Australian Museum, Sydney, New South Wales," and he says that it is not to be regarded as a monograph on Australian Tunicata. He tells us that he was expressly enjoined by the trustees of the Museum "not to enter into anatomical and histological details beyond what he considered necessary for the elucidation of the systematic position and the sufficient description of the various species." The fact, consequently, that he has devoted nearly one hundred large octavo pages and forty-two plates to the description of the sixty-two new species serves as an index to what this veteran ascidiologist believes to be the briefest treatment consistent with exactness in this group.

In his introduction he gives a brief discussion of classification and concludes that, despite the various quite radically different systems that have since been proposed, he sees no sufficient reason for departing widely from the one adopted by him in his *Challenger* report of 1882. And he justly remarks that he feels himself strengthened in his position by the fact that this system has been quite generally adopted by recent writers, notably by Seeliger in his "Tunicata" for Bronn's *Klassen und Ordnungen des Thierreichs*.

He does, however, introduce one modification of considerable importance. He divides the Ascidiæ compositæ into two sections, one of which contains the "compact-bodied families," Botryllidæ and Polystyelidæ, and the other the "remaining families with extended or divided bodies." For these he proposes to adopt the names "Holosomata" and "Merosomata," respectively, if Sluiter, who first used them, but in a somewhat different sense from that in which Herdman proposes to use them, will agree to Herdman's modification. Or if Sluiter refuses to accept this modification, then Herdman will adopt the terms "Pectosomata" and "Chalarosomata" for the respective groups.

There can be no doubt, particularly since the Polystyelidæ and Botryllidæ have been shown to agree so closely in their method of budding, that they should be associated more closely in classification than either family can be with the other families of compound ascid-

ians. I believe, however, that the point of similarity emphasized by Professor Herdman's proposal, *viz.*, the compactness of the body, is considerably less fundamental than some other characters that might be selected, particularly that of the method of budding. Furthermore, the term "Holosomata" does not apply to these two families any more than it does to Perophora, which genus the author does not, of course, associate with the Botryllidæ and Polystyelidæ.

I would not go so far as Garstang has in relying upon the character of the budding as a basis for classifying the compound ascidians, but I believe that in the present state of our knowledge the most natural grouping of them that can be made is into two sections. One of these would include those in which the buds arise directly from the body of the parent, and the other those in which the budding is from a stolon. The first section might well be called the "Somatoblastica" and the second the "Rhizoblastica." These sections would correspond to Herdman's, with the exception that it would remain for the present an open question as to which one should contain the Didemnidæ, the probabilities being, however, that this family would ultimately find its place among the Somatoblastica.

Those who object to mongrel words will be likely to find fault with "Pectosomata" on etymological grounds.

At the close of the report the author has given a list of all the species of Tunicata thus far known from Australian waters. This list includes 187 species, distributed as follows among the three divisions of the group:

Larvacea	1 species
Thaliacea	7 species
Ascidiacea	179 species

The work is a very important contribution to the general zoölogical knowledge of this group. Less can be said in favor of the volume from the bookmaker's than from the naturalist's point of view, but it will serve its purpose well, and that is the essential thing.

Wm. E. Ritter.

The Coccidæ of Mauritius. — M. d'Emmerez de Charmoy has recently published a very interesting account of the Coccidæ of Mauritius, in a pamphlet issued by the Société Amicale Scientifique of that island. As it is probable that this work will not fall into many hands, it may be worth while to give a list of the species,

correcting the nomenclature at the same time, so far as seems necessary : —

Aspidiotus aleæ simplex, n. var., p. 20.
A. articulatus simplex, n. var., p. 21.
A. tesseratus, n. sp., p. 23.
A. maskelli, Ckll., p. 24.
A. cyanophylli, Sign., p. 24.
A. lataniæ, Sign.
= *A. cydoniæ*, p. 25.
A. trilobitiformis, Green, p. 26.
Chrysomphalus aonidum, L.
= *A. ficus*, p. 25.
C. cladii, Mask.
= *A. cladii*, p. 22.
C. aurantii, Mask.
= *A. aurantii*, p. 22.
Parlatoria sp. ?
= *P. zizyphi*, p. 27.
Diaspis euphoriæ, n. sp., p. 28.
D. pentagona, Targ.
= *D. amygdali*, p. 29.
D. calyptroides cacti, Comst., p. 29.
Howardia biclavis, Comst.
= *Chionaspis biclavis*, p. 30.
Chionaspis dilatata, Green, p. 31.
C. sp. ?
= *C. quercus*, p. 30.
C. tegalensis, Zehnt., p. 31.
Mytilapsis hibisci, n. sp., p. 32.
M. greeni, n. sp., p. 33.
M. beckii, Newm.
= *M. citricola*, p. 34.
M. gloveri, Pack., p. 35.
Fiorinia fioriniæ, Targ.
= *F. camelliæ*, p. 37.
F. cockerelli, n. sp., p. 37.
F. alæodendri, n. sp., p. 36.
Aonidia (?) *allaudi*, n. sp.
= *F. allaudi*, p. 35.
A. (?) *allaudi galliformens*, n. var.
= *F. a. galliformens*, p. 36.
Vinsonia stellifera, Westw., p. 38.
Ceroplastes vinsoni, Sign., p. 38.
Lecanium oleæ, Bern., p. 39.
L. hemisphæricum, Targ., p. 40.
L. hemisphæricum filicum, Boisd., p. 40.
L. longulum, Dougl., p. 40.
L. nigrum, Nietn., p. 40.
L. tessellatum, Sign., p. 40.
L. viride, Green, p. 41.
Pulvinaria cariei, n. sp., p. 41.
Asterolecanium bambusæ, Boisd., p. 42.
A. miliaris, Boisd., p. 42.
A. pustulans, Ckll. ?
= *A. quercicola* ?, p. 42.
Oudablis sp. ?
= *Phenacoccus nivalis*, p. 42.
Dactylopius calceolariæ minor, Mask., p. 44.
D. virgatus, Ckll., p. 44.
D. filamentosus, Ckll.
= *D. vastator*, p. 45 (fide Tinsley).
D. sacchari, Ckll., p. 45.
D. citri, Risso, p. 45.
D. longispinus, Targ.
= *D. adonidum*, p. 46.
= *D. pteridis*, p. 46.
Orthezia insignis, Dougl., p. 46.
Icerya seychellarum, Westw., p. 47.
Chætococcus bambusæ, Mask.
= *Sphærococcus bambusæ*, p. 48.

Thanks to M. de Charmoy, the writer has been able to examine some of the new species. The *Mytilaspis hibisci*, unfortunately not figured, is close to *M. crawii*, but easily distinguished by the dark scale. The *Aonidia* (?) *allaudi* is a beautiful and singular thing, and could be considered the type of a new genus. *Aspidiotus tesseratus* is not a Diaspidiotus, as M. de Charmoy has it, but a Pseudaonidia. Singularly enough, it was found almost simultaneously, by Professor C. H. T. Townsend, at Coatzocoalcos in Mexico, and described by the present writer under a different name, which latter,

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NOTICE.

In the year 1888 my predecessor, Dr. E. P. Ramsay, acting on instructions from the Trustees of the Australian Museum, forwarded the collection of Tunicata described in the present catalogue to Prof. W. A. Herdman, of Liverpool. In 1893, however, just as the work was about to be sent to press, circumstances of an official character, beyond the Trustees' control, temporarily put a stop to its publication. It now affords me much pleasure to say that in 1897 it was again possible to contemplate the publication of the catalogue, which was therefore at once completed, and is now issued as one of the Museum Series.

At the time the specimens were forwarded to Prof. Herdman they formed a complete collection of the Tunicata of the New South Wales coast, as then known to us, and very few additional forms have since come to hand. It is, however, unquestionable that by systematic collecting—which, unfortunately, the Australian Museum is not at present in a position to carry out—the list might be very much enlarged.

In addition to the Museum material, Prof. Herdman has incorporated certain forms known to him, but at present not represented in the former. A preliminary list was published by Prof. Herdman in "Annals and Magazine of Natural History," 7th series, vol. I., p. 443, in June, 1898.

R. ETHERIDGE, Junr.,
Curator.

Sydney,
1st December, 1898.

PREFACE.

In the autumn of 1887 I received a letter from Dr. E. P. Ramsay, at that time Curator of the Australian Museum, Sydney, asking me to prepare, for the Trustees of that Institution, this descriptive Catalogue of the Collection of Tunicata in their Museum. The specimens sent to me in several packages arrived in Liverpool during 1888 and 1889; and in the latter year, after I had made a preliminary examination of all the species and had reported upon the number that would require to be described and figured, arrangements were made by the Trustees as to printing the Catalogue in this country and as to the preparation of the plates.

During 1890, and the following year or two, considerable progress was made with the detailed examination of the collection, the MS. descriptions of a number of the Ascidiæ Simplices were written out and 12 plates were prepared, put on the stone, and printed off. Then occurred the unfortunate financial crisis in Australia, and I received a letter from the Secretary to the Trustees telling me to go no further with the work, and incur no fresh expense connected with the catalogue till further notice. The work was put aside, and was only taken up again towards the end of 1897, after a lapse of several years. I am now authorised to complete the MS. and plates, and to deposit them in the hands of the Agent General for New South Wales, in London, with a view to publication of the catalogue as soon as the arrangements of the Museum permit. The type specimens of all the species described have been returned to the Australian Museum.

As some of the earlier plates had to be printed off before their exact position in the series could be determined, I decided to treat each family separately in the numbering; hence the legends on the plates run Clav. I., Asc. I., Bot. I., II., III., and so on. A complete list of the plates in their order is given on p. 122.

Finally, I desire to state that this work is merely a descriptive catalogue, and, although I have tried to make it as complete and as useful as possible, I do not expect it to be regarded as a monograph on Australian Tunicata. I was expressly requested by the Trustees not to enter into anatomical and histological details beyond what I considered necessary for the elucidation of the systematic position and the sufficient description of the various species, and not to treat in any detail of species outside of the collection sent to me from the Museum. I have added, however, at the end of the catalogue a complete list of the Tunicate Fauna of Australian seas so far as it is known to me; and I have given in the Introduction a brief general account (illustrated by Plates A, B, and C) of the structure and life-history of a typical Ascidian which may be useful to those who study the catalogue.

W. A. Herdman.

Liverpool,
January, 1898.

CONTENTS.

SHOWING THE SYSTEM OF CLASSIFICATION.

Plates (arranged as follows: A, B, C, Clav. I., Clav. II., Asc. I., Asc. II., Cyn. I.—Cyn. XX., Mol. I., Dist. I.—Dist. III., Pcl. I.—Pcl. VI., Did. I., Did. II., Pst. I.—Pst. III., Bot. I.—Bot. III.).

INTRODUCTION.

Previous to the publication of the Reports upon the scientific results of the "Challenger" Expedition, comparatively little was known as to the Tunicata of the Australian seas. Some few species had been named and partly described by Savigny, Quoy and Gaimard, Stimpson, J. D. Macdonald, and Heller; but few of these were sufficiently characterised and figured to be really "known" to science.

Savigny (1816) described *Sigillina australis* in considerable detail. Quoy and Gaimard (1834) gave a very insufficient account of various Tunicata which had been found in Australian seas by the French exploring expedition in "L'Astrolabe." Stimpson (1855) named and very briefly described half a dozen species of Simple Ascidians from Port Jackson. Heller (1878) figured and described, with but little anatomical detail, about twelve species of Australian Simple Ascidians from some of the museums of Europe.

But our most interesting contributions are due to Dr. J. D. Macdonald (1859) who, while serving as surgeon on board one of H.M.'s ships in Australian seas, found and described the remarkable forms *Chondrostachys* sp., *Perophora Hutchisoni*, *Diplosoma Rayneri*, *Caesira parasitica*, *C. ficus*, and *C. pellucida*, the last three being species of *Molgula*. Some of these older species are, however, so imperfectly characterised that it is difficult to recognise them or define them in our modern system of classification.

The naturalists of the "Challenger" Expedition collected about 28 species of Simple Ascidians and 14 species of Compound in the Australian seas, nearly all of them new to science.

Since the publication of the Reports of the "Challenger" Expedition, however, a number of species of Tunicata have been described from Australian seas by Sluiter, Traustedt, and others. Dr. C. Ph. Sluiter, while resident in the Dutch East Indies, published a most important series of papers in which he described over 30 species of Tunicata from the seas of the Malay Archipelago. It may be a question whether such localities as the Island Billiton, where Sluiter obtained some of his species, can be considered as coming within Australian seas; but there can be no question but that Thursday Island and Torres Straits, where Semon collected the specimens described by Sluiter in his most recent papers, must be included. These comprise nearly 30 species of Ascidiacea, both Simple and Compound. I believe it will add considerably to the completeness and usefulness of this catalogue if I add a record of all such known Australian species in their proper systematic positions at the end of each family, but distinguished by being enclosed in square brackets [ ].

The method of description of a Simple Ascidian which I adopted in my Reports upon the "Challenger" collection were suggested by the anatomical notes given by Albany Hancock in his last paper,* and have been almost universally followed by writers since. The method consists in describing the external appearance under the heads of shape, colour, size; then the characters of test and mantle; then the structure of the branchial sac, endostyle, dorsal lamina; the number, arrangement, and form of the tentacles, and the condition of the dorsal tubercle; then anything noteworthy in regard to the alimentary canal and the reproductive viscera. I believe if we had these details and the necessary figures in regard to all the named species of Tunicata there would be no difficulty in assigning to each

* Anatomy and Physiology of the Tunicata. Journ. Linn. Soc., Zool., vol. ix., p. 309.

its place in our system; but, unfortunately, the very meagre descriptions of some of the older species do not give us the necessary information. No Ascidian, then, can be properly described without dissection and microscopic examination, and at the least the branchial sac, and, in some cases, the tentacles and the dorsal tubercle, should be figured, as well as the exterior of the animal.

The classification of the Tunicata which I followed in my "Challenger" Reports (1882), is one which has been pretty widely adopted. I gave a Revision of it, with some slight modifications and expansions, in my "Revised Classification of the Tunicata," &c., in 1891.* I am well aware of several other classifications which have appeared since, such as Lahille's in 1887, Garstang's modification of Lahille in 1895, and Sluiter's also in 1895, but after giving them all very full consideration, I am supported in adhering to the "Challenger" classification by finding that it is the one which Seeliger seems to receive with most approval in his great work on the Tunicata now appearing in Bronn's "Klassen und Ordnungen des Thier-Reichs." I am aware that the Ascidiæ Compositæ do not form a natural group, but can be broken into several sets which are related to different kinds of Simple Ascidians. I believe I was myself the first to point out this polyphyletic nature of the group; and yet I consider it a practical convenience to retain the term Compound Ascidians in our classification, especially in a Museum Catalogue, where it is impossible to represent the complexities of a phylogenetic arrangement—of lines branching in the three dimensions of space.

Lahille, in his system of classification, makes use only of the condition and details of structure of the branchial sac, an organ that is physiologically of such dominant importance in Tunicata that it becomes liable to the loss or

* Journ. Linn. Soc., Zool., vol. xxiii., p. 558.

modification of ancient morphological characters. The result, in my opinion, is a largely unnatural grouping. For example, the well-marked group Thaliacea is broken up, and the Doliolidæ are separated from their natural allies the Salpidæ and are united with the Distomidæ.

Sluiter's classification (1895) is much more natural, and as to fundamental facts there is little difference of opinion between us. So much so, that I am in hopes that he may accept a modification which I shall here propose, and which would bring us entirely into accord. In the primary division into the three orders Larvacea, Thaliacea and Ascidiacea we are at one; it is only in the further division of the Ascidiacea that we differ, and that difference resolves itself into the treatment of the Compound Ascidians. Here again, as to the phylogeny or probable course of evolution of the group we are agreed. As I pointed out at full length in my "Challenger" Report,* and also expressed graphically in a phylogenetic-tree diagram, the Compound Ascidians must be regarded as a Polyphyletic group, and the families Botryllidæ and Polystyelidæ are probably derived from Cynthiidæ, while the other Compound Ascidians are more nearly related to the Clavelinidæ and Ascidiidæ. Still I maintain that does not warrant us in separating in our classification the Botryllidæ from the Distomidæ and uniting them with the Cynthiidæ as Sluiter† proposes. Whatever their history has been in the past, the Botryllidæ and the Distomidæ are equally Compound Ascidians at the present day. Both form colonies of Ascidiozooids produced by gemmation and imbedded in a common test, and consequently I consider we are justified in uniting them as Ascidiæ Compositæ.

On account, however, of the differences in origin, expressed in existing forms by certain differences of structure,

* Part II. (1886), p. 387, &c. † Jenaische Denkschr. viii., p. 165.

I should propose to divide Ascidiæ Compositæ into two sections to which Sluiter's names "Merosomata" and "Holosomata" might well be applied. If Dr. Sluiter will accept this modification in the sense of his terms I shall be glad to adopt them. It will leave his term Merosomata unaltered, except for the exclusion of the family Pyrosomidæ; but will mean that Holosomata is used in a very restricted sense as indicating only the remaining Compound Ascidians, *i.e.*, the two families Botryllidæ and Polystyelidæ. If, however, Dr. Sluiter objects to my proposed change in the restriction of his names, the only course open to me will be to propose two new terms for the sections of Ascidiæ Compositæ which I desire to recognise. I should suggest in this case "Pectosomata" for the compact-bodied families Botryllidæ and Polystyelidæ, and "Chalarosomata" for the remaining families with extended or divided bodies.

I divide, then, the Tunicata into three main sections or orders:—

I. Larvacea, the free-swimming, permanently-tailed, larva-like, mostly minute Appendicularians.

II. Thaliacea, the free-swimming, highly modified, tail-less, somewhat barrel-shaped, Salps and Doliolums and their allies.

III. Ascidiacea, the sessile, mostly fixed, Simple and Compound Ascidians.

The collection I am describing does not contain representatives of the two first orders, nor yet of the exceptionally free swimming *Pyrosoma* from the third section; so we have only to do with the ordinary Simple and Compound Ascidians, which are all built up on one general morphological plan, each member of the colony of a Compound Ascidian being comparable in structure with a single solitary Simple Ascidian. It will serve, then, as an introduction to the descriptions of the various forms in this catalogue if I give here a short account

of the structure of a typical Simple Ascidian, dealing chiefly with those points which are of importance in classification and diagnosis. The figures on Plate A. illustrate the following description of an Ascidia :—

The ordinary species of *Ascidia*, such as are found in both European and Australian seas, in shallow waters round the coast, are irregularly ovate bodies, several inches in length, attached by one (the posterior) end to a stone or other foreign body (Pl. A., fig. 1). The opposite (anterior) end has an opening, Br. (the "branchial aperture" or mouth), surrounded by 8 lobes, and leading (fig. 4) by a funnel-shaped passage (the "branchial siphon") into a large cavity (the "branchial sac" or pharynx), which occupies a great part of the interior of the body (fig. 2). The wall of the branchial sac is perforated by numerous slits (the "stigmata," formed by the breaking up or modification of gill slits) by means of which the water taken in at the mouth passes outwards into a space (the "peribranchial cavity" or "atrium"), which nearly surrounds the branchial sac and communicates with the exterior on the "dorsal" surface by an opening (the "atrial aperture") surrounded by 6 lobes (figs. 1, 2, and 4). The positions of the branchial and atrial apertures serve to distinguish the anterior end and dorsal surface.

These branchial and atrial apertures are the only openings on the surface of the body (fig. 1), which is covered all over by a firm and sometimes thick layer, the "test," which is of the nature of a cuticular secretion organised by the immigration of numerous cells (fig. 5), some, at least, of which are mesodermal. The ectoderm, the outer epithelium or continuous layer of cells of the body, lines the test and separates it from the muscular and connective-tissue body wall, known as the "mantle." Outgrowths of the mantle covered by ectoderm (fig. 5) may form branching blood "vessels" in the test (Pl. B, fig. 9). These and

certain cell modifications may produce very various colours, appearances, and histological conditions of the test in different Ascidians. Finally, the test is notable amongst animal tissues for containing "tunicine," or animal cellulose.

The branchial sac (figs. 2, 3, 4) is the dominant organ in the anatomy of an Ascidian, and shows almost endless variations in structure, many of which are made use of in classification and in the diagnosis of species. The wall of the branchial sac is penetrated by a large number of channels, through which blood flows. These form the boundaries of the stigmata (fig. 3, *sg.*) through which the water passes from the branchial to the atrial cavity. The chief vessels or blood channels are:—the "transverse" (Pl. A, fig. 3, *tr.*), which run dorso-ventrally round the sides of the sac, the "interstigmatic" or fine longitudinal (fig. 3, *l.v.*), and the stout internal longitudinal bars (*i.l.b.*) which run antero-posteriorly and with the transverse vessels form prominent meshes containing each a certain number of stigmata. The diagram (fig. 2) shows how the atrium surrounds the branchial sac on all sides, except the ventral, where the wall of the sac becomes continuous with the mantle.

The branchial sac is very large in most Ascidians, and extends nearly to the posterior end of the body, while the rest of the alimentary canal lies (in *Ascidia*) upon its left side. The opening of the pharynx (branchial sac) into the œsophagus is placed far back on the dorsal edge, and is connected with the front of the sac (mouth) by a prominent ridge or fold, the dorsal lamina (*d.l.*, figs. 2, 6, 7).

Along the opposite or ventral edge of the sac runs a conspicuous groove with thickened lips, and containing glandular cells for the secretion of mucus. This is the endostyle. Food particles entering the mouth first pass through a circle of tentacles (simple in *Ascidia*, branched in many other Ascidians) attached round the base of the

branchial siphon, and are then entangled in the strings of mucus which are formed in the endostyle and are driven forward by ciliary action, and then round to right and left by means of the "peripharyngeal groove" so as to reach the front of the dorsal lamina, which in its turn guides the mucus-entangled food downwards to the œsophagus (Pl. A, fig. 4, *œ.*, see also Pl. B, fig. 10).

The œsophagus is a narrow tube which leads to the stomach, a large thick-walled organ lying on the left-hand side of the branchial sac (Pl. A, fig. 4). From the opposite end of the stomach arises the intestine, a large curved tube which ends by opening into the cloacal portion of the atrium, from which the fæcal pellets are carried to the exterior through the atrial aperture by the water current.

The heart is placed alongside the stomach, and is notable in all Tunicata for its remarkable property of periodically reversing the direction of contraction, so that the course of circulation is at one time in one direction, and about a minute later is in the opposite direction (Pl. B, fig. 10). In a common British species of *Ascidia* the reversal of the blood current takes place about every ninety seconds.

The nervous system consists of a single ganglion placed near the front end of the dorsal edge of the body (fig. 4), between the branchial and atrial apertures. Underneath the ganglion is placed the neural, or hypophysial, gland (fig. 6), the duct of which has a curiously-curled or otherwise complicated opening into the branchial sac at the anterior extremity of the dorsal lamina, and which, from its position and its prominence, is known as the dorsal tubercle (figs. 6 and 7, *d.t.*). This tubercle is probably a sense organ. The only other sense organs are the pigment spots between the lobes of the branchial and atrial apertures, the tentacles at the base of the branchial siphon, and possibly some parts of the dorsal lamina.

The walls of the alimentary canal are glandular, and a separate digestive gland may exist in the form of a system of minute tubes ramifying over the intestine, and opening into the stomach. A renal organ is present occupying one loop of the intestine, another loop encloses the reproductive organs (see Pl. A, fig. 4, and Pl. B, fig. 10).

The Ascidian is hermaphrodite through not usually self-fertilising. The ovary and testis are both of them ramified tubes, and their cavities represent a part of the original coelom of the embryo which is not developed into any continuous body cavity in the adult. The reproductive ducts are continuous with the walls of their organs, and lead alongside the intestine to terminate in the atrial cavity close to the anus. In some Ascidians reproductive organs (gonads) are present on both right and left hand sides of the body, and in yet others there are several or even many (in *Polycarpa*) complete sets of male and female gonads attached to the inner surface of the mantle on both sides of the body, and projecting into the peribranchial cavity. The condition of the reproductive system affords valuable characters in classification and the diagnosis of genera and species.

This brief sketch* of the structure of a typical Ascidian will probably serve as an explanatory guide to the technical descriptions of species and diagnoses of genera and other groups that occur in the body of this catalogue.

In Plate B, I have added a few figures illustrating the combination of "Ascidiozooids" to form colonies in the Compound Ascidians. Thus figure 5 shows two Ascidiozooids with a common cloacal aperture; figures 6 to 8 show

* A somewhat fuller account on the same lines will be found in the Article "Tunicata" of the Encyclopedia Britannica, 9th Edn. ; and a much more detailed statement is given in the Introduction to the "Challenger" Report on the Tunicata. After that reference must be made to the original memoirs of Milne-Edwards, Huxley, Savigny, Lacaze-Duthiers, Giard, Traustedt, Sluiter, Herdman, Van Beneden and Julin, Roule, and many others.

the three shapes of Ascidiozooid characteristic of (fig. 6) a Botryllid, (fig. 7) a Distomid, and (fig. 8) a Polyclinid; while figures 1 to 4 represent whole colonies of (fig. 1) a Distomid, (fig. 2) a Didemnid, (fig. 3) a Polyclinid, and (fig. 4) a Botryllid. These figures may help in reading the descriptions of Compound Ascidians in the latter part of this Catalogue.

In consideration of the great importance of the matter, and the use made of it in definitions of the group Tunicata and its larger divisions (see pp. 1, 2, &c.), I have given, on Plate C, a series of diagrammatic figures illustrating the more note-worthy stages in the embryology and early life-history of a typical Tunicate. Figure 1 shows the ovum and spermatozoon, figs. 2 to 6 successive embryonic stages, figs. 7 to 9 the free-swimming tailed "Chordate" larva, and figs. 10 to 12 the process of degeneration into the sedentary adult Ascidian, such as those described from Australia in the following pages.

THE

TUNICATA

OF

THE AUSTRALIAN MUSEUM.

TUNICATA.

The Tunicata (or Urochorda) are hermaphrodite marine chordate animals which show in their development the essential vertebrate characters, but in which the notochord is restricted to the posterior part of the body, and is in most cases present only during the free-swimming larval stages. The adult animals are usually sessile and degenerate, and may be either solitary or colonies, fixed or free. The nervous system is in the larva of the elongated, tubular, dorsal vertebrate type, but in most cases degenerates in the adult to form a small ganglion placed above the pharynx. The body is completely covered with a thick cuticular test ("tunic") which contains a substance similar to cellulose. The alimentary canal has a greatly enlarged respiratory pharynx (the branchial sac) which is perforated by two or many more or less modified gill slits, opening into a peri-

branchial or atrial cavity, which communicates with the exterior by a single dorsal (rarely two ventral) exhalent aperture. The ventral heart is simple and tubular, and periodically reverses the direction of the blood current.

The leading vertebrate characteristics of the Tunicata are the notochord, the dorsal nervous system, the ventral heart and the respiratory pharynx with gill clefts; but these all disappear or undergo modification to such an extent during the metamorphosis, that the degenerate adult would not in most cases be recognised as belonging to the Chordata were it not for our knowledge of the life-history.

Order I. **ASCIDIACEA,** Blv., 1827.

This group includes fixed or free-swimming Simple or Compound Ascidians, which, in the adult, are never provided with a tail and have no trace of a notochord. The free-swimming forms are colonies, and the Simple Ascidians are never free-swimming.

The test is permanent and well-developed; as a rule it increases with the age of the individual.

The musculature of the mantle is in the form of an irregular network, there being no regular circular bands.

The branchial sac is large and well-developed. Its walls are perforated by numerous slits (the stigmata) opening into a single peribranchial cavity, which communicates with the exterior by the atrial aperture.

The anus opens into the peribranchial cavity.

Many of the forms reproduce by gemmation, and in most of them the sexually produced embryo develops into a tailed larva.

The order Ascidiacea is divided into three sections—the Ascidiæ Simplices, the Ascidiæ Compositæ, and the Ascidiæ

Luciæ — of which the last is not represented in the collection.

Sub order I. **ASCIDIÆ SIMPLICES,** Savigny, 1816.

This group contains fixed (rarely unattached, but never free-swimming) Ascidians which are solitary, and very rarely reproduce by gemmation; if colonies are formed, the members of the colony are not buried in a common investing mass, but each has a distinct test of its own, and gemmation is not directly from the body of the parent, but from a basal stolon.

The Ascidiæ Simplices include four families—the Clavelinidæ, the Ascidiidæ, the Cynthiidæ, and the Molgulidæ—all of which are represented in the collection.

Family I. **CLAVELINIDÆ,** Forbes, 1853.

Body attached by the posterior end, and usually by means of a peduncle, to a creeping basal stolon or common stolonial mass, from which young Ascidiozooids are formed by gemmation.

Test gelatinous, rarely cartilaginous, usually thin and transparent. Apertures circular, very rarely distinctly lobed.

Branchial sac not folded, often without internal longitudinal bars. The bars, if present, have no papillæ. The stigmata are straight.

Dorsal lamina represented by languets.

Tentacles simple, filiform.

Alimentary canal usually extending beyond the branchial sac posteriorly to form an abdomen.

Gonads placed in the intestinal loop. In addition to sexual reproduction, colonies may be formed asexually by gemmation from the stolon.

This family contains about 10 genera, and over 30 species. These are probably the most primitive of the Ascidians. They link on in the one direction through *Ecteinascidia* to *Ciona* and the Ascidiidæ, and so to the rest of the Simple Ascidians, and in the other direction through *Diazona* to the Polyclinidæ and other typical Compound Ascidians.

Podoclavella,* Herdman, 1890.

Body extremely long and narrow, divided into thorax and abdomen, and placed on the end of a long slender stalk.

Test on the body thin, on the stalk thick and cartilaginous or horny.

Mantle thin, musculature slight.

Branchial sac with no internal longitudinal bars, and no papilliform connecting ducts; transverse vessels all equally wide, and bearing broad horizontal membranes. Stigmata large.

Visceral mass extending behind the branchial sac to form a distinct abdomen as large or larger than the thorax, and followed by a well-marked post-abdominal peduncle.

There are two species in the genus, which may be separated as follows:—

Colour light bluish green, tentacles in two rows, *P. borealis*, Sav. (Arctic).

Colour purplish, tentacles in one row, . . *P. meridionalis*, Herdm. (Australia).

Podoclavella meridionalis, Herdman† (1890). Pl. Clav. II., figs. 1—4.

External appearance. Body claviform, on a long slender stalk. Anterior end narrow but truncated, bearing both the branchial and the atrial apertures. Attached by lower narrower end of stalk. Surface of upper part of body smooth, of stalk slightly corrugated transversely. Colour of stalk yellow, of upper part of body grey, with a bluish purple tinge in centre. Length over all about 7·5 cm. Length of stalk about 4·5 cm. Breadth of upper part of body 7 mm, average breadth of stalk 2 mm.

Test thin but tough and cartilaginous over the wider part of the body, thicker and more horny on the stalk.

Mantle of a purplish colour, but thin and with little musculature, probably continued down the stalk as a slender tube. Siphons well-marked, with sphincter muscles.

Branchial sac large. The transverse vessels are wide, and all of the same size; they bear wide horizontal membranes. The stigmata are

* A new genus formed for one of the species in this collection, along with the *Clavelina borealis* of Savigny. First characterized in my paper on *Ecteinascidia* and the Clavelinidæ read before the Biological Society of Liverpool, in December, 1890 (see Trans. Biol. Soc. L'pool, vol. V., p. 144); defined more fully in "Revision," Journ. Linn. Soc., Zool., vol. XXIII., p. 603, 1891.

† Briefly diagnosed in "Revision," p. 603; the full description is now given.

fairly large, and are arranged with regularity. There are no internal longitudinal bars, and no papilliform processes on the horizontal membranes.

Dorsal languets are present. They are long and pointed, and are not united at their bases.

The tentacles are numerous and slender, placed in one row.

The viscera form a large opaque mass, longer than the thorax, and of nearly cylindrical form, the stomach forming no marked enlargement. The rectum is very long.

Locality.—Port Jackson.

This form (Pl. Clav. II., fig. 1) has a superficial resemblance to some Compound Ascidians of the genus *Colella*, where the body is placed on the summit of a long slender horny stalk.* The lower end of the stalk is expanded, and gives off root-like prolongations. The viscera and mantle are of a dark purplish colour, which shows through the thin grey test. There is a central cavity continued down the stalk, which probably contained a tubular prolongation from the body similar to that which is found in the stolon of *Clavelina*. It has, however, in these specimens been retracted and torn, no doubt as a result of the mode of killing and preservation, so as to lose its connection with the body proper, but its remains are to be found adhering to the walls of the tube. The branchial and atrial apertures are on small papillæ placed not far apart. The mantle is full of dark purplish pigment corpuscles, which make it quite opaque; the branchial and atrial siphons are especially dark-coloured. The branchial sac is large and has numerous stigmata. The horizontal membranes are especially wide (Pl. Clav. II., fig. 4).

Dr. Sluiter, in describing the Tunicata collected by Prof. Semon at Amboina and Thursday Island, came upon a form which he suspected to be this species. So, before describing it, he courteously consulted me on the matter, and sent me drawings. I had little difficulty in recognising that his specimen belonged to my species, and now that Sluiter's full account has been published,† I am still of the same opinion, notwithstanding a few slight differences in our descriptions and figures. These, I think, do not exceed the limits of individual variation.

* See Herdman, "Challenger" Report, Pt. II., p. 72. See the species of *Colella*, figured further on in this Catalogue (Pl. Dist. I.).

† Jenaische Denkschr. VIII., p. 165.

Stereoclavella,* Herdman, 1890.

Colony with the stolons united in a basal thickening or mass of test. Body not pedunculated, apart from the long abdomen, which is distinct from the thorax. Branchial and atrial apertures circular, not lobed.

Test on the body thin, thicker and cartilaginous posteriorly, where it forms the stolonial basal mass.

Mantle thin.

Branchial sac with no internal longitudinal bars. Transverse vessels all equally wide.

Visceral mass forming a distinct abdomen as large as the thorax.

There are four known species in the genus, *S. (Clavelina) oblonga*, Herdm., from the Atlantic, and *S. (Clavelina) enormis*, Herdm., from the South Atlantic, both obtained during the "Challenger" Expedition, in addition to the two described below. Garstang's *Pycnoclavella aurilucens*, from Plymouth, must be a closely related form.

Stereoclavella australis, Herdman (1891), Pl. Clav. I., figs. 1—11.

External appearance. The colony tassel-shaped, consisting of a large number of Ascidiozooids united together in clumps on the summit of a solid stalk-like mass of test. Free ends of the Ascidiozooids cylindrical, truncated anteriorly, where both apertures are placed not far apart. Colony about 9 cm. in length, and 5 to 6 cm. in breadth at the broadest part, and 3 cm. in thickness at the same place. The average thickness of the basal solid test is 2 cm., and its length about 5 cm. Surface smooth, colour grey.

Test thin over the thoracic, free, part of the Ascidiozooid, thicker over the abdomen, gradually passing into the very thick solid basal mass. Abundance of small test cells in all parts. Over the abdominal part of the body small and very slender unbranched spines project from the surface of the test: each has a test cell at its base. Solid basal part of test with numerous stolonial blood vessels running in all directions and giving rise to many buds.

Mantle with about 6 very distinct longitudinally running muscle bands on each side of body, on the thorax. These spread out and become more numerous on abdomen. Body of Ascidiozooid nearly 2 cm. long and about 5 mm. wide in the thoracic part Thorax globular,

* Briefly defined for the reception of the two "Challenger" species *Clavelina oblonga* and *C. enormis*, along with the present species, in Trans. Biol. Soc., L'pool, vol. V., pp. 160—161; and also in "Revision," Jour. Linn. Soc., Zool., vol. XXIII., p. 603.

with a great ventral projection, and an accumulation of ova and embryos on the dorsal edge. Abdomen long and narrow, swelling at the posterior end where the stomach is placed. A slender stolonial appendage is continued down from the posterior end of the abdomen. The branchial and atrial siphons are well-developed, but not lobed; they have strong sphincters. The mantle, on the whole, is rather strong and opaque, with well-developed musculature and abundant pigmentation.

Branchial sac with about 14 rows of stigmata. The transverse vessels are all alike and are moderately wide. They are provided with horizontal membranes.

Dorsal languets large, triangular, joined to the horizontal membranes, and not united by any longitudinal band.

Tentacles about 20 in number, and of 3 sizes, the larger ones being long and slender.

The visceral mass is very long, and is formed chiefly of œsophagus and intestine. The reproductive organs are placed in the loop. There is a large conspicuous vas deferens running up the inner side of the rectum.

Locality.—"Under stones at low tide, Vaucluse, P.J., John Brazier, F.L.S."

This species in appearance (see Pl. Clav. I., fig 1.) is singularly like a *Diazona*, but differs entirely from that genus in the structure of the branchial sac (figs. 9 and 10). The arrangement of the Ascidiozooids is seen well in fig. 2, in which half of the colony has been cut away; fig. 3 is one of the clumps. Figures 4 and 5 show the appearances of the right and left sides of the body respectively. The spines on the abdominal portion of the test (fig. 6) are not numerous. Each spine springs from immediately over a test cell, but there are far more test cells than spines. Deeper in the test a few "bladder cells" and other modifications of the test cells are found (fig. 7), while in the basal part of the colony there are very many ramifying stolons (fig. 11) with abundance of small buds. The longitudinal muscles of the mantle, which are few and regular on the thorax (see fig. 8, which shows also the distribution of pigment masses), break up over the abdomen, and further back come to be arranged chiefly dorsally and ventrally, about 15 bands on each side of each edge of the body—about 60 longitudinal bands in all. There are no transversely running muscles. In the peribranchial cavity were found many large tailed larvæ, measuring up to 1 mm. in length of body.

Stereoclavella sp. (**?australis**, Herdman), Pl. Clav. II., figs. 5—8.

External appearance. The colony consists of several individuals adhering by their narrow posterior ends to a short thick irregular stolon. The anterior end of each Ascidiozooid is relatively wide and irregularly truncated. The body is elongated and distinctly divided into thorax and abdomen. The apertures are close together at the anterior end. The colour is grey. The length of an Ascidiozooid is 1·2 cm., breadth 4 mm.

Test thin and transparent, rather thicker on stolon.

Mantle thin and transparent, muscle bundles mainly longitudinal.

Branchial sac delicate, transverse vessels all the same size. Stigmata large and numerous. Horizontal membranes present.

Dorsal languets long, and closely-placed, triangular in form.

Locality.—Broughton Islands (No. 43).

The specimen shown at Pl. Clav. II., fig. 5, may possibly be a detached piece from a larger colony, like that figured on the previous plate; but even then it is questionable whether it can be referred to the same species, as the musculature of the mantle (fig. 6) and the proportions of the dorsal languets (fig. 8) are a good deal different. This species, treating it as a distinct one, seems closely allied to *Stereoclavella* (*Clavelina*) *oblonga*, Herdman, from which it differs chiefly in the size and shape of the dorsal languets. In *S. oblonga* they are short and conical, and are placed about their own length apart*; while in the present species they are long and triangular in form (fig. 8), having an expanded base flattened antero-posteriorly, and tapering to a narrow point; the distance between them is only about a fourth of the length of each languet. The languets are united at their bases by a longitudinal band (fig. 8, *d.l.*), which is very different from the condition shown (Pl. Clav. I., fig. 10) in *S. australis*, where the stigmata are uninterrupted round the dorsal edge of the sac.

Several large opaque ova and young embryos were found at the posterior end of the peribranchial cavity, close to the œsophagus, in one of the specimens, which shows that the Ascidiozooids were adult—although possibly they may be only a fragment of a colony.

[The following Clavelinidæ have also been found in Australian seas:—

Perophora Hutchisoni, Macdonald.

Ecteinascidia euphues, Sluit.

E. psammodes, Sluit.

Rhopalopsis crassa, Herdm., Ki Is., 129 faths.

R. fusca, Herdm., Banda, 17 faths.]

* "Challenger" Report, Part I., Pl. XXXV., fig. 8.

Family II. **ASCIDIIDÆ,** Herdman, 1880.

Body attached, usually sessile, rarely pedunculated. Branchial aperture usually 8-lobed, atrial usually 6-lobed.

Test gelatinous or cartilaginous, rarely chitinaceous or horny.

Branchial sac without folds. Internal longitudinal bars present and usually papillated. Stigmata straight or curved.

Tentacles simple, filiform.

Alimentary canal either at one side of the branchial sac (usually the left) or extending beyond it posteriorly.

Gonads placed close to the intestine.

There are four sub-families—the Corellinæ, the Hypobythiinæ, the Ascidiinæ, and the Cioninæ; only the two latter are represented in this collection.

Sub-family **CIONINÆ,** Roule, 1884, Herdman, 1891.

Body more or less cylindrical, attached by posterior end.

Test thin and gelatinous, may be modified anteriorly to form a lobe covering the apertures.

Mantle with the musculature mainly longitudinal.

Branchial sac provided with internal longitudinal bars. Stigmata straight.

Dorsal lamina represented by languets.

Alimentary canal on left side of branchial sac, extending posteriorly to it.

I use this sub-family in a somewhat different sense from that originally proposed by Roule. Keeping *Ciona* as the typical form, I remove *Rhopalæa* to the family Clavelinidæ, and I substitute in its place *Rhodosoma*, which seems to me to have more affinity with *Ciona* than with *Ascidia*.

Ciona* (Savigny, 1816), Fleming, 1828.

Ciona intestinalis (?), Linn., Pl. Asc. I., figs. 1—4.

About two dozen specimens from "off Cockatoo Island, Port Jackson (No. 21)," appear to belong to this common European species. They are very large and soft, and have an overgrown flaccid appearance. The largest is about 10 cm. in antero-posterior extent, even after preservation in alcohol. The test is in most cases exceedingly thin, in some quite membranous: the mantle is also very thin and transparent, and the

* For characters of genus see Herdman, "Revision," p. 598.

muscle bands, although of the usual number, are remarkably weak. The alimentary canal is very clearly visible through the mantle (see fig. 3), and is seen to extend unusually far forwards. The branchial sac has very large papillæ projecting from the internal longitudinal bars; these are relatively larger and more conspicuous than in British specimens of the species. Figure 4 shows the dorsal tubercle. Many of the specimens adhere together in groups by their posterior ends, and their tests have grown together, but there is no reason to regard them as forming colonies. Notwithstanding these few points of difference in detail, I do not feel justified in separating the Australian specimens as a new species. I find also in the collection one specimen of a *Ciona* (figs. 1 and 2) adhering, along with *Colella tenuicaulis*, to the back of the crab *Macippe spinosa*, Stimp. It is 2 cm. in length and 1 cm. in thickness, and is in a greatly contracted state. There are also 3 small specimens of *Ciona* adhering to *Chorizocormus subfuscus*, from Port Jackson. All of these specimens are more or less in bad condition for detailed examination, but appear to be indistinguishable specifically from *Ciona intestinalis*, Linn., although living material might show differences.

[The following Cioninæ have also been recorded from Australian seas:—

Rhodosoma, Ehrenberg, 1828.

R. (Pera) Huxleyi, Macdonald.

R. (Peroides) sp., Macdonald.]

Sub-family **ASCIDIINÆ**, Herdman, 1882.

Body usually attached by left side or posterior end. Branchial aperture with at least 8-lobes, atrial with at least 6-lobes.

Test gelatinous or cartilaginous.

Mantle with the musculature forming an irregular network, which is strongest on the right side.

Viscera on the left side of the branchial sac.

Branchial sac provided with internal longitudinal bars. Stigmata straight.

Dorsal lamina usually a plain membrane, rarely languets *(Abyssascidia)*.

Ascidia, Linn.

Only the typical genus *Ascidia* is represented in this collection. It contains two new species.

Ascidia incerta, n. sp., Pl. Asc. I., figs. 5—8.

External appearance. The body is ovate, with very well-marked, distinctly lobed siphons, upon which the apertures are placed. It is attached by the posterior end. The branchial aperture is anterior, and the atrial is about two-fifths of the way down the dorsal edge. The surface is slightly rough and partly covered with adhering animals. The colour is yellowish grey. Length 5 cm., breadth 3 cm., thickness 1·5 cm.

Test thin, but tough, translucent; conspicuous vessels.

Mantle fairly muscular round the edges of the right side, less muscular in the centre of that side, and very thin and membranous over the viscera. Siphons very distinct; branchial 7-lobed and atrial 6-lobed.

Branchial sac minutely plicated, with transverse vessels all of one size. Meshes nearly square, containing each about 7 stigmata. The internal longitudinal bars bear at the angles of the meshes large curved papillæ, which vary a good deal amongst themselves in size and shape.

The dorsal lamina is rather narrow. It is strongly ribbed, but has a plain edge. The œsophageal aperture is fully two-thirds of the way down.

The tentacles are very numerous, and closely placed. They are long and slender, and differ somewhat in size amongst themselves, but there is no regularity in their arrangement.

The dorsal tubercle is simple but very large, occupying the whole of a very deep peritubercular area. It is elongated antero-posteriorly, with the horns curling outwards at the anterior end.

Locality.—Port Jackson. One specimen.

This specimen from Port Jackson is in some respects very like *Ascidia pyriformis*, found by the "Challenger" Expedition in the same bay at a depth of 6 fathoms. I have given this species the specific name *incerta*, because I still regard it as somewhat uncertain, or open to doubt, whether or not it is distinct from *A. pyriformis*. In using the dichotomising table of the characters of the species of *Ascidia* given in my "Revision," at p. 591, one is led by the characters of the present species straight to *pyriformis* at the top of p. 593; but on looking into further details it is found that there are certain definable points of difference. That being so, I think it wiser to describe *A. incerta* as a distinct species; but I think it quite possible that the examination of a larger series of specimens than the 2 of *pyriformis* and 1 of *incerta* now known, may lead to the union of the two species. The chief differences are: the larger meshes of the branchial sac in *A. incerta* containing 7 stigmata (Pl. Asc. I., fig. 6) in place of 3 or 4, the plain edge to the dorsal lamina (fig. 7), and the remarkably large dorsal tubercle (fig. 8).

In *A. pyriformis* also the dorsal tubercle is remarkable,* but in a different way. If these two forms turn out to be one species, it must have a very wide range of individual variation in its dorsal tubercle.

Ascidia phallusioides, n. sp., Pl. Asc. II.

External appearance. The body is oblong, rather wider posteriorly and with a rounded anterior end. It is attached by the posterior end and a small part of the left side. The branchial aperture is near the anterior end, but is recurved so as to point nearly backwards—it has about 12 lobes; the atrial aperture is on the right side of the dorsal edge, near the anterior end, and points forwards—it has 6 lobes. The surface is smooth, but marked with deep grooves with rounded edges. There may be little rounded knobs scattered over the surface. The colour varies from a warm yellowish grey to a dark smoky brown. The length is 16 cm., the breadth 8 cm., and the thickness 6 cm.

Test thick and cartilaginous, firm, of the same colour and consistency throughout, and smooth on both surfaces. Large vessels from the body enter the test on the left side in front of the middle, and branch through all parts.

Mantle thin, but muscular on the right side. The longitudinal muscle bands are mainly external, and the circular or transverse internal. The anterior part of the left side of the mantle is thinner and less muscular, while the posterior part over the viscera is very thin, and has no muscle bands.

Branchial sac large and strong, minutely plicated. The transverse vessels differ in size, and there are usually 3 smaller between each pair of larger. The internal longitudinal bars bear very large papillæ at the angles of the meshes, and are connected with the transverse vessels by wide membranes. The meshes are elongated transversely, and contain each 6 to 8 stigmata.

Endostyle large, reaching to posterior end of branchial sac.

The dorsal lamina is a narrow but strongly ribbed and toothed membrane. The large œsophageal aperture is placed about two-thirds of the way down it.

The tentacles are not large. They are 36 to 40 in number, and are of two sizes placed alternately.

The dorsal tubercle, is small and simple. It is placed in a large triangular peritubercular area, continuous with the rather narrow pre-branchial zone.

* See "Challenger" Report, Part I., p. 220.

The nerve ganglion is placed only 1 cm. behind the dorsal tubercle, and the whole space between them is occupied by the very large neural gland, which has many complicated openings into the atrial cavity.

The locality is Port Jackson.—Half a dozen specimens.

This large and very solid species approaches in its characters the genus *Pachychlæna*, which was formed (as a sub-genus originally) for the reception of three "Challenger" species, which differed from *Ascidia* in their very massive cartilaginous tests. These three species were, one from Simon's Bay, Cape of Good Hope, and the other two from Bass' Strait, Australia, at a depth of 38 to 40 fathoms. The present species, in the condition of the test, is intermediate between the ordinary *Ascidia* and these species of *Pachychlæna*, consequently I now feel inclined to relinquish the latter genus.

This large species is undoubtedly new to science. I have examined the following specimens:—three typical examples (A, B, C) and one (D) of much darker colour which might be placed as a variety, also 3 additional specimens (E, F, G) which were in the original collection sent to the London Fisheries Exhibition of 1883. The sizes are as follows:—

	Length.	Breadth.	Thickness.	Remarks.
A	14 cm.	7·5 cm.	6 cm.	Several other Ascidians, Cynthiidæ and Molgulidæ are attached.
B	16·5 ,,	8 ,,	6·5 ,,	Typical example.
C	10 ,,	6 ,,	4·5 ,,	This one is darker in colour than the two preceding, and forms a transition to the next.
D	13 ,,	8 ,,	5 ,,	Dark-coloured variety.
E	13·5 ,,	7·5 ,,	7 ,,	Light-coloured ventrally and darker dorsally.
F	11·5 ,,	6 ,,	5 ,,	Lighter coloured throughout.
G	8·5 ,,	5·5 ,,	4 ,,	Lighter coloured throughout.

In size and general shape this species recalls *Ascidia mentula* of European seas, but that the body is more compact in this species, and the atrial aperture is placed further forward. The branchial aperture is very irregularly lobed in the test, but in the mantle there seem to be about 12 lobes, an unusually large number for an *Ascidia*. The surface of the test may have little scattered knobs, which gives an appearance like that of *Phallusia mammillata*. There is a deep groove with several branches running down the middle of the right side (Pl. Asc. II., fig. 1.) in all the specimens. This may be partly due to contraction on death.

In specimen D (No. 12 of Museum labels), where the colour of the test is very dark there is a great deal of pigment found, and there are little black areas 0·5 to 1 mm. in diameter scattered irregularly over the surface. Each of these has a non-pigmented brownish lighter spot in its centre (see figs. 9 and 10.), while similar smaller spots or papillæ are scattered all over the surface both on the black areas and between them. Each such papilla is the enlarged knob of a blood vessel. The test is in all cases very vascular (fig. 3.) When the test, which averages about 5 mm. in thickness, is removed the body looks rather small. It is flat on the right side and convex on the posterior part of the left side, where the viscera form a projection. The siphons are well marked. The large branchial is anterior and the atrial is about one-fifth of the length of the body from the anterior end, and is directed dorsally (fig. 1).

The thick walled branchial sac has a rough appearance internally, due to the large papillæ (fig. 2). It is not reduplicated at the posterior end, and this forms an important point of difference between the present species and *Ph. mammillata*, the type of the genus *Phallusia*, according to Roule's classification. On account, however, of a certain resemblance in form, and also in the condition of the neural gland described below, to that species, I have given the specific name *phallusioides*.

One of the most notable points about this species is the remarkable condition of the neural or hypophysial gland. This organ is large and extends from the dorsal tubercle anteriorly to the nerve ganglion posteriorly (fig. 7). Its aperture on the dorsal tubercle into the branchial sac is small and simple (fig. 5), but it has a large number of complicated secondary openings on the surface which is directed towards the atrial cavity (fig. 8).

In the dark variety (specimen D) the gland is longer and narrower behind the dorsal lamina than in the other specimens, but is otherwise the same, and has many secondary openings.

This adds another to the small number of remarkable Ascidians

which have many small secondary openings from the neural gland, or its duct, into the peribranchial cavity. This condition has been described by Julin and by Herdman in *Phallusia mammillata*, by Roule in *Ascidia Marioni*, and recently by Metcalf* in *Ascidia atra*, from the West Indies. The present species differs from these others in having the neural gland so near to the dorsal tubercle, in having the secondary openings practically sessile upon the gland (fig. 7), and in having these openings so curved and twisted as to look like the opening in a dorsal tubercle (fig. 8). Metcalf points out the indication of relationship between the four species given by this remarkable anatomical condition, and I am inclined to think that the best way to recognise this fact might be to modify the definition of the genus *Phallusia*, so that *marioni*, *atra*, and *phallusioides* may be incorporated therein along with *Ph. mammillata*.

[The following Ascidiinæ have also been found in Australian seas :—

Abyssascidia wyvillii, Herdm , S. of Australia, 2,600 faths.
Ascidia cylindracea, Herdm., Twofold Bay, 120 faths.
A. pyriformis, Herdm., Port Jackson, 6 faths.
Pachychlæna oblonga, Herdm., Bass Str., 40 faths.
P. obesa, Herdm., Bass Str., 40 faths.
A. Sydneiensis, Stimp , Port Jackson, low tide.
A. succida, Stimp., Port Jackson, low tide.
A. bifissa, Sluit., Amboina.
A. empheres, Sluit., Amboina.
A. gemmata, Sluit., Amboina.
A. kreagra, Sluit., Amboina.
? *A. diaphana*, Q. & G., Hobart Town.]

Family III. **CYNTHIIDÆ**, Lac. Duth., 1877.

Body usually attached, rarely free, sometimes pedunculated.

Test membranous, or coriaceous, rarely cartilaginous or covered with sand. Branchial aperture usually 4-lobed, atrial 4-lobed.

Branchial sac, longitudinally folded; internal longitudinal bars not papillated. Stigmata straight, never forming spirals.

Tentacles simple or compound.

Intestine on left side, only slightly, or not at all, attached to the mantle.

* See for an interesting discussion of the subject, Zoological Bulletin, vol. I., No. 3, Boston, 1897.

Gonads on the inner surface of the mantle, either on both sides or on one only.

This very large and important family contains three well-marked sections or sub-families—the Bolteniinæ, the Cynthiinæ, and the Styelinæ—all of which are well represented in the collection.

Sub-family **BOLTENIINÆ**, Herdman, 1880.

Body attached and pedunculated; peduncle usually very long, branchial and atrial apertures having either 4 or less than 4 lobes.

Test coriaceous, membranous or cartilaginous, not covered with sand.

Branchial sac with more than four folds on each side.

Tentacles compound.

It is unfortunate that the eminent French Ascidiologists MM. Lacaze-Duthiers and Yves Delage,* in discussing the characters of the Cynthiidæ in 1889, should have entirely omitted to consider this important sub-family, so as to give the impression that only the sub-families Cynthiinæ and Styelinæ exist. I established the sub-family in 1880, and again gave an account of it and described a number of new species belonging to it in the "Challenger" Report in 1882. The same authors, at p. 524 of their paper, indicate that the Cynthiæ cæsiræ of Savigny are, in their opinion, probably Molgulidæ, and they cite Roule's similar statement (1886) as apparently the only previous investigation of the matter. But I showed in 1882, four years before Roule, and seven years before Lacaze-Duthiers and Delage, that Savigny's Cynthiæ cæsiræ really belonged to the genus *Molgula*.

Boltenia, Savigny, 1816.

Only the genus *Boltenia* in this sub-family is represented. There are three species.

Boltenia pachydermatina, Herdm., Pl. Cyn. I.

This is one of the largest known species of Simple Ascidians, and is apparently very common in southern seas, and especially round the coasts of Australia and New Zealand. It is a striking object, may grow to a very large size, and has probably often been brought to Europe by travellers and collectors. Specimens exist in most museums, but the

* Arch. Zool. Expér. et génér., 2me. sér., t. VII., p. 519.

species had not been named nor described until the Report upon the the "Challenger" Collection* in 1882. Since then von Drasche† has given some further remarks and another figure of the species, from specimens obtained by the "Novara" Expedition to the South of Sydney. Von Drasche describes short knobbed calcareous spicules in the test. I have since found calcareous spicules in these Australian forms not only in the test, but also in the mantle and in the larger vessels of the branchial sac (Pl. Cyn. I., fig. 2). Those of the mantle are elongated fusiform curved spicules, and those in the branchial sac are rather like the spicules of *Culeolus*.

The dorsal tubercle is, in the large specimens, even more complicated in its pattern than I showed in the "Challenger" Report. I give a figure here (fig. 3) which shows also the presence of branched spicules.

The specimens in the collection are a group of 14 individuals adhering to the same basal mass (see Pl. Cyn. I., fig. 1), two others of smaller size attached together, and two or three other specimens of medium size. The largest specimen attains to about 35 cm. in length, including the stalk.

Boltenia tuberculata, Herdman‡, 1891, Pl. Cyn. II.

External appearance. Irregularly club-shaped, the body being of irregularly ovate form placed on a short curved stalk and covered with tubercles or knobs. There is not much lateral compression. The apertures are not far apart, both on one surface, both transverse slits surrounded by many lobes, of which, however, there may be 4 more prominent. Surface very uneven on account of the numerous knobs. Colour dirty creamy white, to light brown. Size (average), body 5 cm. by 3 cm. by 2 cm.; stalk about 12 cm. in length.

Test very irregular in thickness, from 1 mm. to 10 mm., cartilaginous, white in section. Large vessels are found about the top of the stalk.

Mantle thick, closely adherent to test. The finer muscle bundles form a close felted mass, while there are strong longitudinal and circular muscles extending from the siphons over the greater part of each side.

Branchial sac with 6 or 7 folds on the right side, and 6 on the left. The folds converge to the mouth of the œsophagus. There is a mesh work consisting of very stout internal longitudinal bars and more slender

* Report on Tunicata, Part I., p. 89.

† Denkschr. K. Akad. Wiss. Wien, Bd. XLVIII., p. 370. 1884.

‡ Briefly diagnosed in "Revision," p. 571, now fully described and figured.

transverse vessels, which stands on a plane internal to the inter-stigmatic vessels, which are much finer. These larger internal vessels contain spicules.

Dorsal lamina very slight, dying away almost at once behind the dorsal tubercle.

Tentacles 24 in number, 12 large and 12 small, placed alternately.

Dorsal tubercle forming two close spirals with their apices directed away from one another.

Locality.—Port Jackson, about a dozen specimens.

This species differs from the other Boltenias externally in its knobbed appearance (Pl. Cyn. II., figs. 1, 6, and 7), and internally in the structure of the branchial sac, the number of the tentacles, and the nature of the dorsal tubercle. Many of the specimens are covered with a smooth closely incrusting layer of sponge. This is one of the largest of Simple Ascidians. Although the stalk is not so long, the body attains a larger size than in *Boltenia pachydermatina.*

The sizes of the specimens before me are as follows:—

No.	Body.	Stalk.
1	4·5 × 2 × 1 cm.	12·5 cm.
2	4 × 2 × 1 ,,	8 ,,
3	5 × 1·5 × 1 ,,	13 ,,
4	6·5 × 3 × 2 ,,	20 ,,
5	4·5 × 1 × 2 ,,	4 ,,
6	9 × 5 × 3 ,,	14 ,,
7	6·5 × 3 × 3 ,,	7 ,,
8	5 × 1·5 × 1·5 ,,	9 ,,
9	4 × 1·5 × 1 ,,	7·5 ,,
10	7·5 × 4 × 2·5 ,,	20 ,,
11	5·5 × 3 × 2·5 ,,	25 ,,
12	12 × 7 × 5 ,,	cut short—

which shows a considerable variation in the proportions. The amount of tuberculation also differs in specimens. There may be as many as 40 knobs on the body. The apertures are very remarkable. In one specimen I can count 13 lobes round the branchial aperture and 12 round the atrial, but others differ; frequently, however, four of the lobes are much larger than the rest, so as to present a 4-lobed appearance (see figs. 2 and 3).

The branchial sac is very strong. There are some wide irregular vessels on the back, then the fine inter-stigmatic network, and then

the large meshes formed by the transverse vessels and the internal longitudinal bars (Pl. Cyn. II., fig. 5). This last (internal) mesh work, with its spicules, clearly corresponds to the whole wall of the branchial sac in the genus *Culeolus*. We must regard the latter as derived from *Boltenia* by the suppression of the stigmatic network.

The alimentary canal is large, and forms a close loop extending along the whole length of the left side. A gonad is present on each side, on the left in the loop of the intestine, and on the right, where it is much larger, it forms an elongated curved body, partly broken up into two rows of rounded masses.

Several of the specimens of this species are firmly attached to other kinds of Simple Ascidians (Pl. Cyn. II., figs. 6, 7) upon which they have apparently grown.

Boltenia gibbosa, Heller.

(? = *Ascidia spinifera*, Quoy and Gaimard).

Two little specimens in the collection from Port Jackson probably belong to this species. They have variously shaped spicules in the test, showing gradations from simple bars to stellate forms. There are also branched spicules in the mantle and the chief vessels of the branchial sac, which show "contour" marks or lines of growth like those in the genus *Culeolus*. There are 6 folds on each side of the branchial sac. There are 4 longitudinal bars in the interspace between folds, and about the same number on each fold. Every fourth transverse vessel is wider than the intermediate ones, which are of one size. The meshes are oblong, each containing 9 to 10 stigmata, occasionally divided by narrow membranes, which do not, however, divide the stigmata. There are tapering languets along the dorsal lamina. Only 10 tentacles are present. The dorsal tubercle is nearly circular, with one horn coiled inwards. I think it possible that this species may eventually prove to be a young form of one of the others.

[The only other species of this sub-family which has been recorded from Australia is *Boltenia australis* (Q. and G.) from Port Jackson. We can scarcely say with certainty now what this species was.]

Sub-family **CYNTHIINÆ**, Herdman, 1880.

Body attached, sessile, or very shortly pedunculated. Branchial and atrial apertures with 4 lobes each.

Test coriaceous, rarely cartilaginous, rarely covered with sand.

Branchial sac with more than 4 folds upon each side (except *Forbesella tessellata*, Forbes).

Tentacles compound.

Alimentary canal with no marked stomach, but with a glandular lobed appendage.

Of the four described genera of this sub-family, the two commoner ones, *Cynthia* and *Microcosmus*, are well represented.

Microcosmus, Heller 1877.

This genus is distinguished (see Heller, and "Revision," p. 573) from *Cynthia* by the narrow intestinal loop and the plain dorsal lamina. Several species were previously known from Australian seas, and three new ones have been added by the present collection.

Microcosmus Draschii, Herdman,* (1891), Pl. Cyn. III. and IV.

External appearance. Shape irregularly ovate or reniform, flattened from side to side, attached by a variable extent of the posterior end. Apertures both on the anterior end, large, on prominent knobs, distinctly 4-lobed. Surface very irregular, often grown over with other animals, usually corrugated and crinkled. Colour from pale yellow to dark brown. Size up to 16 by 12, by 6 cm. thick.

Test leathery or pergamentaceous, rough and irregular on the outside, smooth, glistening, and white or pearly on the inside. The posterior part may be greatly thickened, and is then soft and spongy.

Mantle very thick, opaque, muscular, and densely crowded with calcareous spicules. The large siphons have very strong sphincter muscles.

Branchial sac large and much folded. There are from 12 to 15 folds on each side. About a dozen internal longitudinal bars on a fold, and four in the interspace. Meshes small, nearly square, containing 2 or 3 stigmata only. The larger vessels contain large fusiform echinated calcareous spicules, and smaller ones are present in the finer vessels.

Dorsal lamina represented by a row of small pointed languets.

Tentacles large and branched, of 2 sizes, 12 larger and 12 shorter, placed alternately.

Dorsal tubercle very large, of circular form, with a very elaborately curved pattern all over its surface.

Alimentary canal large, forming a narrow loop along the posterior edge of the left side.

* Briefly diagnosed in "Revision," p. 575; now fully described and figured.

Locality.—Port Jackson and Port Stephen; nearly a dozen specimens.

I have formed this species for the reception of a number of specimens which vary somewhat amongst themselves, and which seem in most respects rather closely allied to *Microcosmus Julinii*, von Drasche; but which, on the other hand, I feel somewhat inclined to remove from the genus *Microcosmus*, and place in the genus *Rhabdocynthia*, alongside *R. complanata*, Herdm.

The specimens are all of large size. The largest is the one from Port Jackson, whose measurements are given above, and which is figured about half natural size in fig. 1 (Pl. Cyn. III.). The test in this specimen is tough, leathery, and of a rich dark-brown colour on the outside, as if it had been tanned or tarred externally. The posterior end of the test is provided with a number of tufted, branched processes or tags for attachment (fig. 1). When this test is cut open, however, it is found that nearly the posterior half (6·5 cm.) is solid, and so the space left for the body is much reduced (see fig. 2). Another large specimen is attached to the posterior end of a large *Ascidia*, and bears in its turn four specimens of *Polycarpa* belonging to two species (Pl. Cyn. IV., fig. 1). It is of a distinctly lighter-brown colour, and has the siphons or projections bearing the apertures relatively longer and narrower, but the internal structure is much the same. Then there are three larger specimens (between 12 cm. and 18 cm. in length) closely resembling the last, but more or less covered externally with colonies of a *Leptoclinum* and many other smaller animals.

There is a specimen from Port Stephen measuring about 7·5 cm. in length and 6·5 cm. in breadth, so that the form is nearly discoidal; and finally, there are half-a-dozen other specimens of varied shape and colour, extending from 12 cm. down to about 6 cm. in length.

With the exception of the very dark specimen (Pl. Cyn. III., fig. 1), the prevailing colours throughout the species are those bright yellows and ruddy browns which are already known in several other members of the genus. In the anterior part of the body the test is thin but tough, and it is seen in sections (fig. 4) that the projections on the surface are not mere folds, but are permanent outgrowths. The remarkable thickened part of the test forming the posterior half of the body in one specimen (fig 2) is very soft, and spongy in texture. The large apertures are square, 4-lobed, or cross-slit in shape, according to the state of contraction. When the test is removed the siphons are seen to be very muscular and very long. They may be as much as 3 cm. in

length and 1·5 cm. in diameter. Besides the very powerful sphincters (fig. 3), the rest of the mantle has strong muscle bands running in all directions, and forming a close but irregular network. The muscles are imbedded in gelatinous connective tissue, which is so densely packed with spicules as to have a felt-like appearance. The chief layer of connective tissue and spicules is on the inner side of the mantle. The spicules are shown in fig 5, and are seen to be of at least three sizes, the largest in longitudinal bands, the medium sized in rows running transversely, and the smallest scattered.

The branchial sac has generally 12 folds on each side, but in one specimen, from Port Stephen, I count 11, and in one from Port Jackson there are 15 on each side, while in another there are 12 on one side and 13 on the other. I do not find any with 14, the number given by von Drasche for *M. Julinii.*

On Pl. Cyn. IV., fig. 2 shows the general appearance of the folds round the œsophageal aperture, fig. 3 shows the lines of spicules on the outer side of the branchial sac, and fig. 4 shows part of the sac from the inside. This is a fairly regular part. In some specimens many irregularities occur.

The endostyle is very wide and shallow. Spicules are everywhere, short ones in the test, longer in the mantle, several sizes in the branchial sac, largest, perhaps, in the folds, long ones also in the tentacles.

The tentacular circle is about 2 cm. in diameter. The tentacles are in all cases very large (up to 2 cm. in length) and much branched (Pl. Cyn. IV., fig. 2), but they vary a little in number in the different specimens. Twelve larger and twelve smaller is certainly the usual and characteristic arrangement, but I have seen 10 of each, and in one case can only find 17, several of the smaller ones being evidently absent.

The dorsal tubercle may be from 7 mm. to 1 cm. in diameter, and is to the eye a convex circular elevation with a minutely marked spongy surface. Slight magnification with a lens shows that the usual slit is curved in meandering lines all over the surface, so as to form a close pattern (fig. 5). The large alimentary and reproductive viscera are completely imbedded in the thick mantle so as to be scarcely visible. There are specially large spicules in the mantle around the stomach and the ovaries.

I have left to the last the curious character that the dorsal lamina in place of being a plain smooth-edged membrane, is represented by a series of very small languets. Strictly speaking, this character ought to remove the present species from the genus *Microcosmus* and put it in

Cynthia, or rather, on account of the numerous spicules, in my genus *Rhabdocynthia*. But all the other characters agree so closely with those of species of *Microcosmus*, and the animal seems so closely related to *M. Julinii*, v. Dr., that I am inclined to think that what is at fault is our present definition of the genus *Microcosmus*, and that we shall have to admit within its limits either dorsal lamina or dorsal languets, as we have had to do in *Cynthia*. Consequently, I consider that I am placing the present form nearest to its natural allies in calling it a *Microcosmus*. I regard it as closely related to *M. Julinii*, v. Dr., which was brought by the "Novara" Expedition from Sydney. In fact, there are some points, such as the remarkable dorsal tubercle, in which it entirely agrees with that species, and at first I thought I had specimens of *M. Julinii* before me, but the presence of the languets renders that identification impossible, as von Drasche's species has a smooth edged dorsal lamina.

There are some points of resemblance between the present species and *Rhabdocynthia complanata*, Herdm., which was found by the "Challenger" Expedition at Port Jackson. The spicules and their arrangement are remarkably alike. The dorsal tubercle of *R. complanata* looks as if it might be a young form of that of the present species.

If *Microcosmus draschii* is ever moved to the genus *Rhabdocynthia*, its place will be beside *R. complanata*, and *M. Julinii* will have to accompany it.

Microcosmus australis, n. sp., Pl. Cyn. V.

External appearance. Shape erect oblong with the branchial aperture at the anterior end and the atrial one-third down the dorsal edge. Attached by the posterior end, scarcely compressed from side to side. Apertures both prominent, but small. Surface much wrinkled and roughened. Colour tawny yellow. Size about 3 cm. by 2·5 cm. by 1·5 cm.

Test thin, but tough; white on inner surface; its prolongation into the branchial siphon bearing minute spines in its outer part, and simple tentacles in its inner part.

Mantle opaque yellow, muscular, with circular bands outside and radial inside.

Branchial sac with 8 to 10 folds on each side. Several of those next the endostyle slight. There are about 6 or 7 internal longitudinal bars on each fold and about 3 to 5 in the space between. Every 6th or 7th transverse vessel is much wider than the intervening ones, sometimes every third one is a little wider. The meshes contain about 6 stigmata each, occasionally as many as 10 or 12.

Dorsal lamina a plain membrane with a smooth edge.

Tentacles 16, 8 larger and about 8 smaller, placed alternately. The larger ones much branched.

Dorsal tubercle formed of 2 spiral cones turned away from each other.

Gonads a large single mass upon each side.

Locality.—Port Jackson, about 20 specimens.

This is a small *Microcosmus*, but apparently, from the condition of the gonads, quite mature. It has the usual crumpled condition of the test, characteristic of the genus. Although the apertures are on considerable prominences (Pl. Cyn. V., figs. 1—3), the actual cross-slit openings are very minute. The figure (fig. 1) is not an exact portrait of any one of the specimens, but is a combination drawing presenting what seem to me the average characters. Each specimen seems more or less contracted or abnormal in some part. In a group like Ascidians, where there may be so much individual variation externally, due merely to an accident of the environment, I believe it would generally be more useful, where there are a number of specimens of a new species, to prepare a combination figure, giving what the observer considers the permanent characteristic features, rather than an exact representation of one individual with all its defects. Figure 3 shows a variation in form, and fig. 2 a cluster of half-a dozen specimens adhering together.

The sizes of the 4 best specimens are as follows:—

A.	3·5 cm.	×	3	cm. ×	2	cm.
B.	4 ,,	×	2·5	,, ×	1·5	,,
C.	3 ,,	×	2	,, ×	2	,,
D.	3 ,,	×	2·5	,, ×	1·5	,,

The mantle is about equally muscular all over.

The branchial sac is neat and regular in its vessels. In most cases it has 10 folds on each side. The internal longitudinal bars are rather narrow (fig. 5), and between the folds they are not placed at very regular distances apart. In some places the transverse vessels are arranged as follows:—very broad, narrow, narrow, narrow, broad, narrow, narrow, narrow, very broad (see fig. 6); in other places they are less regular.

The prolongation of the test which lines the branchial siphon (see fig. 4 *sc.*) bears in its outer narrower part a large number of minute spines or pointed scales, so close set as to produce a shagreen-like surface. This condition I first of all pointed out in 1882, in the case of *Cynthia arenosa*. Later on (1884) Lacaze-Duthiers described it in some other Cynthiidæ, and in 1885 I discussed the matter in a note on the armature of the branchial siphon. Next comes a much corrugated zone, which marks the position of the sphincter muscle (fig. 4, *cor.*). Further down

the siphon, where the invaginated test becomes very thin and membranous, it bears scattered simple finger-like tentacles of moderate size (fig. 4, *tn.*). These, of course, are supplementary to, and are placed anterior to the usual circle of much larger compound tentacles at the entrance to the branchial sac.

Microcosmus affinis, Heller, Pl. Cyn. VI., figs. 6—8.

This species was briefly described by Heller in 1878. In the present collection there are half-a-dozen specimens which I refer to the species, and as Heller gave only a figure of the exterior, I think it right to re-describe and re-figure it. Three of our specimens are united in a clump, the other three are separate. The exterior agrees well enough with Heller's description, and fig. 6 shows the characters. Our largest specimen measures 3 cm. by 2·5 cm. by 1 cm. The invaginated test of the branchial siphon shows 4 slight semilunar valves near the base of the tube. The branchial sac has usually a 9th slighter fold next the endostyle on one or both sides which does not extend to the posterior end of the sac. There are 8 bars on a fold and 2 in the interspace. The stigmata are rather short, wide and rounded. There are about 6 in the larger meshes. Every 7th or 8th transverse vessel is much wider than those between (see fig. 7).

The tentacles are of two sizes, about 9 of each, the larger ones are very bushy. The dorsal lamina is a plain membrane. The dorsal tubercle is broadly cordate, with both horns spirally coiled inwards (fig. 8).

This form not only resembles *M. claudicans*, Savigny, as pointed out by Heller, but also very closely agrees with Heller's other species, *Microcosmus distans*, which was found at New South Wales. I strongly suspect they are all one species. It is also allied to the new species, *M. Ramsayi.*

Microcosmus Ramsayi,* n. sp., Pl. Cyn. VI., figs. 1—5.

External appearance. Shape irregularly ovate, somewhat compressed, attached by the posterior end. Apertures moderately far apart, usually prominent, and anterior, both 4-lobed. Surface folded and wrinkled. Colour dull yellowish brown. Size 5 cm. in length, 3·5 cm. in breadth, and 2 cm. in thickness.

Test tough and leathery; rather thin over most of body, thickest round apertures.

* I have named this characteristic Australian species after Dr. E. P. Ramsay, who was Curator of the Museum at the time the collection was sent to me.

Mantle yellow, opaque, muscular. The muscle bundles are strong, but loosely arranged. The chief ones run radially from the siphons and circularly round the body.

Branchial sac with 8 well-marked folds on each side, up to 12 internal longitudinal bars on a fold, and 3 or 4 in the interspace. Occasional transverse vessels very much wider than the rest. Meshes rather small, elongated transversely, containing about 6 stigmata; horizontal membranes well-marked.

Dorsal lamina a plain smooth-edged membrane.

Tentacles about 18, 9 large and much branched, and about the same number of much smaller intermediate ones.

Dorsal tubercle prominent, with both horns coiled inwards, sometimes so much coiled as to form a pair of conical spirals.

Locality.—Port Jackson; about 20 specimens.

This species—probably a common one at Port Jackson—has the characteristic external appearance of a *Microcosmus*. The actual shape differs much in the various specimens (see Pl. Cyn. VI., figs. 1, 2, 3). Several of the smaller specimens have the apertures on prominent siphons, of which the branchial may be very long (fig. 3); the colour in these young specimens is whiter. In older specimens the siphons are less marked, and the shape is more irregular. The size varies from 5 cm. down to about 2 cm. in length. There are four that measure about 4 cm. by 3 cm. by 2 cm. Then there are the four shown in fig. 2, some others more irregularly shaped, and half-a-dozen small ones, like fig. 3. The invaginated test lining the branchial siphon is armed with numerous little spines closely placed. Near the base of that siphon there are four pouch-like folds forming a partial diaphragm (fig. 5); and in the atrial siphon there is a single large crescentic fold springing from the anterior side, and forming a valve or partial septum.

The loosely arranged muscle bundles of the mantle are in places closely attached to the inner surface of the test.

In the branchial sac there is a very slight 9th fold on each side, next to the endostyle, and only extending for part of the length of the sac. Figure 4 shows one of the very wide transverse vessels. The dorsal tubercle (fig. 5) is in some specimens a good deal more coiled, so as to form a pair of prominent cones.

This species of *Microcosmus* and specimens of *Styela personata* apparently occur together, as they were mixed in several packages. Externally they are very much alike, and it is impossible to tell the *Microcosmus* from the *Styela* until the branchial sac or tentacles have been examined.

Cynthia, Savigny (1816).

This genus is represented by seven species, six of which are new to science.

Cynthia præputialis, Heller, Pl. Cyn. VII., figs. 1—3.

Of this curious species four specimens, of somewhat different forms, exist in the collection from Port Jackson. I give reduced outline figures of three of them, to show the variation in proportions. The characteristic anterior end is, however, the same in all; all have the ring-like pad or fold of test surrounding the two apertures. In one case (fig. 3) I have cut away part of the test to show the relation of parts in a section. This figure also shows the solid posterior part of the test. In another specimen (fig. 1) more than two-thirds of the body is solid test.

The sizes of the specimens are as follows:—

A.	length 5	cm.,	breadth 8	cm.	at base,	thickness 5	cm.
			6	,,	at top.		
B.	,, 25	,,	,, 10	,,	at top,	,, 8	,,
			5	,,	at base,	,, 5	,,
						[at base.	
,, (test removed)	,, 7·5	,,	,, 4·5	,,		,, 3	,,
C.	,, 11	,,	,, 7	,,		,, 5	,,
D.	,, 8	,,	,, 5	,,		,, 3·5	,,

Shapes like B and C (figs. 1 and 3) agree perfectly with Heller's excellent figures and description,* but A (fig. 2), with no approach to a stalk or posterior thickening of the test, is quite an exceptional form; it is probably a younger specimen. Our largest specimen is more than twice the size of the largest previously recorded.

In internal structure our specimens agree with the account given by von Drasche† in 1884. The dorsal tubercle is certainly a double cone, as shown by von Drasche, and not the horse-shoe-shaped form referred to by Heller. I am informed that the native name for this species in Australia is "Cunjeboy," and that the natives use it for bait.

Cynthia molguloides, n. sp., Pl. Cyn VII., figs. 4—10.

External appearance. Shape globular, with a large dorsal projection bearing the atrial aperture. No lateral flattening, probably not attached. Branchial aperture median, anterior, on a long slender siphon; atrial

* Sitzb. Akad. Wiss. Wien. Bd. LXXVII., p. 12, 1878.
† Denkschr. Akad. Wiss. Wien. Bd. XLVIII., p. 374.

dorsal, on a wide projection. Surface almost wholly covered with a thick layer of sand and shell fragments. Colour of exposed anterior end yellow brown. Length 3·3 cm., breadth (dorso-ventral) 4 cm., thickness 3 cm.

Test thin parchment-like and brittle, but covered with a very thick layer (from 5—10 mm.) of matted hairs containing mud and sand grains, and having larger fragments on the exterior. A few slender vessels ramify in the inner layer of the test.

Mantle yellow and muscular with strong sphincters which are continued as a circular muscle layer over the greater part of the body. Internally there are longitudinal muscle bands radiating from the long branchial and atrial siphons.

Branchial sac with 6 or 7 folds on each side. About 8 internal longitudinal bars on a fold, and 2 or 3 in the interspace. Usually one wide (about 6 stigmata) and two narrow (about 3 stigmata) rows of meshes between two folds. Stigmata short and rounded, irregular in places.

Dorsal lamina composed of a row of long, pointed languets, closely placed.

Tentacles much branched, about 8 larger and eight smaller.

Dorsal tubercle small and simple, an elliptical slit in a deep triangular peritubercular area.

Alimentary canal forming a wide loop.

Gonads on both sides.

Locality.—Port Jackson; one specimen.

There is only one specimen of this species, but it has such a striking form and appearance (Pl. Cyn. VII., fig. 4) that it cannot be mistaken for anything else. The long narrow branchial siphon sticks up, free from sand and shells, and the hole in the dorsal projection (fig. 4) probably during life allowed the atrial siphon to protrude in a similar manner. The large shell fragments are all on the surface, and most of them are attached by their edges, so that the sandy test bristles with them. The matted mass of hairs and sand can be peeled off, leaving the thin and brittle true test, which is seen under the microscope to be closely peppered over with the finer sand grains, and to have a few slender vessels ramifying in the interior.

When the test is removed (fig. 5), the curious shape of the long slender atrial siphon is seen stretching outwards from almost the posterior end of the dorsal edge. The folds of the branchial sac are a little difficult to determine along the edges, although quite distinct in the middle of the

sides. In the single specimen there seem to be 7 folds on the right side, and 6 only on the left; this may well be an individual variation, so it is impossible to say yet whether the normal number is 6 or 7.

Towards the left side of fig. 6 is seen an irregularity in the stigmata of the branchial sac, such as is present here and there. The dorsal languets (fig. 7) spring from a narrow membrane, which has a strong muscle band at its base. The simple little dorsal tubercle is shown in fig. 8; while figs. 9 and 10 show the alimentary and reproductive viscera of the left and right sides respectively. The gonads are broken up into ovate masses, nearly detached from one another, merely adhering by twigs to a central stem and packed closely together.

Cynthia solanoides, n. sp., Pl. Cyn. VIII.

External appearance. An irregularly ellipsoidal mass of solid appearance, and with both apertures on the wide anterior end. Not flattened laterally. Not attached, or only very slightly, by the narrow posterior end. Apertures both prominent and 4-lobed. Surface even, but roughish; partly encrusted. Colour dirty grey brown. Length 8 cm., breadth 5·5 cm., thickness 5 cm.

Test firm, cartilaginous; thin anteriorly, thickening up to 7 mm. posteriorly.

Mantle muscular anteriorly, thin and membranous posteriorly. Both siphons very large and muscular. Sphincters especially powerful.

Branchial sac with about 8 folds on each side. Internal longitudinal bars very wide, ribbon-like; meshes elongated transversely, containing each about a dozen wide stigmata. Very wide loose horizontal membranes present on the transverse vessels.

Dorsal lamina a very short smooth ridge.

Tentacles very large and much branched, forming a tangled mass about 1·5 cm. in length. There are 6 larger and 6 smaller.

Dorsal tubercle large, and spongy in appearance.

Alimentary canal and *gonads* sunk in the thick fleshy mantle.

Locality.—Port Jackson; one specimen.

This species has a peculiarly solid appearance, and looks not unlike a dirty stone, and still more like an old, somewhat battered potato, hence the specific name.

The apertures are most conspicuous (fig. 1), and are both of them cross-slit.

The test is very stiff and solid for its thickness. There are a number of thin vessels ramifying freely through all parts (fig. 4).

The front part of the mantle is remarkably muscular, and the siphons are powerful (fig. 5). The sphincter muscle mass, at the base of the branchial siphon, is 8 mm. in thickness. The invaginated test lining the branchial siphon is thick and white. In its deeper part it bears a number of minute tentacles (fig. 2), while nearer the aperture there are a number of microscopic spines (fig. 3). I think it possible that the siphons may be protruded to a considerable extent when the animal is alive.

The branchial sac is remarkably delicate, and is in very bad condition, most of the epithelium being lost, so it is impossible to determine exactly the number of folds. The great horizontal folds on the front of the numerous transverse vessels, and the long rows of stigmata in the meshes (fig. 6), give a characteristic appearance.

The 12 much-branched tentacles form an enormous tangled mass extending 1·5 cm. from the base of the branchial siphon. The larger ones are very bushy, and have stout bases.

The œsophageal opening is placed far forwards, very close to the tentacles, and that makes the dorsal lamina short.

The dorsal tubercle is 4 mm. long, 2 mm. wide, and 2 mm. high. It is merely an ovate, convex, spongy-looking pad (fig. 7)

Cynthia multiradicata, n. sp , Pl. Cyn. IX., figs. 1—5.

External appearance. Of short cylindrical form, scarcely compressed, narrowed at the anterior end to a short stalk, which at once spreads out into a large number of branching roots, by which a firm attachment is effected. Branchial and atrial apertures both on the dorsal edge, rather far apart, sessile but distinct. Surface raised into a few abrupt rounded knobs, otherwise smooth. Colour a dirty yellow white. Size 5 cm. long, by 2·5 cm. broad (dorso-ventrally), by 2·3 cm. from side to side.

Test leathery, but rather soft and flexible, moderately thick.

Mantle thick, opaque brown in colour, and moderately muscular, with strong sphincter muscles.

Branchial sac with 6 folds on each side. Internal longitudinal bars not wide, but distinct; about 12 on a fold and about 6 in the interspace. Meshes mostly rather longer transversely, and containing about 8 stigmata, crossed by a narrow horizontal membrane. There are about 3 narrower transverse vessels between a pair of wider.

Dorsal lamina represented by a row of very short, blunt, closely-placed languets

Tentacles about 12 larger and 12 smaller placed alternately.

Dorsal tubercle nearly globular, only attached by a short stalk at the back. The free surface covered by a pair of closely-incurved spirals.

Locality.—Port Stephen; one specimen, attached to *Styela Whiteleggii*, n. sp.

In external appearance (Pl. Cyn. IX., fig. 1) the most noteworthy points are (1) the tangled mass of roots by which the specimen is attached to the outside of the large *Styela*, and (2) the curious position of the branchial aperture close to the point of attachment. The fact is that the animal is attached by the ventral edge of its anterior end. The relative positions of the apertures recall some species of *Boltenia*. The test is of much the same colour inside as out. Its continuation into the branchial siphon is provided with minute fusiform imbricating scales (fig. 5, *a*, *b*, *c*).

In the branchial sac the folds are rather wider than the interspace (fig. 2), and have twice as many bars. The transverse vessels are in some parts of three sizes, arranged with regularity, as shown in the figure. Figure 4 shows the short dorsal languets, and fig. 3 the globular dorsal tubercle.

Cynthia cataphracta, n. sp., Pl. Cyn. XI., figs. 1—7.

External appearance. Shape quadrate, compressed laterally, attached by both posterior end and parts of the dorsal and ventral edges. Apertures at the two ends of the wide anterior end, sessile, inconspicuous. Surface even and moderately smooth, minutely granulated all over, with a few long tag-like processes round the apertures and down the edges. Colour of a pale creamy yellow. Length 3 cm., breadth 2·5 cm., thickness 1·5 cm.

Test very stiff and hard. The surface finely papillated all over, and containing many large globular calcareous spicules, and also many swollen ends of vessels.

Mantle muscular. Sphincters very strong.

Branchial sac with 6 folds on each side. The internal longitudinal bars are narrow. There are 6 bars on a fold and three visible between. The transverse vessels are of two sizes, generally 3 narrower between a pair of wider. The meshes are large and about square, and are generally crossed by a narrow horizontal bar. There are no horizontal membranes on the transverse vessels.

Dorsal lamina a series of languets.

Tentacles 6 large and 6 small, branched.

Dorsal tubercle cordate, turned with the opening to one side.

Locality.—Attached to *Styela personata*, n. sp., from Port Jackson.

This small *Cynthia* has a very remarkable test. The surface is hard and gritty to the feel when cut. Thin sections of the surface show that there are large numbers of calcareous spicules of stellate and spherical form imbedded in the superficial layer (Pl. Cyn. XI, fig. 3). The spicules appear to commence as minute granules, which become stellate (fig. 4). Then the number of rays increases greatly, and the tips broaden and flatten out, and the spicule becomes a sphere or ellipsoid covered with small flat bosses (fig. 3).

The larger specimen of this *Cynthia* (fig. 1) is joined on to two specimens of *Styela personata*, n. sp. It shows the tag-like processes of the test, especially around the apertures. There are also two very much smaller specimens, one 8 mm. across (fig. 2), and the other 5 mm., which have long branched root-like processes of test at the posterior end.

There are no atrial tentacles, but there is a slight diaphragm at the base of the atrial siphon which ends in short rounded lobes or projections (fig. 7). The lining of the atrial siphon contains a network of blood vessels, in some of which are fusiform or triradiate spicules, rather like those found in the genus *Culeolus*.

Strong radial muscles radiate from the bases of the siphons and interlace with circular muscles to form a strong network.

The 6 larger tentacles (see fig. 6) are very much branched. The meshes in the branchial sac are of very different sizes, as the internal longitudinal bars between the folds (fig. 5) are by no means equidistant.

The gonads form a number of angular yellow masses placed both in the intestinal loop, and also over the right side of the mantle. These masses are united on each side of the body by delicate ducts.

Cynthia spinifera, n. sp., Pl. Cyn. X., figs. 1—12.

External appearance. Shape nearly globular, attached by a small flattened area at the posterior end. No lateral compression. Apertures both on the rounded anterior end, moderately far apart, sessile, and not conspicuous. Surface covered with remarkably long, branched, and echinated spines, which are especially well-developed in two tufts on the anterior end close to the apertures. Colour dull greyish brown. Size 1·5 cm. by 1·3 cm. by 1·3 cm.

Test rather thin but tough, covered on its surface with large and small spines.

Mantle of a yellow brown colour, muscular; siphons short.

Branchial sac with 6 folds on each side. Internal longitudinal bars 8 on a fold and 4 in the interspace. Transverse vessels alternately larger

and smaller. Meshes about square, with 6—8 stigmata, and divided by a horizontal membrane.

Dorsal lamina a smooth edged plain membrane.

Tentacles 12 large and bushy, with 12 very much smaller between.

Dorsal tubercle small and simply cordate in form, with both horns coiled inwards.

Locality.—Port Jackson ; one specimen.

This species is in external appearance singularly like the European *C. echinata*, L., and at first I provisionally placed it under that name. An examination of the interior showed, however, that the branchial sac is of a perfectly normal character, and has not the stigmata running transversely to the internal longitudinal bars, as is the case in *C. echinata* (first pointed out by Alder in 1863). The dorsal lamina has, however, a smooth edge as in British specimens of *C. echinata*, although that species is sometimes described as having a series of dorsal languets. In regard to this latter character it is curious to find that, whereas Traustedt in his first paper on Simple Ascidians of Denmark, in 1880,* described *Cynthia echinata*, L., as having a dorsal fold with a smooth edge, in his later paper on the Kara Sea Ascidians† (1886), he describes the dorsal fold as long, and having its edge beset with tongue-shaped processes.

Johan Kiær, writing more recently (1893),‡ about these same northern forms, does not allude to Traustedt's contradictory statements, but he describes the dorsal fold as smooth edged. I think possibly Traustedt's Kara Sea specimens, and also those described by Wagner§ may belong to a species distinct from our North-Western European *C. echinata*, and characterised by 7 or 8 branchial folds in place of 6, the processes on the dorsal lamina, and 25 tentacles in place of 12. Our Australian *C. spinifera*, then, is distinct from both of these, although to some extent it combines their characters. The only other described species it comes near is *C. hilgendorfii*, Traustedt, from Japan, which, however, has 9 folds on each side, and long branchial and atrial siphons. Its stigmata are of the normal type. I have, however, some specimens of a species looking externally like *C. echinata*, which I dredged in the summer of 1897 off Port Townsend in Puget Sound. These have the stigmata transverse, as in *C. echinata*, but the branchial folds are from 8 to 9 on each side, the dorsal lamina has processes on its edge, and the tentacles are about 20 in

* Vid. Medd. Naturh. Foren Kjobenhavn, 1879-80, p. 404.

†Dijmphna-Togtets Zoologisk-Botaniske Udbytte, p. 428.

‡ Christ. Vidensk. Selsk. Forh., 1893, No. 9, p. 63.

§ Die Wirbellosen des Weissen Meeres.

number. In all these characters this species* agrees with Traustedt's Kara Sea specimens.

The critical characteristics of these five allied species may then be arranged as follows :—

C. echinata, L. (British and Danish specimens.)	*C. echinata* (?) (Traustedt's Kara Sea specimens.)	*C. villosa*, St. (Puget Sound.)	*C. spinifera*, H. (Port Jackson.)	*C. hilgendorfii*, Tr. (Japan)
Branchial sac 6 folds.	7—8 folds.	8—9 folds	6 folds	9 folds
Stigmata transverse	transverse	transverse	longitudinal	longitudinal
Dorsal lamina Smooth	with processes	with processes	smooth	with processes
Tentacles 12	about 25	15 to 20	12 large & 12 small	12

Cynthia crinitistellata, n. sp., Pl. Cyn. IX., figs. 6—7 ; X., fig. 13 ; and XI., figs. 8—10.

External appearance. Shape irregular, with knobs, foldings, and corrugations. Attached by posterior end. Apertures not far apart, on anterior end, surrounded by dense tufts of branched spines. Surface uneven, with simple and branched spines, and with a fine down all over. Colour dirty yellow. Size, length 5 cm., breadth 3 cm., thickness 2 cm.

Test tough and leathery, not thick ; corrugated, and bearing long and short echinated spines all over surface.

Mantle opaque yellow, moderately muscular.

Branchial sac with 9 or 10 folds on each side. Internal longitudinal bars distinct, but not wide ; 9 on a fold and 5 in interspace. Occasional very wide transverse vessels with about half-a-dozen narrower between.

* Which is very probably the species *Cynthia villosa* insufficiently described by Stimpson, from the same locality, in 1865. There was also an *Ascidia villosa*, which may be a *Cynthia*, described by Fabricius from Greenland.

Meshes square to oblong in shape, with 4 to 7 stigmata each Meshes often divided by a narrow horizontal membrane.

Dorsal languets numerous, short, tentacular in shape.

Tentacles very large and bushy. There are 16, 8 larger and 8 smaller, but all of them considerably branched.

Dorsal tubercle forming a double spiral cone.

Intestine forming a wide open loop. Gonads are large lobed masses on each side.

Locality.—Port Jackson ; five specimens.

This remarkable species recalls the brief description given by Stimpson of his *Cynthia dumosa*, also from Port Jackson. All the information we possess in regard to that species is as follows :—

"10. *Cynthia dumosa.* Globular, of a yellowish brown colour; surface villous and provided with numerous stout sub-conical processes of the test, which have short irregular branches. Apertures cross-shaped when contracted ; the branchial more than twice the size of the anal. Branchial sac with twelve very large folds, which are much broader than their interspaces. Tentacula also twelve in number, including four or five small ones ; biserrate, folded longitudinally, and curved so as to present their pinnae towards the branchial cavity. Diameter 1 inch. Found in the circumlittoral zone, on muddy bottoms. Hab. Australia, at Port Jackson."*

The external characters given in this description agree well enough with those of the present species, and taken along with the internal characters given, they are sufficient to show that *C. dumosa* belongs to the sub-family Cynthiinæ. The branchial sac and tentacles differ from our present species, as defined above, and so I feel bound on our present evidence to consider *C. crinitistellata* as a distinct form new to science. Its spinose condition (Pl. Cyn. X., fig. 13) is very remarkable, and still more curious is the minute downiness over the surface, which, when magnified, is seen to be caused by closely-placed and beautifully stellate papillæ (Pl. Cyn. XI., fig. 10).

The four remaining specimens in the collection are of the following sizes :—

A.	...	5	cm. ×	3	cm. ×	2	cm.
B.	...	2·5	,, ×	2	,, ×	1·5	,,
C.	...	3	,, ×	2	,, ×	1	,,
D.	...	6	,, ×	4	,, ×	2	,,

* Proc. Acad. Nat. Sci., Philadel., July, 1855.

The test on section and inner surface is like that of a typical *Microcosmus*. The muscle bundles of the mantle form a rather loose irregular network. The branchial sac is of a yellow colour with 9 wide folds on each side, and there may be a 10th very slight fold next to the endostyle. The transverse vessels are rather irregular in their arrangement (fig. 9).

The languets form a continuous row bordering one edge of a flat membranous area, which runs along the dorsal edge of the branchial sac; but there are also a few slighter languets (fig. 8) placed here and there along the other edge of the membranous area, and corresponding to transverse vessels of the branchial sac.

[The following Cynthiinæ have also been recorded from Australia:—

Microcosmus polymorphus, Heller.
M. Helleri, Herdm.
M. propinquus, Herdm.
M. Julinii, v. Dr.
M. distans, Heller.
Rhabdocynthia complanata, Herdm.
R. tenuis (?), Herdm.
R. sp. (?), Sluiter.
Cynthia arenosa, Herdm.
C. formosa, Herdm.
C. cerebriformis, Herdm.
C. irregularis, Herdm.
C. fissa, Herdm.
C. arcuata, Heller.
C. grandis, Heller.
C. hispida, Herdm.
C. dumosa, Stimps.
C. sabulosa, Stimps.
C. laevissima, Stimps.

and probably the following species placed under *Ascidia* by Quoy and Gaimard:—*A. aurora*, *A. reticulata*, *A. erythrostoma*, *A. ianthinostoma*, *A. cœrulea*, *A. spinosa*.]

Sub-family **STYELINÆ**, Herdman, 1881.

Body attached, sessile, rarely incrusted with sand. Branchial and atrial apertures either 4-lobed or irregular.

Test usually coriaceous, rarely cartilaginous.

Branchial sac with at most 4 folds upon each side.

Tentacles simple, unbranched.

Alimentary canal with a well-marked stomach, and no distinct glandular cæcum or "liver."

Gonads in the form of one or a few elongated tubes, or a large number of small scattered masses ("polycarps") attached to the inner surface of the mantle.

Only the two more ordinary genera of this sub-family, *Styela* and *Polycarpa*, are represented in the collection. Both are apparently common in the Australian seas.

Styela, MacLeay, 1824.

This genus is represented by 6 species, 5 of which are new to science.

Styela pinguis, n. sp., Pl. Cyn. XII., figs. 1—10.

External appearance. Shape elongate ovate, compressed laterally, adhering by posterior third of left side. Apertures both on dorsal edge, branchial at anterior end, atrial one-third of the way back; both distinctly 4-lobed, but sessile. Surface smooth, but marked by slight branching grooves. Colour dirty white. Length 5 cm., greatest breadth 3 cm., thickness 2 cm.

Test leathery, but soft on the surface, moderately thick and tough, smooth and glistening on the inner surface. Matrix clear, but crowded with very small test cells. Numerous small vessels with globular terminal knobs; some of the vessels are convoluted or spiral.

Mantle yellowish brown, rather thin, but fairly muscular. Muscle bundles very thin, forming a close network.

Branchial sac with 4 distinct but rather distant folds on each side. About 9 internal longitudinal bars on a fold and 6 in the interspace. Transverse vessels of two sizes placed alternately. Meshes square, containing each about 8 stigmata, and divided transversely by a narrow horizontal membrane, which rarely interrupts the stigmata. Occasional extra, partial, horizontal membranes are also present. The stigmata are large, and regularly placed. A good many muscle fibres in the larger transverse vessels.

Endostyle very long, but not conspicuous.

Dorsal lamina very inconspicuous. A narrow membrane with a corrugated edge forming slight teeth.

Dorsal tubercle ovate in outline. Both horns turned inwards and slightly coiled.

Tentacles long and slender, about 16 in number.

Alimentary canal large and closely folded on itself. Stomach very arge, with wall finely plicated longitudinally.

Reproductive organs in the form of 6 long tubular ovaries on the right side of the mantle, and two shorter ones on the left, converging towards the atrial aperture, and covered, especially about their middle, by numerous short ovate or cylindrical spermatic vesicles, which often branch at their free ends.

Locality.—Port Jackson; two specimens.

The two specimens figured (Pl. Cyn. XII., figs. 1 and 2) seem to belong to the same species, notwithstanding the difference in their shape. The dimensions given above are those of fig. 1; the other specimen has the posterior end prolonged to form a short stalk, which makes the body 6 cm. in total length. It is 2·5 cm. in breadth, and 1·5 cm. in thickness. The vascular condition of the soft white test is shown in fig. 3. The invaginated test lining the branchial siphon bears numerous small, sharp-pointed spines (fig. 4), all pointing the one way. The stigmata of the branchial sac are unusually long and regular (fig. 5). The narrow dorsal lamina is shown in fig. 6, and the curiously stout dorsal tubercle in fig. 7. The alimentary (fig. 8) and reproductive (figs. 9 and 10) viscera have been sufficiently described above. A Copepod was found in the peribranchial cavity of one of the specimens.

This species recalls *Polycarpa sulcata*, Herdman, of the "Challenger" collection, but is quite distinct from that species.

Styela Etheridgii, n. sp., Pl. Cyn. XIII., figs. 1—8.

External appearance. Shape somewhat ovate, the posterior end being the narrower, compressed laterally. Branchial aperture anterior, on ventral edge, on a short siphon, or sessile, indistinctly lobed. Atrial aperture on dorsal edge, close to anterior end or a little way down, sessile, but conspicuous, indistinctly 4-lobed. Surface irregular and rough, partially covered with sand and shells, especially on left side and posterior end. Colour greyish brown to yellow. Length 9 cm., breadth 6·5 cm., thickness 4·5 cm.

Test thin, leathery, inner surface greenish white and glistening; posterior end irregularly thickened.

Mantle does not adhere to test, moderately thick, musculature strong; colour light brown; thickened and gelatinous at posterior end.

Branchial sac, 4 folds on each side, united closely to mantle; 7 or 8 internal longitudinal bars between two folds, and about the same

number on each fold. Every 6th transverse vessel very wide. Meshes transversely elongated. About 6 or 8 stigmata in each mesh. Arrangement of transverse vessels very irregular in places.

Dorsal lamina a plain-edged membrane.

Tentacles, 24 in number, simple; of different sizes but not arranged symmetrically; some very long.

Dorsal tubercle prominent, and circular in outline; slit varying from two simple spirals to a much convoluted condition or several distinct apertures.

Locality.—Port Jackson; five specimens. Port Stephen; three specimens.

This large and irregular *Styela* (Pl. Cyn. XIII., fig. 1) has very much the appearance of a *Microcosmus*. The colour, texture, and encrusted condition of the test all remind one of that genus; but it is in structure a true *Styela*. The form, test, mantle, tentacles, and branchial sac are fairly constant in all the specimens. The dorsal tubercle, however, is rather variable, although in all cases it is a large hemispherical prominence. Figs. 3 to 7 show the exact form of the slit in several of the specimens. A regular part of the branchial sac is shown in fig. 2; some parts are, however, rather irregular, and there are wide vessels running in several directions on the back. In some places there may be as many as 10 bars on a fold and the same number in the interspace. Occasionally a few of the tentacles may be larger than the rest, and attain to a length of 1 cm. A considerable number of Amphipod Crustacea were present in the branchial sacs of most of the specimens.

At the posterior end of the body the mantle is prolonged into several short ragged tags, which are received into irregular crypts in the thickened basal part of the test.

The alimentary canal is rather short and wide (fig. 8). The stomach is raised on its inner surface into longitudinally running ridges. In the loop between the stomach and the intestine lies an irregular pad of gelatinous connective tissue. The anus is wide and has a plain margin.

There is a single large, rounded reproductive mass (fig. 8, *r.g.*; *l.g.*) on each side of the body. That on the right side is absent, or very slightly developed in most of the specimens. There is a short oviduct, and either one or several (see fig. 8, *l.g.*) more slender sperm-ducts leading from each reproductive mass.

I have associated this species with the name of the present Curator of the Australian Museum, Mr. R. Etheridge, junr.

Styela plicata, Lesueur.

(= *Styela gyrosa*, Heller.)

There are 7 specimens from Port Stephen, 2 clumps of 3 individuals each and a solitary one; and also a large clump from Port Jackson, which measures about 16 cm. by 14 cm. by 7 cm., and contains 20 individuals more or less closely united by their bases.

This species seems almost cosmopolitan in its distribution—from Australia to the Mediterranean.

Styela Whiteleggii, n. sp., Pl. Cyn. II., figs. 6—7; Pl. Cyn. XIV., figs. 1—6.

External appearance. Shape elongate rounded, with the apertures conspicuous, generally on prominent siphons; body compressed laterally and attached by the posterior end, which may be prolonged to form branched rootlets. Surface a little grooved, or furrowed, but fairly even and not roughened. Colour a dull yellowish grey-brown. Length 10 cm., breadth 6 cm., thickness 3 cm.

Test coriaceous, tough but flexible, not thick, except at the posterior end.

Mantle adhering to test, of a dark brown colour, very muscular and rather thick.

Branchial sac very large, with 4 folds on each side; 6 to 10 internal longitudinal bars on the fold and about 12 in each interspace. Meshes containing about 6 stigmata each, and divided by a narrow horizontal membrane. The transverse vessels are of several sizes, arranged with regularity; an occasional very much wider transverse vessel is present. Large oblique vessels run on the outer surface of the branchial sac.

Dorsal lamina a plain membrane, very slightly developed.

Tentacles about 40, all rather large.

Dorsal tubercle a slightly raised area of ovate form and spongy appearance; a number of small apertures scattered over it.

Gonads a large branched mass on each side of the body.

Locality.—Port Stephen; two specimens. Port Jackson; seven specimens.

This large species is found in several cases associated with other Ascidians. One large specimen has four individuals of *Boltenia tuberculata* attached to it (Pl. Cyn. II., fig. 7). Another bears the only specimen of *Cynthia multiradicata* (see Pl. Cyn. IX., fig. 1), and other three are attached to Boltenias (Pl. Cyn. II., fig. 6). In some cases the

siphons are much more prominent (Pl. Cyn. XIV., fig. 2) than in others, and the curvature of the body, and the direction in which the atrial siphon projects, are liable to considerable variation (see figs. 1 and 2).

The mantle and branchial sac are in all cases of a very dark brown colour, and the internal organs are generally in rather bad condition. The branchial sac is always more or less macerated, and has lost most of its epithelium. In most of the specimens the branchial sac is strongly curved, with the convexity ventral. Both internal bars and transverse vessels are of a dark brown colour, so as to form a conspicuous network (fig. 3).

The dorsal tubercle is inconspicuous (fig. 4), and forms an ovate convex area, upon which a number of small, simple apertures are scattered (fig. 5), very much as in the case of *Polycarpa sulcata*. In some cases the tubercle is scarcely raised, and forms merely a triangular punctated area.

The alimentary canal is short and wide, and the anus is crenated round its margin (fig. 6, *a*.).

In the largest specimens the tentacles may attain to 45 in number. They are large and stiff, and are in all cases of a dark brown colour, like the lining of the siphons and all the other internal organs.

The reproductive glands form a large branched organ on the right side, and a smaller on the left, ending in each case in several tubes converging to the base of the atrial siphon (fig. 6, *d*.).

Several of the specimens are, like the Boltenias with which they are associated, covered by a thin encrusting soft sponge, like a *Halisarca*.

Styela personata, n. sp., Pl. Cyn. XV., figs. 1—7.

External appearance. Body short, squat, from globular to quadrate in form, with wide anterior and posterior ends, and compressed laterally. Attached by the posterior end. Apertures at the extremities of the anterior end, distinct but not on long siphons, both 4-lobed. Surface rather corrugated, and in places minutely wrinkled. Colour from light yellow to dark brown. Length 4 cm., breadth 4·5 cm., thickness 2 cm.

Test thin but tough, coriaceous, yellowish on inner surface, and glistening.

Mantle dark yellow, opaque, not strongly muscular; adhering to test only at apertures.

Branchial sac with 4 well-marked folds on each side. There are about 8 to 10 rather wide internal longitudinal bars on the folds and 4 visible in the interspace. The meshes are small, elongated transversely,

and contain each about 6 to 8 narrow closely placed stigmata. The transverse vessels are all much of the same size, but are rather irregular in their course. They have rather wide horizontal membranes.

Dorsal lamina a plain membrane, fairly wide.

Tentacles about 24 larger and the same number of much smaller intermediate ones, also minute buds.

Dorsal tubercle simple, and of broad cordate form, with both horns turned in.

Locality.—Port Jackson; 16 specimens, along with *Microcosmus Ramsayi.*

The specimens of this species are all much alike, and have the external appearance and colour of a *Microcosmus* (Pl. Cyn. XV., fig. 1). The test, however, is only wrinkled, not encrusted with foreign bodies.

The dorsal tubercle is wider than high (fig. 6), and the horns are more or less coiled in, in different specimens. Figure 7 shows an extreme case.

The gonads consist of one or two large sausage-like glands upon each side of the body.

Figure 4 shows 2 rows of meshes and part of a fold from the branchial sac.

In size the specimens vary from 2 by 2 by 1 cm. to 4·5 by 5 by 2 cm. In nearly all cases the body is as wide or wider than its length, and about twice its thickness. Figures 2 and 3 show two other variations in shape.

The tentacles are shown in fig. 5. In addition to the large ones visible to the eye, there are smaller intermediate, and also quite minute buds, which do not project over the edge of the strong muscular band. I have named this species *personata*, on account of its close resemblance externally to the totally different Ascidian *Microcosmus Ramsayi*, with which it appears to be frequently associated.

Styela stolonifera, n. sp., Pl. Cyn. XV., figs. 8—11.

External appearance. Shape irregularly ovate, with the posterior end the wider, and the body compressed laterally. Both apertures are anterior, and are on distinct elevations not far distant. The posterior end bears a large tuft of remarkable root-like processes nearly as long as the body. The surface is smooth, but slightly grooved and wrinkled. Colour milk white. Length 4 cm., breadth 3 cm, thickness 2 cm., length of processes nearly 4 cm.

Test soft and leathery, whiter inside than on the surface.

Mantle pale yellow, thin, not very muscular.

Branchial sac soft, with 4 well-marked folds on each side. There are 6 internal longitudinal bars on the fold and 3 in the interspace. There are 3 or 6 narrower transverse vessels between each pair of wider ones. The stigmata are slender and regular, and about 10 or 12 in each of the elongated meshes.

Tentacles numerous, long, closely placed; all much of same length.

Dorsal tubercle simple, cordate in form, but with the 2 horns turned symmetrically out.

Locality.—Moreton Bay; one specimen.

The notable feature about this species is the remarkable bunch of root-like or stolon-like processes from the posterior end (Pl. Cyn. XV., fig. 8). There are about 20 of these, and most of them are simple and finger-like in shape; a few, however, divide, and here and there are placed knob-like thickenings. The surface test of the processes and knobs is slightly sandy, and bears minute processes or villi. The mantle at its posterior end is prolonged into several tubes in the test (fig. 9), and these prolongations split to supply the processes. The knobs contain enlargements of the mantle, but apparently nothing else.

The mantle has its musculature in the form of a minute network of interlacing fibres, so as to form a fine felting.

The occasional larger transverse vessels of the branchial sac are very much wider than those between (fig. 11). The longitudinal bars are rather stout. Figure 10 shows the symmetrical dorsal tubercle.

The gonads form 4 or 5 elongated masses, converging to the atrial aperture.

Polycarpa, Heller, 1877.

This is the genus that contains the largest number of species in the present collection. There are 12, of which 6 are new to science. Some of the species of *Polycarpa* come very close to *Styela*, and it is quite a question whether these genera will ultimately remain separate.

Polycarpa fungiformis, n. sp., Pl. Cyn. XVI., figs. 1—10.

External appearance. Body irregularly globular, and placed on the end of a long stalk, which is rooted by a spreading lower end. Apertures both on the upper end, distant, minute, inconspicuous. Surface even, and fairly smooth. Colour quite black. Greatest extent of body, which is dorso-ventral, 3·5 cm.; breadth, antero-posteriorly, 2·5 cm. Length of stalk 5·5 cm., thickness from about 3 mm. to 8 mm.

Test stiff and leathery, of a dirty white colour inside.

Mantle thick, pigmented with minute brown dots, not very muscular, prolonged for a short distance down the stalk.

Branchial sac is thick, and of a dark brown colour. The 3 folds next the endostyle on each side are rounded pad-like projections; the 4th is more distant, and does not project. The bars and vessels are thick and numerous, and the stigmata are very narrow. There are about 3 stigmata in a mesh.

Dorsal lamina a narrow membrane, beset with minute papillæ.

Tentacles short and stout, about 24, and of a dark brown colour, with much smaller intermediate ones.

Dorsal tubercle large, and spongy in appearance.

Gonads numerous elongated polycarps.

Locality.—Moreton Bay; one specimen.

This is, perhaps, the most remarkable of the new Polycarpas, and its extraordinary form (Pl. Cyn. XVI., fig. 1) almost warrants the creation of a new genus. It is like a black fungus in appearacce. It is stiff in all parts, and slightly sandy on the stalk (fig. 2). The test is marked with slight lines or creases running circularly around it (figs. 1 and 2). When the test is removed (fig. 3) the positions of the branchial and atrial apertures are seen with their conspicuous sphincters. The posterior prolongation of the mantle seems to run for a short distance only into the stalk. The mantle is from 1 mm. to 3 mm. in thickness, and the curious polycarps project from its inner surface (figs. 4 and 5). The polycarps are slightly constricted at the base, then sausage-like in form, and finally taper, so that the upper end has a conical form. They are pigmented at the tip, and dotted all over (fig. 5).

There are unusually strong connectives between the mantle and the branchial sac. The branchial sac is remarkably thick and opaque (figs. 6, 8). The 3 ventral folds on each side are rather near the endostyle, which forms a conspicuous pad, with a very narrow slit between 2 swollen lips.

The dorsal fold on each side is not a projection, but is merely 12 internal longitudinal bars massed together, recalling the condition in *Styelopsis grossularia*. The fine vessels between the stigmata are traversed by bundles of muscle fibres (fig. 7), which divide and anastomose in the transverse vessels. On the back of the branchial sac all the larger vessels, both transverse and longitudinal, bear numbers of small papillæ, irregularly placed (fig. 8).

The dorsal lamina (fig. 9) is also papillated irregularly on its surface.

The dorsal tubercle is very remarkable (fig. 10). It shows what seem to be cæca of the neural gland, and meandering lines under a thin membrane. If there are any apertures they are very minute and difficult to find.

Polycarpa stephenensis, n. sp., Pl. Cyn. XVII., figs. 1—5.

External appearance. Shape oblong, almost quadrangular, attached by wide posterior end, and flattened laterally. Apertures at dorsal and ventral edges of anterior end. Surface a little corrugated and somewhat encrusted with shells, &c. Colour greyish yellow. Length 10 cm., breadth 6 cm., thickness 2 cm.

Test leathery but rather soft; thickened up to nearly 2 cm. at the posterior end, thin elsewhere; vascular and rather cartilaginous in its thicker parts.

Mantle thick, yellow, opaque, but not muscular. There are no strong muscle bands, but numerous thin fibres running in all directions to form a close felting.

Branchial sac with 4 well-marked folds on each side. There are 6 internal longitudinal bars on a fold and 4 in the interspace; the bars are wide and ribbon-like. The transverse vessels are all rather wide, but occasional much wider ones occur. The meshes are much elongated transversely, and may contain as many as 12 of the small stigmata.

Dorsal lamina a plain narrow membrane, slightly curled round.

Tentacles large, numerous, and closely placed. There are about 45 to 50 of the longest size, and at least the same number of smaller ones between.

Dorsal tubercle cordate, almost circular in outline, with both horns turned in.

Gonads very many small polycarps imbedded in the mantle on both sides of body.

Locality.—Port Stephen; one specimen.

This large species grows erect from a slightly spreading base of attachment (Pl. Cyn. XVII., fig. 1). Its surface has scattered over it a number of specimens of a small Serpulid Annelid, and towards the posterior end a few shell fragments, &c., are attached. The test is soft for a *Polycarpa*, and between coriaceous and cartilaginous in texture. A large vessel enters it from the mantle near the posterior end, and breaks up into the numerous ramifying vessels.

The mantle and branchial sac are of a yellow colour, and the mantle is thickened up to nearly 1 cm. at the posterior end. The stigmata are

unusually small (fig. 2), and leave wide transverse vessels which contain muscle fibres. The meshes are occasionally sub-divided by a narrow horizontal membrane, which does not interrupt the stigmata.

The dorsal lamina is very slightly developed in this and some other species of *Polycarpa*. It is quite narrow, and occasionally seems to almost die away. The dorsal tubercle extends up to the bases of the tentacles, but is simple in form (fig. 3). The intestine leaves a wide open loop (fig. 4) which is occupied by a pad of gelatinous connective tissue. The polycarps (figs. 4 and 5) are very numerous, but are not at first conspicuous, as they are imbedded in the thick and rather tough mantle, which is divided up by grooves into rudely quadrangular areas on its inner surface. There may be 10 to 20 polycarps in each such area, and each polycarp is of globular form like a little rounded sac with either one or two spout-like ducts (see fig. 5).

Polycarpa Sluiteri, n. sp., Pl. Cyn. IV., fig. 1, P^{1}; and Pl. Cyn. XVII., figs. 6–9.

External appearance. Shape ovate, attached along the dorsal edge and part of both sides. Posterior end rounded, no lateral compression. Branchial aperture at the anterior end, atrial one-third down the dorsal edge; both on short rounded projections. Surface even, but finely roughened all over by encrusting sand grains. Colour dark greyish brown. Length 5·5 cm., breadth 3 cm., thickness 2·5 cm.

Test thin, but stiff, brittle; with sand grains imbedded throughout.

Mantle very thin, adhering closely to test; scarcely muscular at all.

Branchial sac with 4 rather narrow folds. Each fold has 10 internal longitudinal bars, and there are 8 in the interspace. The meshes are square, and contain each 4 to 6 large stigmata regularly crossed by a narrow horizontal membrane.

Dorsal lamina a narrow plain membrane, rather curled round to form a canal.

Tentacles 8 large, 8 smaller, and about 16 very minute, arranged regularly.

Dorsal tubercle simple U-shaped, with both horns turned slightly in.

Gonads numerous small polycarps (separate ovaria and spermaria) imbedded in the mantle, and having long slender ducts.

Locality.—Port Jackson, on *Ascidia phallusioides*; one specimen.

This is a stiff-tested species (Pl. Cyn. IV., fig. 1, P^{1}) somewhat like *Polycarpa rigida*, but differing from that species in structure. The single specimen occurs united in one mass with a large specimen of *Ascidia*

phallusioides, a specimen of *Microcosmus Draschii* and several small Ascidians, of globular form and encrusted with sand, which prove to be specimens of *Molgula Forbesi*.

The very slightly developed mantle shows no muscle bands, but merely microscopic fibres running in various directions. This very slight development of the musculature and resultant absence of power of contraction, is obviously correlated with the stiff inflexible test to which the mantle is attached. In the gelatinous connective tissue of the mantle (Pl. Cyn. XVII., fig. 9) we find imbedded the reproductive elements, little ovate clumps or patches of ova in various stages of development, and triangular spermatic vesicles with long straight ducts, which unite in small groups just before opening into the peribranchial cavity.

The branchial sac (fig. 6) is well formed, and the stigmata are large and regular. The simple dorsal tubercle and the tentacles are shown in figs. 7 and 8, on Pl. Cyn. XVII.

Polycarpa rigida, Herdman, Pl. Cyn. XVIII., figs. 1—4.

This is a species which was obtained in Bass' Strait by the "Challenger" Expedition. In the present collection there are about a dozen specimens, 5 from Port Jackson, and the rest from Port Stephen at a depth of 20 to 30 fathoms. One of the specimens from Port Jackson is figured (fig. 1.), because of its somewhat curved shape; the others are more like that figured in the "Challenger" Report. Some, however, have the atrial siphon considerably elongated. The smaller Ascidians adhering to our specimen are *Polycarpa viridis*, Herdm.

The dorsal tubercle is somewhat variable; 2 specimens examined had the forms shown in figs. 2 and 3. In another case the tubercle was reversed, the opening being directed posteriorly. The dorsal lamina is shown in fig. 4. The branchial sac may have every 6th or every 12th transverse vessel wider, the meshes may contain from 6 to 12 stigmata each, and the internal longitudinal bars may be from 10 to 12 on a fold, and from 6 to 8 in the interspace.* The tentacles may be 20 larger and 20 smaller, placed alternately. A very characteristic point about this species is that the test is so thin, and so completely permeated by sand grains, that it becomes stiff and rigid, but very brittle.

Polycarpa viridis, Herdman, Pl. Cyn. XVIII., figs. 1 and 5—10.

This species was originally found by the "Challenger" Expedition at Port Jackson, where the specimens in the present collection are also

* Compare "Challenger" Report, p. 176.

from. We have about two dozen, of various shapes, and with various lengths of stalk. Three, of which one is sessile, adhering to a *Polycarpa rigida*, are shown in fig. 1, another with a longer stalk and more covered with sand, is given in fig. 5, while fig. 7 shows a specimen entirely encrusted with sand. Very few of the specimens are so green as the "Challenger" ones, and a few of the sandy ones (figs. 5 and 7) have the test more of a dirty yellow than a green colour.

The dorsal tubercle, while always simple, varies a little in outline, and direction of opening. One is figured (fig. 6) which is not quite like that of the "Challenger" Report, while others have one horn turned outwards. In all other particulars our present specimens agree with the original description.* It may be added, however, that the smaller tentacles are generally 3 between each pair of larger ones, and of the 3, the central one is longest (fig. 9). The irregular membranous expansion of the transverse vessels alluded to in the "Challenger" Report, takes the form in some of these specimens of a number of simple and compound bud-like processes, growing out from both the transverse and the fine inter-stigmatic vessels (fig. 8). Another interesting detail of structure about the branchial sac is the curiously vesiculated structure of the outer edge of the internal longitudinal bars, shown in fig. 8, under a high magnification. Finally, at the base of the atrial siphon, is a membranous diaphragm, which bears a series of minute atrial tentacles (fig. 10).

It may be said that there are 2 series, or varieties, amongst these specimens—the sandy ones with yellowish tests, and brown mantles, and branchial sac, and those that have very little sand, and show more or less green in both test and mantle; but there are no constant points of structural difference that would enable these to be defined as distinct species.

Polycarpa sacciformis, n. sp., Pl. Cyn. XIX., figs. 1—4.

External appearance. Body oblong and erect, compressed laterally. Anterior end narrowest, almost pointed; posterior end broad and rounded; dorsal edge rather convex, ventral somewhat concave. Slightly attached by posterior end, towards dorsal edge. Branchial aperture at end of short siphon, terminal at ventral edge, directed anteriorly; lobes indistinctly marked. Atrial aperture at end of short siphon, on dorsal edge, about one-third of way from anterior to posterior end, projecting, directed dorsally and anteriorly; 4-lobed, lobes distinct. Surface rough,

* "Challenger" Report, p. 168.

marked by creases, especially at dorsal edge and posterior end. Covered with particles of sand and shells. Colour greyish brown. Length 9 cm., breadth 4 cm., thickness 1·5 cm.

Test leathery, thin but tough, slightly stiffened by sand grains; inner surface smooth and glistening.

Mantle does not adhere to test; yellow, opaque, but with musculature feeble. No distinct muscle bands visible.

Branchial sac has 4 folds on each side. Transverse vessels wide and of 3 sizes. There are 6 to 8 internal longitudinal bars seen on each fold, and 4 or 5 in the interspaces. The meshes are elongated transversely; they contain each 5 or 6 stigmata. Horizontal membranes are very slight, and the meshes are not divided.

Dorsal lamina is a narrow and plain edged membrane.

Tentacles about 48 in number, of 3 sizes, arranged symmetrically; 6 longer, 6 medium, and about 36 shorter.

Dorsal tubercle large and somewhat horse-shoe shaped. Left horn coiled inwards; right horn not coiled but turned outwards.

Gonads in the form of many small polycarps, imbedded in the thickness of the mantle.

Locality.—Port Jackson; one specimen.

This large and rather sandy species (Pl. Cyn. XIX., fig. 1) resembles *Polycarpa longisiphonica* in external characters, but differs in the non-adherence of mantle to test, in the arrangement of transverse vessels in the branchial sac, in the number and arrangement of tentacles, and in the shape of dorsal tubercle.

Although there is a good deal of sand on the test, it is not so much imbedded as to render the test brittle, as in *Polycarpa Sluiteri*.

The mantle is moderately thick, but there are no large muscle bands. The polycarps are very slightly developed, and are entirely sunk in the mantle. The stigmata are rather small (fig. 2), so as to leave rather wide transverse vessels.

The tentacles (fig. 4) are all rather small, and the larger ones are very few. The minute intermediate ones are always 3 together. The dorsal tubercle (fig. 3) has a very wide pre-branchial zone separating it from the tentacles.

Polycarpa longisiphonica, Herdman, Pl. Cyn. XIX., figs. 5, 6.

This is one of the species found by the "Challenger" Expedition at Port Jackson, and I now refer to it a specimen in the present collection labelled "Port Stephen, 25 to 30 faths., and agreeing in all

essential respects with the description in the "Challenger" Report.* The specimen measures 4 by 3 by 3 cm. (Pl. Cyn. XIX., fig. 5). The dorsal tubercle, although described, was not figured in the "Challenger" Report, so I give a figure of it now (fig. 6).

Polycarpa Jacksoniana, n. sp., Pl. Cyn. XIX., figs. 7—9.

External appearance. Form ovate, nearly globular, attached by left side. Branchial aperture at end of long siphon on anterior dorsal edge, directed forwards and dorsally. Atrial aperture on dorsal edge, half way down, directed backwards, on short thick siphon. Openings indistinct, 4-lobed. Surface nearly covered with sand, pieces of shells and sea-weed, and somewhat wrinkled. Colour brown. Length 4·5 cm., width 3·5 cm., thickness 2 cm.

Test leathery, thin but stiff, dark brown on outer surface, whitish and glistening on inner surface.

Mantle adheres slightly to test; thick; musculature rather strong.

Branchial sac, 4 folds on each side. About 7 longitudinal bars on each fold, and about 6 in the interspaces. Every 7th transverse vessel wider than intermediate ones; 5 to 7 stigmata in each mesh. Meshes elongated transversely.

Dorsal lamina a narrow plain membrane with even edge.

Tentacles simple, 24 in number, arranged symmetrically; 6 longer, with 3 smaller between each pair, middle one of the 3 rather longer than its neighbours.

Dorsal tubercle simple, somewhat horse-shoe shaped, one horn coiled inwards, the other outwards.

Locality.—Port Jackson.

This species (Pl. Cyn. XIX., fig. 7) has a test rather like that of a typical *Microcosmus*—leathery and wrinkled, with adhering sand, shells, &c. Figs. 8 and 9 show the branchial sac and dorsal tubercle. They do not call for any further remarks.

This species is probably closely related to *P. longisiphonica*.

Polycarpa pilella, Herdman.

This species was described from specimens obtained during the "Challenger" Expedition, off Bahia, in Brazil. On the surface of some of the large specimens of *Microcosmus Draschii*, from Port Stephen, there are a number of minute sandy balls, which prove to be a species of *Polycarpa*. I have not found any gonads in those I have examined, so

* Part I., p. 177, 1882.

it is quite possible that these minute specimens, on the average about 3 mm. in diameter, are the young of some other species of *Polycarpa*, or even *Styela*. As, however, they agree in structure in all points I have been able to determine with the account of *P. pilella* in the "Challenger" Report, and are precisely like that species in appearance, I think it best to place them under the above name—at least, until some Australian zoologist traces them in adult specimens to another species.

Polycarpa tinctor, Quoy and Gaimard, Pl. Cyn. XX., fig. 9.

There are about 30 specimens of this common Australian species in the collection. It was first found during the voyage of the "Astrolabe," and was figured by Quoy and Gaimard (1834) in the Report on the results of that expedition. Later on it was obtained at Port Jackson by the "Challenger" Expedition, and was more fully described and re-figured in the Report (1882). There is nothing further to add, as the present specimens agree with those of the "Challenger" collection, except that in one individual examined the dorsal tubercle has the right horn coiled outwards and the left inwards (see Pl. Cyn. XX., fig. 9).

Polycarpa aurata, Q. & G., var. *plana*, nov., Pl. Cyn. XX., figs. 1—5.

External appearance. Shape irregularly triangular, the anterior end being long and pointed, and the posterior broader. The body is compressed laterally, and is attached by the posterior end and part of the left side. Branchial aperture at the extremity of the long narrow anterior end; atrial on a long siphon springing from the dorsal edge less than half way back; both apertures are wide. Surface with slight longitudinal ridges and grooves. Colour pale yellowish brown. Length 8 cm., breadth 4 cm., thickness 2 cm.

Test leathery, flexible, not thick; full of small vessels, with numerous little knobs close to the surface.

Mantle thin, very dark in colour, slightly muscular, closely adherent to test.

Branchial sac with 4 rather wide folds on each side. About 6 internal longitudinal bars on a fold and 4 to 6 in the interspace. About 6 stigmata in a mesh.

Dorsal lamina a plain membrane.

Tentacles very numerous and closely placed.

Dorsal tubercle very large, triangular in outline, and having the opening of the duct broken up into a large number of small simple apertures.

Locality.—Port Jackson; one specimen.

This species was in the collection along with some specimens of *Polycarpa rigida*, from which it differs, not only in internal structure, but also in the external form and in the consistency of the test. The body is more flattened from side to side, and is more narrowed anteriorly. The apertures are remarkable for their wide open condition. The surface is not rough, nor minutely wrinkled, nor sandy; but is marked by low rounded ridges with grooves between, which run mainly longitudinally (Pl. Cyn. XX., fig. 1). On the left side the body is partly covered by a thin layer of a smooth encrusting sponge, and at the posterior end are attached various pieces of cinder. The test on section shows many little brown dots, which are the dilated knobs on the numerous vessels. At the base of the wide atrial siphon there is a circular fold which bears about 40 atrial tentacles. These tentacles are minute, and their terminal parts are slender, but the bases are swollen so as to be in contact with their neighbours (fig. 5).

The branchial sac is, like the mantle, of a very dark brown colour; both are thin, and are closely pressed against the test. Most of the transverse vessels are very narrow (fig. 2); usually every 6th or 7th is much wider. The large, soft porous-looking dorsal tubercle is seen in fig. 3, and its condition is magnified about 50 times in fig. 4. Several other species are known, in which the hypophysial duct is broken up into several openings. Herdman described *Cynthia irregularis* with 9 openings in 1882. Sluiter has since described, amongst other species, *Styela (Polycarpa) pneumonodes* (=*Ascidia aurata*, Quoy and Gaimard), with about 26 openings, and *Polycarpa sulcata*, Herdm.,* has also the aperture of the duct broken up; but the present form has more than a hundred openings, and they are quite closely placed (see fig. 4).

This form at once recalls *Polycarpa sulcata*, Herdm., of the "Challenger" collection, and I have come to the conclusion, after a careful comparison, that they are so closely related, as to be at most only 2 varieties of the same species. Sluiter's *Styela pneumonodes* is clearly the same as my *P. sulcata*, and must therefore lapse, and since writing the "Challenger" Report, I have become convinced that my species may be referred to the *Ascidia aurata* of Quoy and Gaimard, and that the correct name for all the above forms is, therefore, *Polycarpa aurata*, Q. and G.

* "Challenger" Report, Tunicata, Pt. I., and also von Drasche, Denkschr. K. Akad Wiss. Bd. XLVIII., Pl. VII., fig. 2.

The present form, however, differs from the species in not having the regularity of form and marking seen in Quoy and Gaimard's figure. On account of the absense of the marked sulci, I have named it variety *plana*, and have given it the above detailed description.

Polycarpa attollens, n. sp., Pl. Cyn. XX., figs. 6—8.

External appearance. Shape ovate, with a long anterior projection, which bears the branchial aperture at its extremity. Atrial aperture on a long projection, which springs from the dorsal edge half-way down, and is directed forwards. Body not compressed, attached by well-marked branched roots at the posterior end. Surface slightly marked with sulci, otherwise smooth. Colour a dirty smoky white or yellow. Length 5·5 cm., breadth 2·5 cm., thickness 2 cm., roots extending for 4·5 cm. beyond the posterior end.

Test leathery, flexible, not thick.

Mantle not thick, moderately muscular, closely attached to test.

Branchial sac with well-marked folds. About 8 internal longitudinal bars on a fold and 4 in the inter-space. Three narrower transverse vessels occur between rather wider ones; here and there there are occasional very much wider transverse vessels. The stigmata are short and wide, and are usually about 6 in a mesh.

The dorsal lamina is a slight membrane.

The tentacles are large and numerous, about 40, with about the same number of very much smaller ones projecting from their bases.

The dorsal tubercle is remarkable. It is large, of triangular form, completely filling the peritubercular area. The slit is on a closely convoluted band.

Locality.—Port Jackson.

This species is like *Polycarpa pedata*, Herdm., in superficial appearance (Pl. Cyn. XX., fig. 6); but is quite distinct from that species in structure. The notable external points are the prolonged anterior end and the large root-like processes for attachment.

Figure 7 shows part of the branchial sac. The large tentacles are closely crowded, and the smaller intermediate ones are inconspicuous, and required to be found with the microscope.

The dorsal tubercle (fig. 8) recalls that of *Ascidia pyriformis*, Herdm. The double sinuous line branches occasionally, and is interrupted once or twice at most.

[The following Styelinæ have also been recorded from Australian seas :—

Styela humilis, Heller.
S. captiosa, Sluit.
S. palinorsa, Sluit.
S. phaula, Sluit.
S. solvens, Sluit.
S. radicosa, Herdm.
S. exiqua, Herdm.
Polycarpa radicata, Herdm.
P. pedunculata, Heller.
P. elata, Heller.
P. Stimpsoni, Heller.
P. obscura, Heller.
P. nebulosa, Heller.
P. Bassi, Herdm.
P. molguloides, Herdm.]

Family IV. **MOLGULIDÆ**, Lac.-Duth., 1877.

Body usually free, sometimes fixed, rarely pedunculated.

Test cartilaginous, coriaceous, or membranous, usually covered with sand, &c., which adheres to long hair-like processes of the test. Branchial aperture 6-lobed, atrial aperture 4-lobed.

Branchial sac usually longitudinally folded (5 to 7 folds on each side); internal longitudinal bars not papillated; stigmata more or less curved, usually arranged in spirals.

Tentacles always compound, usually much branched.

Intestine attached to the inner surface of the mantle on the left side.

Renal sac present, upon the right side of the body.

Gonads on the inner surface of the mantle usually developed on both sides. Larvæ usually tailed, in a few specimens anurous.

Only two of the eight genera of the family are represented, viz., *Molgula* and (doubtfully) *Ascopera*.

Molgula, Forbes, 1853.

There are 4 species in the collection which fall into this genus, and 3 of them seem new to science.

Molgula mollis, n. sp., Pl. Mol. I., figs. 1—4.

External appearance. Shape between ovate and pyriform, much compressed laterally, not attached. Anterior end wide, bearing both

apertures moderately far apart. Apertures slightly projecting, but no well-marked siphons. Posterior end rather narrow. Surface closely covered with fine sand. Length (antero-posterior) 2 cm., breadth (dorso-ventral) 1·5 cm.

Test is thin, soft and flexible.

Mantle thin, moderately muscular about the siphons.

Branchial sac with 7 folds on each side. Stigmata large and numerous, coiled in large spiral infundibula.

Tentacles branched, 16, large and small alternately.

Dorsal tubercle small and simple, U-shaped or elliptical; with an exceedingly large neural gland which extends forwards to the tubercle.

Gonads ring-like, one on each side of body.

Locality.—Port Jackson; about a dozen specimens.

This species in external appearance (Pl. Mol. I., fig. 1) is exceedingly like *Molgula Forbesi* obtained by the "Challenger" Expedition at Port Jackson in shallow water; but differs from that species in the structure of the branchial sac (fig. 3) and notably in the condition of the dorsal tubercle and neural (or hypophysial) gland (fig. 4). It also has the test much softer and more flexible than in most Molgulas, a feature which I have indicated by the specific name *mollis*. The hypophysial gland completely covers the ganglion in some specimens and extends beyond it in every direction. It is composed of a very large number of ovate or short tubular cæca (fig. 4, *s.n.gl.*) In another specimen examined the horns of the tubercle meet anteriorly, so as to make an elliptical figure. Figure 2 shows the left side of the body after removal of the test. The intestine is long and narrow. The ring-like gonad is placed near the loop.

I was in hopes when I saw this small *Molgula* in the collection that I might be able to revive and re-describe one of Macdonald's species of "*Cæsira*"; but I find that this species will not really correspond to any of them in appearance and structure, nor will it agree with Stimpson's description of his *Molgula inconspicua*.

Molgula sydneyensis, n. sp., Pl. Mol. I., figs. 5—9.

External appearance. Body roughly circular in outline from the side, but much compressed laterally; soft and flaccid. Both apertures on the broad anterior end, rather far apart, conspicuous, but not very prominent. Surface covered with very fine silvery sand. Length and breadth each about 2 cm.

Test very thin, with delicate, slightly-branched hairs.

Mantle moderately muscular.

Branchial sac with 7 strongly-marked folds on each side. The main vessels, both transverse and longitudinal, very wide. The finer interstigmatic vessels much as usual. Stigmata curved and arranged in infundibula.

Tentacles, 8 very large and much-branched, alternating with 8 very much smaller ones.

Dorsal tubercle cordate, with the opening anterior, and both horns turned equally outward, but not coiled.

The specimen described above is one labelled "from Sydney," with no date or other particulars which I happened to have in my possession, and which I thought had better be treated as belonging to this collection of Australian Tunicata. The most notable external characters are the very flat condition of the body and the softness and looseness of the test (Pl. Mol. I., fig. 5). No lobes are visible round the apertures externally, but when the test is removed there are rather long well-marked siphons (figs. 6 and 7). The mantle and the alimentary and reproductive viscera are of the ordinary Molgulid character. The most noteworthy point about the branchial sac is the exceptional width of the vessels (fig. 8). A large parasitic Copepod was found in the branchial sac.

Molgula Forbesi, Herdm.

Three small specimens attached to the large *Ascidia phallusioides* and *Microcosmus Draschii*, from Port Jackson, seem to belong to this "Challenger" species. They are shown on Pl. Cyn. IV., fig. 1. The specimen obtained at Port Jackson by the "Challenger" was apparently free, while the present specimens are attached, but in all other respects and details of internal structure they agree with the original description of *Molgula Forbesi*.*

Molgula recumbens, n. sp., Pl. Cyn. VI., figs. 9—13.

External appearance. Shape ovate, compressed laterally, and attached by the greater part of the right side. Apertures conspicuous, both on long, permanent siphons, which are recurved, so that the branchial points ventrally and the atrial dorsally. Surface even, but entirely encrusted with fine sand. Colour dark grey brown. Length 1·8 cm., breadth 1·5 c.m., thickness ·8 cm.

Test thin, but strong, flexible.

* "Challenger" Report, Tunicata, Part I., p. 78, 1882.

Mantle moderately muscular. The long siphons are surrounded by circular fibres, and radiating bundles issue from their bases.

Branchial sac with 7 folds on each side, with about 6 bars on a fold. The stigmata are straight and regularly arranged at the base of a fold, but more or less curved elsewhere, and in some places arranged in spiral infundibula.

The dorsal lamina is a plain membrane.

The tentacles are 12 large and 12 smaller, placed alternately.

The dorsal tubercle is a simple crescent-shaped slit, with the aperture placed laterally.

Locality.—Port Jackson; one specimen.

This single specimen differs from most species of *Molgula* in being attached by the greater part of one side, and in having the long recurved siphons (Pl. Cyn. VI., fig. 9). When the body is taken out of the test (figs. 10 and 11) the siphons are seen to be marked by 6 and 4 echinated ridges. The siphons are opaque brown, the rest of the mantle transparent. The branchial sac (fig. 12) has no special character, and the dorsal tubercle (fig. 13) is remarkable for its simple condition. The gonad on each side shows an ovary in the centre and a mass of spermatic vesicles around it.

Ascopera, Herdm., 1880.

The following species seems nearer to this genus than to *Molgula*, but may come to be regarded as an annectant form.

Ascopera nana, n. sp., Pl. Mol. I., figs. 10—14.

External appearance. Body urn-shaped, with a swollen body, and sometimes a short median posterior stalk. Apertures both at the wide anterior end, but placed at its extremities so as to be rather far apart. Both apertures on prominent papillæ turned in opposite directions, the branchial ventrally and the atrial dorsally. Surface a little wrinkled, but otherwise smooth, with only a very few shell and sand fragments adhering towards the posterior end. Length 2·5 cm., breadth 2 cm.

Test leathery and tough, with only a few short hair-like projections.

Mantle stronger and more opaque than is usual. Siphons very thick, almost globular.

Branchial sac with 7 folds on each side. Longitudinal vessels regular and of moderate size. Transverse vessels in places very wide, and quite irregular. Stigmata in some places very small and rounded, quite

irregularly placed; in other parts, on and near the folds, straight and arranged in regular rows; never regularly curved to form infundibula.

Tentacles 12 to 14 in number, much branched, of different sizes, but not regularly arranged.

Dorsal tubercle rather simple, U-shaped, with a shorter horn turned in and a larger one coiled out, placed in a deep peritubercular area.

Locality.—Port Jackson; three specimens.

I refer this species with a little hesitation to the genus *Ascopera*, founded for two very remarkable and very large Ascidians obtained by the "Challenger" Expedition to the south of Kerguelen Island in the Antarctic Ocean at a depth of 150 fathoms. In appearance (Pl. Mol. I., fig. 10) the present animal suggests a dwarf form of the "Challenger" *Ascopera gigantea;* hence the specific name. Externally it has more of a Cynthiid than of a Molgulid appearance, and somewhat resembles *Molgula cæpiformis* from British Seas. It is exceptional amongst the Molgulidæ in having practically no covering of sand or gravel, and in being fixed by a peduncle; but in both these characters it agrees with the other two species of *Ascopera*. The irregularity of the branchial sac also, and the absence of curved stigmata arranged in spirals or infundibula (fig. 12) is noteworthy. Our figure shows one of the more irregular parts where the stigmata are all small. The figure shows also another interesting feature, viz., imperfect or budding internal longitudinal bars (fig. 12, *i.l'.*). Such are known in *Corella* and elsewhere in the family Ascidiidæ, but have not been previously described in the Molgulidæ. This goes far, in my opinion, to establish the real identity of nature of the internal longitudinal bars throughout the Ascidiæ simplices which is apparently doubted by Lahille, Garstang, and others. In some places the branchial sac between the bars has regular rows of straight stigmata like those of a Cynthiid. When the test is removed (fig. 11), the body is very globular and the siphons are most curiously shaped and are directed quite away from one another. Figures 13 and 14 show the dorsal tubercle and one of the much-branched tentacles. The horns of the dorsal tubercle are in some cases more coiled. A large parasitic Copepod was found in the branchial sac.

[The following Molgulidæ have also been recorded from Australian seas:—

Cæsira (? Molgula) parasitica, Macd., King George's Sound,
C. (? M.) ficus, Macd., Shark Bay,
C. (? M.) pellucida, Macd., Shark Bay,
Molgula inconspicua, Stimp.,

and possibly the following species insufficiently described by Quoy and Gaimard:—*Ascidia reticulata*, *A. tumulus*, and *A. sabulosa*, from Port Western.

Sub-order II. ASCIDIÆ COMPOSITÆ, Savigny, 1816.

This group contains fixed Ascidians, which reproduce by gemmation so as to form colonies in which the Ascidiozooids are buried in a common investing mass, and have no separate tests.

It is now agreed by all authorities that this is, in all probability, a polyphyletic group, the Compound Ascidians having been derived from several distinct groups of ancestral Simple Ascidians. They are thus a semi-artificial assemblage consisting of those fixed Ascidians which have retained or acquired the power of reproducing by gemmation, so as to form colonies, and in which the Ascidiozooids have remained so intimately united that their tests form a common colonial mass.

Some zoologists, such as Lahille, Garstang and Sluiter, would break up this group at once, and scatter its constituents amongst the families of Simple Ascidians; but I am supported by Seeliger, Ritter and others in thinking that such a course would be premature, that the colonial form and common test, whether acquired independently or not, represent a community of structure which ought to be expressed in our classification, that we may get further light upon genetic affinities when the method of budding is known in many more genera, and that, consequently, it is a practical convenience to retain for the present the group Ascidiæ Compositæ.

The seven families of Compound Ascidians may, however, be arranged in two well-marked groups to which Sluiter's

terms, Holosomata* and Merosomata, may be appropriately applied. The Holosomata would comprise those forms with compact bodies—the Botryllidæ and the Polystyelidæ—which we believe are derived from ancestral Cynthiidæ; while the Merosomata are the remaining families, with more or less spread out bodies, which are more closely related to the Clavelinidæ.

Section A. **MEROSOMATA**, Sluiter, 1895.

Compound Ascidians in which the alimentary and reproductive viscera lie behind the branchial sac, so as to form an "Abdomen" distinct from the "Thorax."

Of the five families in this section three—the Distomidæ, the Polyclinidæ, and the Didemnidæ—are represented in the collection.

Family I. **DISTOMIDÆ** (Giard, 1872), Herdm., 1885.

Colony rounded and massive, rarely incrusting, either sessile or supported on a long or short peduncle.

Systems irregular, inconspicuous or absent.

Ascidiozooids of moderate length, and having the body divided into two regions, thorax and abdomen; they may be provided with long vascular ectodermal appendages.

Test gelatinous or cartilaginous, often thickened at the base to form a peduncle, which may be traversed by large canals containing the vascular appendages of the Ascidiozooids. There are sometimes calcareous spicules, which, however, are not stellate.

Branchial sac well developed; no internal longitudinal bars present.

Dorsal lamina represented by a series of languets.

Alimentary canal placed posteriorly to the branchial sac, so as to form an abdomen.

Gonads and heart in the intestinal loop, or alongside it. Spermatic vesicles numerous, vas deferens straight.

This is a large family, containing 7 genera, but only one of these, *Colella*, is represented in the present collection.

* Sluiter used Holosomata in a much wider sense, to include also the Simple Ascidians.

Colella, Herdm.

The two species *Colella pedunculata* and *C. Thomsoni*, obtained during the "Challenger" Expedition, were fully described, and the present genus was first formed for their reception by me in my Thesis on the Synascidiæ, accepted by the University of Edinburgh for the degree of Doctor of Science in March, 1880. This account of the genus *Colella* was afterwards incorporated in the second part of my "Challenger" Report, dealing with the Compound Ascidians, and published in 1885. Briefly put, *Colella* includes pedunculated Distomidæ, provided with an incubatory pouch or diverticulum of the atrial cavity, in which the embryos undergo their development. For a more detailed description I must refer readers to the "Challenger" Report, Part II., p. 72.

Nine species, and a variety, of *Colella* were obtained during the "Challenger" Expedition. Four of these and the variety were from Australian seas, and the present collection adds four newly described species (one of which is possibly an old, imperfectly described, species of Quoy and Gaimard), making in all eight species of *Colella* known from the neighbourhood of Australia.

The various known species of the genus may be distinguished as follows:—

	Peduncle branched	1
	Peduncle unbranched	2
1	Lower end of peduncle branched	3
	Upper end of peduncle branched	*C. plicata.*
3	Peduncle short and wide	*C. concreta.*
	Peduncle long and narrow...	4
4	Tentacles all one size	*C. ramulosa.*
	Tentacles of two sizes	*C. tenuicaulis.*
2	Peduncle longer than body	5
	Peduncle not longer than body	6
5	Colour red	*C. pulchra.*
	Colour blueish	*C. Thomsoni.*
	Colour greyish-yellow	7
7	Tentacles large	*C. pedunculata.*
	Tentacles small	*C. Gaimardi.*
6	Colony wide at top	8
	Colony narrow at top	9
8	Colour grey	*C. Murrayi.*
	Colour with a reddish brown tinge ...	do., var. *rubidum.*

9	Body not longer than broad	*C. Quoyi.*
	Body longer than broad	10
10	Ascidiozooids not less than 5 mm. long ...	11
	Ascidiozooids less than 2 mm. long ...	*C. elongata.*
11	Colour dark blue all over	*C. cyanea.*
	Colour not blue (grey in spirit)	*C. claviformis.*

There are, of course, many other differences between the species The characters in the above table merely give an indication of which species to turn to.

I shall now describe the four new species of the Museum collection.

Colella plicata, Herdm.,* Pl. Dis. II., figs. 1—15.

? = *Aplidium cerebriforme,* Q. & G.

External appearance. The colony consists of a peduncle, usually short and wide, and a vertically flattened, expanded and greatly folded or convoluted body. The peduncle is of a very pale yellowish grey, and quite smooth. The lower part is columnar, while the upper part is flattened and fan-like, and appears to be formed by branches from the lower part which, in most cases, are not completely separated, but are united by a thin membrane. The expanded body, or upper part of the colony in which the Ascidiozooids are borne, is a flattened band or ribbon-like structure, plicated or folded upon itself, and continuous from branch to branch in those cases where the peduncle sub-divides. The colour of the body is very pale yellow, almost white, and considerably lighter than that of the peduncle. The following measurements are taken from a medium-sized colony:—Length of peduncle 3·7 cm., diameter of peduncle 1·0 cm.; length (vertically) of body proper 1·0 cm., breadth (horizontal) of body proper 6 cm. (following all the plications 26 cm.), thickness (laterally) of body 0·5 cm.

The Ascidiozooids are placed in vertical rows, about 6 in each, in the body, two rows being always placed close together, and separated from the neighbouring double rows by ridges of test. The Ascidiozooids in each pair of adjacent rows are placed alternately so as to pack close together. The rows are slightly divergent so as to produce a fan-shaped figure, and in each row the Ascidiozooids at the base are very young, while those towards the free edge of the body are large and old. The vascular appendages from the Ascidiozooids can be seen running downwards, and converging for some distance through the upper part of the

* See Revision, p. 611.

peduncle. The length of the Ascidiozooids is about 2 mm., and the breadth 0·5 mm. The thorax and abdomen are about equal in size, but separated by a considerable constriction formed of œsophagus and rectum. There is an incubatory pouch and a vascular ectodermal appendage.

The test is soft and smooth and glistening, and of a whitish colour on the upper part of the body. In the peduncle it is tougher and of a darker colour, but still smooth. The matrix is clear and structureless, and contains stellate and fusiform test cells. A few white pigmented cells and bladder cells are scattered through the test of the upper part of the body; while in the peduncle there are no bladder cells, but the test is very much cut up by the numerous longitudinally running canals, in which the vascular appendages are placed.

The mantle is moderately developed. The muscle bands runs longitudinally.

The branchial sac contains 3 rows (occasionally 4) of stigmata, with about 10 in each row, on each side; so there are about 60 stigmata altogether. They are very large and closely placed.

The endostyle is very distinct, and has an undulating course. It projects slightly beyond the branchial sac at the posterior end.

The dorsal languets are very short.

The tentacles are 10 in number, 5 large and 5 small, placed alternately.

The dorsal tubercle is a simple circular opening.

The viscera form an ovate mass attached to the branchial sac by a long narrow peduncle. The stomach is of an elongated pyriform shape. The intestine is long and narrow. The reproductive organs lie in the loop of the intestine.

Locality.—Port Jackson.

There are about 27 specimens of this very remarkable species, which may possibly be the *Aplidium cerebriforme* of Quoy and Gaimard. In the largest specimen the peduncle is 7·4 cm. in length and 2·2 cm. in diameter, while the greatly-expanded upper part of the body is over 43 cm. in horizontal extent following all the folds. It is only 1·1 cm. in vertical extent and 7 mm. in thickness. The chief point in which the measurements of specimens differ is the horizontal extent of the body, which in the smallest specimen is only 5·5 cm. The peduncle shows all stages between a perfectly simple columnar and a very much subdivided tree-like condition. In some of the branched specimens the intervals between the branches are open, but in most cases they are filled up by a thin membrane-like layer of test.

The upper part of the body in which the Ascidiozooids are placed is of extraordinary extent, and is thrown into a remarkable series of close folds (see Pl. Dist. II., figs. 1—11). This folded band-like structure is continuous across from branch to branch of the peduncle, but there is evidence that this continuity is the result of concrescence, since points of junction with more or less perfect union can be discovered (see figs. 3, 7, 9, 10, *c*.). In some of these cases the connecting bridges of tissue are still very small (fig. 3). In one very remarkable specimen (fig. 7) a continuous band with two narrow connecting points stretches between what are apparently two distinct colonies with separate peduncles and bases. In some cases the peduncle is very short and stumpy, in others it is long and slender (fig. 8). The different conditions of branching also give rise to very different appearances of the colony. In some the upper end of the peduncle is flattened and expanded so as to be fan-like, but is not sub-divided (fig. 4).

The test of the body proper is transparent and very delicate, and very little is present between the Ascidiozooids in adjacent rows. Buds are either produced from, or become early connected with, diverticula of the vascular appendages, and a gradation can be traced from the vascular appendages in the top of the peduncle upwards through the very young Ascidiozooids to the fully-developed forms near the free upper edge of the colony (see fig. 5). The vascular appendages lie in large canals, so that the test of the peduncle, as seen in a transverse section, is reduced to a mere reticulum (fig. 13). The bladder cells and test cells are seen in fig. 14.

The shape of the Ascidiozooid (fig. 12) is remarkable on account of the very long narrow pedicle connecting the thorax and abdomen. The branchial sac is not long but is rather wide, the stigmata are very long, and the dorsal languets remarkably short (fig. 15). The Ascidiozooids examined were all in a male condition with spermatic vesicles lying in the intestinal loop.

Colella tenuicaulis, Herdm.,* Pl. Dist. I., figs. 1—16.

External appearance. The colony consists of an irregularly pyriform body, or mass (the Ascidiarium) in which the Ascidiozooids are placed, borne on the upper end of a long slender peduncle. Several colonies are united in groups by their peduncles being joined at their lower ends by a slightly branched stolon provided with tufts of adhering rootlets or hairs

* See Revision, p. 611.

which are given off chiefly near the bases of the peduncles (Pl. Dist. I., fig. 2), and are found to be encrusted with sand and shell fragments. The Ascidiarium is frequently flattened so as to assume an equilateral-triangular shape as seen from the side (fig. 10). The peduncle is from twice to six or eight times the length of the Ascidiarium. The stolon is of much the same thickness and appearance as the peduncles. The peduncle is of a dull yellow colour, but the Ascidiarium varies considerably. It is sometimes of a dark brown colour, with narrow light-coloured streaks between the rows of Ascidiozooids, sometimes yellow or grey or slate colour, and in a few cases it is a dark purple brown. The following measurements are taken from an average-sized specimen:—

Length of peduncle	9·7 cm.
Diameter of peduncle	6 mm.
Length of Ascidiarium	4·4 cm.
Breadth	3·3 cm.
Thickness	1·8 cm.

There is a great variation in the size. The peduncle may extend up to 22 cm. and the stolon to 10 cm.

The Ascidiozooids are closely placed and are arranged in double vertical rows, the Ascidiozooids in each pair of rows being placed opposite to one another and alternately with those of the next double row (Pl. Dist. I., fig. 3). Very little test is left between the Ascidiozooids, and so the test is soft and flexible and not elastic. In the upper part of the peduncle where it joins the body the young Ascidiozooids may be seen developing. At the top of the Ascidiarium, where the rows have diverged somewhat, the old Ascidiozooids are decaying and falling out of the white transparent test, and there is generally a narrow band at this edge free from Ascidiozooids. In the young colonies attached to a stolon (fig. 11) the slender peduncle rises to a considerable height before a terminal knob forms in which Ascidiozooids develop as young buds. In fig. 11 the youngest colony has a peduncle 3 cm. in height and the next 7 cm., and in both of these the Ascidiozooids are still in an embryonic condition. On an average there are about 20 double rows of Ascidiozooids in a colony. The colony shown in fig. 1 differs from all the others in having the body of a dark purple brown colour, which is found to be due to a dark brown pigment thickly disseminated in the mantle of the Ascidiozooids. Each Ascidiozooid is about 2 mm. in length and about 1 mm. in breadth. The thorax and abdomen are about of the same size. Vascular appendages are continued from the posterior end of the abdomen downwards into the stalk.

The test is soft and spongy. It contains fusiform, spherical and stellate small test cells. There are also large bladder cells, but no pigment cells.

The mantle is thin. The muscle bundles run longitudinally. The branchial aperture is 6-lobed.

The branchial sac is wide, and has large stigmata, which are about seven times as long as they are wide. The transverse vessels are narrow. There are 5 rows of stigmata, with 12 in each row.

The dorsal lamina is represented by a series of 4 languets. These are large, stout, and not tapering, but bluntly rounded.

The tentacles are usually 12 in number, 6 large and 6 small, placed alternately.

The dorsal tubercle is simple, with an oval aperture.

The alimentary canal crosses so as to resemble a figure of eight. The stomach is placed far back, and the intestine crosses the œsophagus to reach the dorsal edge of the thorax.

The spermatic vesicles form a nearly spherical 8-lobed mass, lying immediately behind the stomach, and therefore not in the intestinal loop. The vas deferens arises from the centre of the mass and runs along the intestine to the cloaca.

Locality.—Port Jackson and Port Stephen; also some on a crab (*Macippe spinosa*, Stimpson).

There are nearly thirty specimens, many of them being united in groups by the branched stolon. This species is closely related to *Colella pedunculata*, from which it differs, however, in the fact that here the peduncles branch at their lower ends to form the stolon which unites several colonies together in groups, and also in the number and condition of the tentacles, those of *C. pedunculata* being 16 in number, and all of the same size. In the present species, however, there is a good deal of variability in the number and arrangement of the tentacles, partly due, no doubt, to difference in age and size of the Ascidiozooids. I have found 6 small similar ones, 8 of two sizes, 3 long and 9 very short, 10 of varying sizes, 12 alternately large and small, and finally 18 or 20 large and small, with 2 or 3 of the larger ones much longer than the rest.

There are also fifteen colonies from Port Jackson, which probably belong to the present species. They are all small and evidently immature. One measures as follows:—Length of body 6 mm., breadth 6 mm., thickness 4 mm., length of peduncle 5·5 cm., diameter 2 mm. They resemble the above-described species in the external appearance, in the shape and number of their stigmata, the shape of the stomach,

and the arrangement of the alimentary canal. Five of these small colonies are attached to the carapace of a crab, *Macippe spinosa*, Stimpson.

Colella claviformis, Herdm.,* Pl. Dist. III., figs. 1—15.

External appearance. The colony consists of a short, stout peduncle bearing a large irregularly pyriform or ovate body which tapers roughly to a blunted upper extremity. The wider ends of both body and peduncle are at the point where they join (Pl. Dist. III., fig. 3). The body and peduncle are of much the same length, and a number of colonies are united together by a mass of branching and anastomosing rootlets which spring from the lower ends of the peduncles (fig. 1). The surface is smooth. The colour is whitish grey, and glistening on the body, and is of a dull yellowish grey tint on the peduncle. The yellowish brown Ascidiozooids show through the grey test, and the abdominal parts of the lowest row can be seen extending into the upper end of the peduncle. The surface of the body is pitted owing to the contraction of the Ascidiozooids, and so each aperture appears to be placed at the bottom of a pit. The peduncle is marked by slight transverse creases and ridges. The dimensions of an average colony are as follows:—Length of peduncle 4·4 cm., thickness of peduncle below body 1·5 cm., and at base 7 mm. Length of body 4 cm., breadth of body 3 cm., thickness of body 1·8 cm.

The Ascidiozooids consist of a small thorax, and an oval abdomen provided with a long vascular appendage, but differ greatly in shape at the upper and lower ends of the colony. Those near the top have short and wide bodies (3 mm. long and 2 mm. broad), and have each an incubatory pouch containing developing embryos, and no reproductive organs in the short intestinal loop; while those at the base have very long, narrow bodies (5 mm. long and 1 mm. broad) with long U-shaped intestinal loops, no incubatory pouches and masses of reproductive organs placed in the intestinal loops. It is evident that these two sets of Ascidiozooids are at different stages in their life history, and that as the reproductive elements are set free and become transformed into embryos, developing in the incubatory pouch, the abdomen shortens considerably in length.

The test is firm on the outer surface, but soft and whitish-grey, glistening and semi-transparent in the inside of the upper part of the colony; while in the peduncle it is tougher and more opaque, and of a yellower tint. On section the test is very smooth and dense like

* See "Revision," p. 611.

india-rubber. On account of the contraction of the Ascidiozooids there are large spaces left in the test (see fig. 4) which were occupied by the thoracic regions when in the expanded state. The structureless matrix contains spherical and ellipsoidal large cells, and smaller stellate and and spherical test cells, and also yellow pigment cells (figs. 5 and 6).

The mantle has muscle bands running longitudinally, and also a few regularly placed transverse bands. An incubatory pouch is present on the dorsal edge.

The branchial sac has 6 or 7 rows of stigmata (fig. 10), which are closely placed. The stigmata are from five to seven times as long as broad (figs. 11 and 12). The transverse vessels are narrow.

The dorsal lamina is represented by long, narrow, almost tentacular languets (fig. 13).

The tentacles are 30 in number, and consist of 5 very long, 10 medium sized, and 15 very short, placed with regularity as follows:—long, short, medium, short, long. The short tentacles spring from a level further posteriorly than the line of insertion of the others.

The dorsal tubercle has a simple circular aperture leading into a long, narrow funnel shaped cavity.

The alimentary canal is long and narrow in the younger Ascidiozooids at the base of the colony (fig. 7), but becomes much shorter as the reproductive elements are shed, and the Ascidiozooid is pushed up nearer to the top (figs. 8 and 9). The lining of the stomach and intestine are thrown into numerous folds.

The reproductive organs, both male and female, are placed in the intestinal loops of the young Ascidiozooids. Embryos in various stages of development are seen in the incubatory pouches of the older Ascidiozooids (fig. 8).

Locality.—Port Jackson.

There are about 30 colonies of this species, but of these 15 smaller ones are united into one mass by the branching rootlets given off by the lower ends of their peduncles. Other 4 larger colonies are similarly united, as shown in fig. 1. The Ascidiozooids differ considerably in shape and size in different parts (figs. 7—10). Near the top of the peduncle Ascidiozooids are found with a long-looped alimentary canal, and reproductive organs in the loop, while at the top of the colony are found Ascidiozooids having short-looped intestines, and provided with incubatory pouches. The stolon-like appendages from the Ascidiozooids are shown in figs. 14 and 15.

This species is evidently very abundant on some parts of the Austra-

lian coast. Mr. Saville-Kent, in his book, "The Naturalist in Australia," reproduces, at p. 216, a photograph of Ascidian-covered rocks at Roebuck Bay, Western Australia, which shows many hundreds of specimens of what, I think, must be the present species, festooning every ledge and crevice.

Mr. Saville-Kent, in letters, informs me that this Ascidian occurs near extreme low-tide level. He describes the colour of the living colony as being a smoky grey, upon which the ends of the Ascidiozooids show as a bright cobalt blue. Mr. Kent also tells me, in his letters, of another allied species of a "creamy or light ochre hue," which he dredged from 6 fathoms off the Lacepede Islands further north.

Professor Ritter, of Berkeley, Cal., tells me that he finds on the Californian coast a species that is either *Colella claviformis* or a closely-allied form.

Colella cyanea, n. sp., Pl. Pcl. IV., figs. 1—6.

External appearance. The colony consists of a long and rather stout peduncle supporting a very long and gently tapering body, which terminates in a blunted upper end (Pl. Pcl. IV., fig. 1). The colour all over is a dark blue, darker, however, in the body than on the peduncle, while the depressed bodies of the Ascidiozooids are darkest of all, with the two apertures showing on each as two whitish blue spots. In consistency the head is soft and flaccid, while the peduncle is much firmer. The wide base of the peduncle spreads out to form short strong rootlets for attachment (Pl. Pcl. IV., fig. 1). The larger colony measures:—Length of body 11·5 cm., breadth 2 cm., thickness 1·5 cm., length of peduncle 9 cm., diameter 1·3 cm.

The Ascidiozooids are arranged without definite order, but are about equally spaced all over the body. An Ascidiozooid is about 5 mm. long and 1·5 mm. broad. It consists of thorax and abdomen, which are of equal size. The vascular appendages from the abdomen are exceedingly long and stout, and run half-way or more down the peduncle.

The test has many bladder cells, and many dark-coloured pigment cells (fig. 2). The test cells are very large and numerous, and are found of spherical, fusiform, stellate, and other shapes.

The mantle has muscle fibres, which run longitudinally, and also transverse bundles along the level of each transverse vessel. The branchial aperture is 6-lobed. There are many dark-coloured pigment cells in the mantle.

The branchial sac has 5 or 6 rows of exceedingly long, narrow stig-

mata (fig. 4), about fourteen to sixteen times as long as broad. The sac is produced ventrally into an endostylic prolongation, and the dorsal edge is only about half as long as the ventral (fig 3). There are altogether about 20 stigmata on each side of the branchial sac.

The dorsal lamina is represented by a few very long languets, which are wide at the base and taper rapidly (fig. 5).

The tentacles are 24 in number, and are of three distinct sizes, arranged alternately (fig. 6). Of the six long ones, 3 are a little longer than the others, and one of these 3 (placed laterally) is longer than its fellows. The 6 medium-sized are very much shorter than the 6 long, and vary a little amongst themselves in size and shape. The 12 short tentacles are exceedingly short, being mere papillæ (fig. 6). The 6 long tentacles spring from a line a little posterior to the insertion of the others. The tentacles are pigmented.

The alimentary canal is a simple U-shaped loop, which, from the great ventral prolongation of the branchial sac, appears to arise half-way along the dorsal edge of the thorax. The œsophagus is wide, but narrows before passing into the oval stomach. The intestine is wide and rather thick-walled. It contained, in the specimen examined, a very large number of parasitic *Gregarinida*.

There are no reproductive organs in the intestinal loop.

Locality.--Port Jackson.

Two colonies of this remarkable blue species were found in the collection, labelled *Sigillina australis*, Savigny. They differ, however, very markedly from the description and figures given by Savigny, and even if Savigny's *Sigillina* turns out to have been one of the Distomidæ, which is not likely, still it must be regarded as at least specifically distinct from the present form. Savigny gives the colour of his form as being yellowish green, while in the present specimen it is a very dark blue. Then, again, the form of the Ascidiozooids and the branchial sacs differ. I can find no trace of a post-abdomen in these specimens, and so place the species in the present family. At first I was inclined to regard the form as a Polyclinid.

[The following Distomidæ have also been described from Australian seas :—

Colella pedunculata, Q. and G., Port Western.
C. pulchra, Herdm., Torres Str.
C. elongata, Herdm., P. Jackson.
C. Murrayi, Herdm., S.E. Australia and Port Jackson.

Do., var. *rubida*, Bass Str.
Distoma decrata, Sluit., Torres Str.
? Chondrostachys sp., Macd., Bass Str.
? Polyclinum cylindricum, Q. and G., Port Western.]

Family II. **POLYCLINIDÆ**, Giard, 1872.

Colony usually massive; sometimes encrusting, sometimes lobed or even pedunculated.

Systems of various shapes, sometimes very irregular or absent. Common cloacal apertures usually inconspicuous.

Ascidiozooids always elongated antero-posteriorly, and usually divided into three distinct regions. Branchial 6- or 8-lobed; atrial aperture often with atrial languet.

Test gelatinous or cartilaginous, sometimes rendered stiff by imbedded sand grains.

Branchial sac usually small, and not highly developed. Stigmata usually small. There may be papilliform connecting-ducts, but never internal longitudinal bars.

Dorsal lamina represented by a series of languets.

Tentacles small, and not numerous.

Alimentary canal extending considerably beyond the branchial sac posteriorly.

Gonads placed behind the intestinal loop in the post-abdomen. Testis represented by a number of small spermatic sacs, attached to a large vas deferens.

Gemmation from the post-abdomen, which has the heart at its extremity.

Of the many genera in this family only three are represented. One of these *Psammaplidium* includes the colonies encrusted with sand. I think it best to refer all the forms with smooth stomachs to *Polyclinum*, and the rest to *Amaroucium*.

Amaroucium, M. Edw., 1841.

The following four species seem to be new, and probably belong to this genus.

Amaroucium rotundatum, n. sp., Pl. Pcl. I., figs. 1—4.

External appearance. The colony consists of a short, stumpy peduncle, which bears a large, somewhat hemispherical mass, the Ascidiarium, placed with its convex surface uppermost (Pl. Pcl. I., fig. 1). The peduncle is very thick and solid. It is of a dark grey colour and is in

great part covered with sand grains, shell fragments, worm tubes, and other adhering foreign bodies. The lower end of the peduncle is attached by a wide surface. The Ascidiarium is firm, light grey in colour, and fairly transparent. On account of the retraction of the Ascidiozooids, its surface is pitted all over. The dimensions are :—Length of Ascidiarium 5 cm., breadth 8·5 cm., thickness 4·8 cm. Length of peduncle 3·5 cm., thickness 4·2 cm.

The Ascidiozooids are irregularly placed. They are very long (Pl. Pcl. I., fig. 4), being about 2 cm. antero-posteriorly. The body is divided into thorax and abdomen, with a long vascular appendage. The thorax in the contracted state is only half the length of the abdomen, and is of a clear white colour, with a dark streak along the dorsal edge, caused by the rectum, and regular longitudinal lines which indicate the muscle bands. In some cases the thorax is greatly distended with developing embryos. No tailed larvæ were seen.

The test is firm and cartilaginous. It has no pigment cells. The test cells are large and stellate or spherical. Bladder cells are also present.

The mantle is not very delicate, and is moderately muscular. Longitudinal muscle bands run at regular intervals over the thorax, and each bifurcates as it approaches the branchial aperture. There are about 20 of these longitudinal muscle bands. At the posterior end of the thorax they converge ventrally and dorsally to form two very powerful muscles, which run posteriorly over the abdomen.

The branchial sac is rather wide. It has about 12 rows, of about 40 stigmata in each row. The stigmata are moderately long, and are regular. The transverse vessels are strong, and have horizontal membranes attached to their inner edges (Pl. Pcl. I., fig. 2).

The dorsal lamina is represented by a series of exceedingly long and closely-placed languets (Pl. Pcl. I., fig. 3), each being at least 0·5 mm. long. There are about 20. They taper from a very wide base to a fine point, and are covered with large cilia.

The tentacles are 24 in number, and are of two sizes, placed alternately. The larger ones vary in size.

The alimentary canal forms a very long, narrow U-shaped loop. The very long œsophagus runs back to a posteriorly-placed stomach, from which the long, thin-walled intestine passes forwards, to end near the atrial aperture. The stomach wall is folded longitudinally.

The reproductive organs lie in the intestinal loop, and extend a little beyond it posteriorly.

Locality.—One colony of this species was in the collection from Port Jackson.

Amaroucium protectans, n. sp., Pl. Pcl. III., figs. 7—10.

External appearance. The colony is thick, massive, dome-like, and not stalked. On its lower surface it is concave where it is slightly attached to the dorsal surface of the crab *Dromia excavata*, Haswell (Pl. Pcl. III., fig. 7). The upper surface is strongly convex, and has the Ascidiozooids scattered all over it. The colour is a dull yellowish grey, in some cases being darker towards the lower part of the colony from the presence of imbedded sand grains. The average dimensions of two shapes of colony are as follows:—

	A.	B.
Length (height)... ...	4·5 cm.	5·5 cm.
Breadth	10·0 cm.	7·5 cm.
Thickness	7·5 cm.	6·5 cm.

The Ascidiozooids are about 1 cm. to 1·5 cm. in length and 1·5 mm. in breadth. They lie in the test at right angles to the surface. The body is divided into thorax, abdomen, and a short post-abdomen (Pl. Pcl. III., fig. 8) terminating in a vascular appendage, which, in some cases, is long, branched, and budding.

The test has many bladder cells, but no pigment cells. The small test cells are chiefly spherical, and are not very numerous.

The mantle has strong longitudinally-running muscle fibres over the post-abdomen, and both longitudinal and transverse fibres are present in the mantle over the branchial sac, the transverse bundles being very closely placed. Sometimes the mantle over the branchial sac is marked with black pigment spots.

The branchial sac has about 10 rows of long, narrow stigmata (Pl. Pcl. III., fig. 10). The transverse vessels bear large horizontal membranes. There are usually a series of tailed larvæ placed in a single row along the thorax.

The dorsal lamina is represented by a series of rather long languets, set about their own length apart, opposite the transverse vessels (Pl. Pcl. III., fig. 9).

The tentacles are 24 in number and of three sizes, 6 large, 6 medium, and 12 very much smaller, which arise on a level anterior to the others.

Alimentary canal. The œsophagus is long and has its wall thrown into transverse folds; and before entering the stomach it narrows considerably. The stomach is globular or oval, and has its wall longitudinally grooved (Pl. Pcl. III., fig. 8). The intestine is narrow on first leaving the stomach, and runs for a short distance posteriorly, and then becomes rapidly wider and thin-walled, and runs anteriorly alongside the

long œsophagus to the dorsal edge of the branchial sac. It is constricted at intervals.

Reproductive organs. The masses of spermatic vesicles lie on the posterior edge of the abdomen and extend over the intestine. The vas deferens is large and conspicuous.

Locality.—There are half-a-dozen colonies of this species from Port Jackson.

In *Nature* for February 6th, 1890, Dr. R. v. Lendenfeld wrote a letter drawing attention to the fact that in the Australian seas there is a crab which attaches a large Ascidian to its back for protective purposes. In the following number of *Nature*, vol. XLI., p. 344, I had a letter on the subject, from which I quote the following as to the present species of *Amaroucium* :—

"The Compound Ascidian referred to by Dr. R. v. Lendenfeld in yesterday's *Nature* (p. 317) is one of the Polyclinidæ and probably a new species. It belongs to the genus *Atopogaster*, and is closely related to *A. informis* ('Challenger' Report, Part II., p. 171).

"I have before me now five good specimens of the crab and Ascidian (the crab in this case is *Dromia excavata*, Haswell) dredged in Port Jackson, and sent to me by the Australian Museum, Sydney; they measure as follows :—

Specimen	Crab (greatest diameter)	Ascidian (length × breadth × height)
	cm.	cm. × cm. × cm.
A	4	10 × 8 × 5
B	3·5	10 × 6 × 5
C	2·5	8 × 6 × 5·5
D	2·5	6 × 6 × 5
E	2·5	5·5 × 4·5 × 3

"In the largest of them the Ascidian seems to be quite twenty times the size of the crab.

"I notice in these specimens that the last pair of thoracic legs of the crab, which are much larger than the preceding pair, are turned up dorsally, and are so firmly embedded and attached by their sharp claws in the test of the Ascidian, that it is easier to disarticulate them than to loosen their hold." . . . .

At that time I thought I could put the species in my "Challenger" genus *Atopogaster*, but I now consider that it will be safer to regard it as an *Amaroucium*.

Amaroucium distomoides, n. sp., Pl. Pcl. IV., figs. 7—13.

External appearance. The colony is of oblong massive form, attached by a small area at one end and rounded at the other. It is of a yellowish grey colour, and the numerous small yellow Ascidiozooids are conspicuous over the greater part of the surface. The colony is soft and easily deformed. The length is 7·3 cm., the breadth 3·2 cm., and the thickness 1·7 cm.

The Ascidiozooids are small as seen on the surface, and are very numerous. They are arranged in definite systems (Pl. Pcl. IV., fig. 7), which are in some places circular or stellate in outline, but in other parts become larger and more complicated, and then form branched lines and networks. Cloacal passages are visible in places running through the test. The Ascidiozooids are of an opaque yellow colour, and show distinctly against the grey test. The body is divided into thorax, abdomen, and post-abdomen (fig. 11). The thorax and abdomen are about 2 mm. in length and the post-abdomen may be about 8 mm., or even longer, and very slender. The thorax and abdomen run at right angles to the surface, but the post-abdomen soon turns downwards and runs vertically through the centre of the colony. The post-abdomen terminates in a delicate vascular appendage. The branchial aperture has 6 lobes, the atrial has one large tri-lobed languet. The atrial aperture is dorsal.

The test is soft. It contains many bladder cells (Pl. Pcl. IV., figs. 8 and 9). There are white pigment cells, and many small stellate and spherical test cells. The outer layer of the test is firmer, and forms a membrane.

The mantle has muscle fibres running longitudinally over the branchial sac, and also 2 or 3 transverse bands. The mantle is very delicate over the abdomen and strong again on the post-abdomen, where there are about 10 longitudinal muscle bands. It is crowded with yellow pigment cells, which, in some Ascidiozooids, are aggregated to form stellate and branched masses (Pl. Pcl. IV., fig. 10).

The branchial sac has the ventral edge prolonged backwards, so that the posterior end of the endostyle projects (fig. 11). There are 3 or 4 rows of long, narrow stigmata, each about ten times as long as wide. The transverse vessels bear horizontal membranes (fig. 12).

The dorsal lamina is represented by a series of languets set rather more than their own length apart (fig. 12).

The tentacles are 14 in number, alternately large and small.

The dorsal tubercle is placed close to the base of a tentacle, as there is no peritubercular area, and the peri-pharyngeal bands come far anteriorly. The opening leads into a wide infundibulum (fig. 13).

Alimentary canal. The œsophagus curves round ventrally, and enters the stomach on the side. The stomach is oval and lies transversely (fig. 11). It has 3 or 4 longitudinal folds on each side. The intestine is rather narrow, and runs first posteriorly and then widens suddenly into a thick-walled heart-shaped cavity, which tapers off into the intestine, which then turns anteriorly and runs up the dorsal side of the thorax, nearly as far as the atrial languet. The rectum is wider than the intestine, but very thin-walled, so that the fæcal pellets show through distinctly.

Reproductive organs. None of the Ascidiozooids examined showed any trace of reproductive organs in the post-abdomen. Vascular appendages are present, budding freely, both from the ends and sides of the post-abdomen (fig. 11).

Locality.—Port Jackson; one colony.

Amaroucium anomalum, n. sp., Pl. Pcl. III., figs. 11—16.

External appearance. The colony is small, and of nearly globular form. It is attached to the side of a small sponge (Pl. Pcl. III., fig. 11). The colony is of a light grey colour, the Ascidiozooids showing through of a darker tint. The anterior ends of the Ascidiozooids are all at the upper end, which is twisted over to one side. The rest of the colony is smoother and more compact. The length of the colony is 1·5 cm., and the breadth 1·2 cm.

The Ascidiozooids are set at right angles to the surface, and are all nearly parallel in position. The thorax and abdomen measure about 7 mm., and the post-abdomen about 5 mm. (fig. 14).

The test is soft and gelatinous round the anterior ends of the Ascidiozooids. On the rest of the colony it is firm and compact. It contains no bladder cells and no pigment cells, but many rather large test cells. The test is traversed by vascular appendages arising from the post-abdomen of the Ascidiozooids, which run almost parallel with one another towards the lower end of the colony, and give off, usually alternately, short lateral branches, which bear clumps of terminal bulbs (see fig. 16). There seems to be no anastomosis between the various branches. The ectoderm covering these vessels is distinctly columnar.

The mantle is very strong and muscular. The thorax has longitudinal fibres, and also transverse bands running round between the rows of stigmata. The longitudinal muscle bands are strong over the post-abdomen.

The branchial sac is rather opaque. There are 9 or 10 rows of

stigmata, and about 40 in a row on each side. The stigmata are fairly wide, but are seven times as long as wide (fig. 13). They are rather wider than the thickness of the inter-stigmatic vessels. The transverse vessels bear narrow horizontal membranes.

The dorsal lamina is represented by about 10 closely-placed languets (fig. 12), with large out-spreading bases, and reaching a length of about 0·3 mm.

The tentacles are all similar. There are about a dozen.

The alimentary canal has a very long and narrow œsophagus, which enters a heart-shaped stomach at its wider end (fig. 14). The stomach has 4 longitudinal folds in all. The posterior end of the stomach passes by a narrow constriction into the intestine, which widens again suddenly. The intestine runs posteriorly, and then at its most posterior point it, in some cases, widens again slightly. It then turns anteriorly, and becomes narrow for some distance, and then finally swells into the wide, thin-walled rectum, which runs up the dorsal edge of the thorax. The gland running over the intestine (fig. 15) is unusually large, and can be clearly seen with a 1 in. objective. Its duct seems wide and flattened, or ribbon-shaped.

The reproductive organs are not present in all Ascidiozooids. When present, the post-abdomen is filled with spermatic vesicles up to the bend of the intestine. The masses have a polygonal shape, and fit closely side by side so as to form a long sausage-like mass.

Locality.—I have one colony of this species from Sydney harbour.

The branched vascular appendages in the test are in a particularly interesting condition. They show an intermediate state between the straight unbranched vascular appendages of the Distomidæ (*e.g.*, *Colella*) and the branched anastomosing vessels of the Botryllidæ; while, from the presence of a post-abdomen, the species clearly belongs to the Polyclinidæ. It may possibly be the form alluded to, but not fully described, by Macdonald under the name of "*Polyclinoides*"—a name which has been proposed several times over by various authors.

Polyclinum, Sav., 1816.

I place the following seven species, which seem to be undescribed, in this genus, chiefly on account of the stomach walls not showing any grooves or thickenings.

Polyclinum clava, n. sp., Pl. Pcl. I., figs. 5—8.

External appearance. The colony consists of an ovate Ascidiarium borne on a stout peduncle, which tapers downwards to a narrow base of

attachment (Pl. Pcl. I., fig. 5). The widest part is about the middle of the Ascidiarium. There is no marked line of demarcation at the top of the peduncle. The colour is light yellowish grey all over, except close to the point of attachment, where it is a little darker. The dimensions of the larger colony are :—Length of Ascidiarium 6 cm., breadth 4·7 cm., thickness 4·5 cm. Length of peduncle 4 cm., thickness 2·5 cm., tapering down to 1·3 cm.

The Ascidiozooids are scattered irregularly. They are large, being 1·5 cm. in length and 1·5 mm. in breadth. The thorax is only half as long as the long, narrow abdomen (fig. 6). They are all retracted, so as to lie deeply in the test, and in some the thorax is much contracted. The long bodies of the Ascidiozooids penetrate the test in all directions.

The test contains many bladder cells and large test cells. There are no pigment cells.

The mantle is strong over the thorax. It is provided with longitudinal muscle bands running with regularity down the thorax and bifurcating at the base of the branchial siphon. The apertures are 6-lobed. An incubatory pouch is present, but no tailed larvæ were seen.

The branchial sac has about 10 rows of stigmata, with 15 in each row. The stigmata are about 8 times as long as wide. Narrow horizontal membranes are present, running along the transverse vessels (fig. 7).

The dorsal lamina is represented by a long series of closely-placed, rather small languets (fig. 8).

The tentacles are 14 in number and of 2 sizes, placed alternately. The larger ones are not all of the same size, and one of them (placed laterally) is much larger than the rest.

The dorsal tubercle has a simple circular opening.

The alimentary canal forms a very long and narrow loop, rather wider posteriorly than where it joins the thorax (fig. 6). The œsophagus and intestine are both very long and straight. The ovate stomach is placed posteriorly.

The reproductive organs are placed in the intestinal loop, the spermatic vesicles being posterior to the ovary. The spermatic vesicles are arranged in grape-like clusters. They are small and numerous, while the ova are few and large. In the younger Ascidiozooids the ova are rather more numerous and the spermatic vesicles fewer and smaller. It is evident that the Ascidiozooids are protogynous.

Locality.—Port Jackson ; two specimens. The second is only about half the size of the one measured.

Polyclinum giganteum, n. sp., Pl. Pcl. II., figs. 1 and 2.

External appearance. The colony consists of a short, thick peduncle, bearing a pyriform or ovate massive Ascidiarium. The peduncle narrows to its point of attachment, and is of a darker grey than the upper part of the colony. It is slightly encrusted with sand on its surface. The colour of the Ascidiarium is a light yellowish grey. Its consistency is soft and spongy, and it is readily deformed (fig. 1). The dimensions are as follows:—Length of Ascidiarium 7 cm., breadth 4·5 cm., thickness 3·3 cm. Length of peduncle 3·5 cm., thickness 2 cm.

The Ascidiozooids are not much retracted. They are scattered over the surface. Each is about 6 mm. in length and 2 mm. in breadth. The abdomen is twice as long as the thorax. The vascular appendages are very long, and some have buds.

The test is rather firmer on the outside than inside. The small test cells are spherical, fusiform, and stellate. There are no pigment cells, and very few bladder cells.

The mantle is strong and rather contracted on the thorax. It has longitudinal muscle bands (formed of two fibres each), which run with regularity over the thorax.

The branchial sac is very opaque and corrugated, being thrown into folds and obscured by the contracted state of the mantle. The stigmata are about 8 or 9 times as long as broad.

The dorsal lamina is represented by a large number of short and very closely-placed languets.

The tentacles are about 20 in number, and are of 2 sizes, placed alternately.

The dorsal tubercle has a simple circular or oval opening.

The alimentary canal forms a narrow loop. The thick-walled œsophagus passes back to the posteriorly-placed simple stomach, from which the delicate intestine runs anteriorly and dorsally, to end about one-third of the way up the thorax.

The reproductive organs lie in the intestinal loop. The spermatic vesicles are numerous, and closely placed.

Locality.—Port Jackson; two colonies.

The larger colony (fig. 2) measures 11 cm. by 9 cm. by 4 cm. The figure represents it nearly natural size. The other colony (fig. 1) is smaller, and has the anterior ends of the Ascidiozooids more distinctly marked.

Polyclinum globosum, n. sp., Pl. Pcl. II., figs. 3—8.

External appearance. The shape of the colony is like that of many Fungi, and consists of a short and very stout peduncle, bearing a massive dome-shaped Ascidiarium. The Ascidiarium has its length, breadth, and thickness about equal. Its top is convex, and not pointed. It is of greyish white colour, and is fairly hard and elastic. The peduncle is covered externally with sand grains (fig. 3). It is of a very dark grey colour, and is about twice as thick as its length. The dimensions are as follows:—Length of Ascidiarium 5·3 cm., breadth 5·5 cm., thickness 5·0 cm. Length of peduncle 2·7 cm., thickness 3 to 5 cm.

The Ascidiozooids have retracted about 5 mm. from the surface (fig. 4). They measure 1·2 cm. in length and 1·5 mm. in breadth. The abdomen is twice or two and a half times the length of the thorax (fig. 5). The vascular appendages are filled with blood corpuscles, and are budding. Numerous tailed larvæ and embryos are to be found in the incubatory pouches. The average length of the tailed larva is 1 mm., and the breadth at the broadest end is 0·67 mm. (see fig. 8).

The test contains many bladder cells with fusiform nuclei. There are rather large test cells, but no pigment cells.

The mantle is exceedingly thick and strong, and is much contracted. It has longitudinal muscle bands (of two fibres each) running with regularity over the branchial sac and bifurcating at the branchial sphincter.

The branchial sac is very much corrugated and obscured by the contraction of the mantle. The longitudinal vessels are wider than the stigmata (fig. 7), which are about nine or ten times as long as wide. There are 8 transverse vessels in the branchial sac.

The dorsal lamina is represented by a series of small, tentacular languets, placed about their own length apart (fig. 6).

The tentacles are rather short and stiff. There are 8 or 10, all of the same size.

The alimentary canal is a long, simple loop, like that of the last few species, having a thick-walled œsophagus, and a thin-walled intestine; while there is a simple ovate stomach placed posteriorly. The rectum only reaches the posterior end of the thorax (fig. 5).

The reproductive organs lie in the intestinal loop. Ova, spermatic vesicles, and tailed larvæ are all present in the same Ascidiozooids.

Locality.—Port Jackson; three colonies.

This species and the last described are undoubtedly very closely related; if, indeed, they are distinct. They differ chiefly in their tentacles and the dorsal languets, and these may possibly, when more specimens come to be examined, be found to vary considerably. In the meantime, I think it best to describe both forms fully, even though it may afterwards become necessary to unite them under one specific name.

Polyclinum complanatum, n. sp., Pl. Pcl. I., figs. 9—12.

External appearance. The colony is very wide and flat, but has evidently, in the only specimen, been very much distorted by pressure from above downwards. The peduncle has been pressed up against the Ascidiarium, and its wide base of attachment is now concave (Pl. Pcl. I., fig. 9). The Ascidiarium is almost rectangular in outline, and is of a yellowish white colour. The peduncle is rather greyer, and is slightly encrusted with sand. The dimensions are as follows:—Length of Ascidiarium 3·5 cm., breadth 10 cm., thickness 8 cm. Length of peduncle 2 cm., thickness 4 cm.

The Ascidiozooids are from 7 to 15 mm. in length, and are 1·5 mm. in breadth. They lie principally near the base of the Ascidiarium, but are not much retracted from the surface, the two apertures being very distinctly visible. The body consists of thorax, abdomen, and a short post-abdomen, with vascular appendage (fig. 10). The abdomen is twice or more the length of the thorax. The vascular appendages are branched. Incubatory pouches crowded with embryos may be present.

The test contains numerous large spherical, stellate, and fusiform test cells.

The mantle has longitudinal muscle bands, which run over the thorax and bifurcate near the branchial siphon, each half then joining with the neighbouring half under the sphincter muscle.

The branchial sac is very opaque, and is corrugated on account of the contraction of the mantle over it. The stigmata are very long, about eight or nine times their width (fig. 11). The inter-stigmatic vessels are narrow.

The dorsal lamina is represented by a series of slender languets, which may be coiled (fig. 12), and are set rather less than their own length apart.

The tentacles are about 12 in number, and all of one size.

The alimentary canal consists of a long œsophagus, a simple and wide stomach, and a thin-walled intestine, which only reaches a little way up the thorax (fig. 10). It is usually distended with fæcal pellets.

The reproductive organs, both ova and spermatic vesicles, lie in the short, stout post-abdomen behind the intestinal loop.

Locality.—Port Jackson. A single colony attached to the carapace of a *Dromia*, 1882.

Polyclinum fuscum, n. sp., Pl. Pcl. III., figs. 1—6.

External appearance. The colony consists of a short, wide peduncle, supporting a globular, massive Ascidiarium. The single colony is imperfect, about one-third, at least, of the head having been cut off. The whole colony is of a dark brown colour. The peduncle is encrusted with dark yellowish brown sand and shell fragments, &c. The lower 3 cm. of the Ascidiarium has no apertures of Ascidiozooids in it, but is smooth test externally. This region is partly encrusted with foreign bodies. The dimensions are :—Length of Ascidiarium 10 cm., breadth probably 10 to 12 cm., thickness 6·5 cm. Length of peduncle 3·5 cm., breadth 7 cm., thickness 3·5 cm.

The Ascidiozooids are all slightly retracted, but are not more than 5 mm. from the surface. They are closely placed all over the surface, except in the basal 3 cm. They are very long, varying from 1·5 to 2·5 cm., antero-posteriorly ; of this the thorax is 3 or 4 mm. only. An incubatory pouch is present, containing about 4 tailed larvæ (fig. 2).

The test contains bladder cells and many brown pigment cells (fig. 3). The test cells are few and small. There are also numerous crystals, which are probably due to post-mortem changes.

The mantle is delicate, and is not pigmented. The muscle bands of the thorax run longitudinally only.

The branchial sac is long and rather narrow. The stigmata are long and narrow, being about eight or nine times as long as wide (fig. 4). The branchial sac is rather corrugated and opaque. There are about 12 rows of stigmata.

The dorsal lamina is represented by about 12 languets, which are set three-quarters of the length apart. Each is about 0·2 or 0·3 mm. in length and rather stout (fig. 5).

The tentacles are 24 in number. There is one very large tentacle and 5 others on a level with it ; while further back, and alternating with these 6, are 6 others of about the same size as the 5 first ; then still further back are 12 very small and stiff tentacles, alternating with the other 12 (see fig. 6).

The alimentary canal forms a long, narrow loop four or five times as long as the branchial sac. The stomach is simple. The intestine only reaches a very short way up the thorax.

The reproductive organs are placed in a short post-abdomen behind the intestinal loop (fig. 2).

Locality.—Port Jackson; one colony.

Polyclinum prunum, n. sp., Pl. Pcl. IV., figs. 14—16.

External appearance. The colony consists of a globular mass placed on a short peduncle. The surface is smooth and even, and the Ascidiozooids are inconspicuous. The colour is a dull yellowish grey, the peduncle being slightly darker and encrusted with sand (fig. 14). Length 4·6 cm., breadth 5·2 cm., thickness 3·5 cm. Length of peduncle 1 cm., thickness of peduncle 1·2 cm.

The Ascidiozooids are retracted into the test; each is about 7 mm. in length, and is divided into thorax, abdomen, and post-abdomen (fig. 15). Tailed larvæ are present in the thorax.

The test is much crowded with test cells, many of which are fusiform. There are no bladder cells and no vessels, but a few yellow pigment cells are present. The outer layer forms a firm membrane over the much softer mass inside.

The mantle is opaque. Longitudinal muscle fibres run over the thorax, and stronger ones along the post-abdomen. The branchial aperture has 6 lobes; the atrial aperture is rather irregularly lobed.

The branchial sac is very opaque, and much corrugated. There are many rows of small stigmata, which are about twice as long as wide. The stigmata are wider than the inter-stigmatic vessels (fig. 16).

The dorsal lamina is represented by long slender languets, one opposite each transverse vessel (fig. 16).

The tentacles are very numerous. There are more than 20, closely placed, and of different sizes.

The dorsal tubercle has a small triangular opening. The neural gland is large.

The alimentary canal has a short œsophagus, entering a cordate stomach placed with the wider end posterior. The stomach wall is not grooved (fig. 15). The wide intestine runs for some distance posteriorly, and then turns and ends about two-thirds of the way up the dorsal edge of the branchial sac.

The reproductive organs consist of many spermatic vesicles, placed in the post-abdomen, with a conspicuous vas deferens and a few ova (fig. 15).

Locality.—Port Jackson; one colony.

(?) Polyclinum nigrum, n. sp., Pl. Pcl. I., figs. 13—16.

External appearance. The colony is encrusting and expanded horizontally, of roughly ovate form, and with a convex upper surface. The irregular lower surface is attached to some small oyster shells, barnacles, and pieces of stone, which are all more or less grown over by the test. The colour is a very dark slatey or indigo blue, so dark as to be almost black in parts. The upper surface is smooth and glossy. The extreme length of the colony is 10 cm., the greatest breadth about 4·5 cm., the greatest thickness 3 cm., and the usual thickness about 1·5 cm.

The Ascidiozooids are scattered evenly over the whole upper surface, but are not arranged in systems. They lie at right angles to the surface. They are about 5 mm. in length, the thorax being from 2 to 3 mm. long (fig. 14). The post-abdomen is very short. It gives off a narrow vascular appendage, which runs for some distance through the test.

The test is firm and cartilaginous. Bladder cells are present (fig. 15), and many dark-coloured pigment cells. The test cells are large and very numerous, so that the test looks crowded. The muscle bands are strong and opaque.

The mantle is rather muscular and is pigmented. Both longitudinal and transverse fibres are present on the thorax, while longitudinal are on the post-abdomen. The atrial siphon is very long, while the branchial is short. The branchial aperture is 6-lobed and the atrial 4-lobed (fig. 14).

The branchial sac is exceedingly opaque and contracted. The stigmata are very long, about nine or ten times as long as they are wide (fig. 16).

The dorsal lamina is represented by about half-a-dozen large, strong languets. The most anterior languet is shorter than the rest and wider at the base (fig. 16, *a.l.*).

The tentacles are 10 in number, alternately larger and smaller.

The alimentary canal forms a very long loop (fig. 14). The narrow œsophagus leads to a somewhat cordate, thick-walled stomach, the wider end of which is anterior. The intestine is narrow and thin-walled on first leaving the stomach, and becomes wider and thick-walled towards the posterior end of the loop. It then turns anteriorly and becomes undulating in its course, and then finally straight. It crosses over the œsophagus to reach the dorsal side of the branchial sac.

The reproductive organs lie in the very short post-abdomen, and extend forwards into the intestinal loop. Only male organs were found.

Locality.—There is one specimen of this species in the collection. It is labelled "72, Naucluse, Port Jackson, John Brazier, F.L.S."

Psammaplidium, Herdman, 1886.

This includes those species where a great part of the bulk of the test is made up of imbedded and encrusting sand grains. Nine species were previously known, and this collection has added 5 more.

Psammaplidium solidum, Herdman,* Pl. Pcl. V., figs. 1—5.

Colony rather massive, formed of thick lumps, with few lobes, scarcely branched (fig. 1). No visible place of attachment. Ends of Ascidiozooids visible on the surface, closely crowded together. No common cloacal apertures seen. Closely covered with encrusting and imbedded sand grains. Surface rather smooth and glistening in parts. Colour a grey sand tint. Length about 8 cm., breadth 4·5 cm., thickness 1 cm.

Test thickly encrusted with sand grains and other foreign particles, which penetrate into the centre of the colony. Outer layer rather tougher than the rest, so as to form a membrane. No bladder cells, pigment cells or vessels visible in test; test cells small and not very numerous (fig. 2).

Ascidiozooids placed at right angles to the surface, small. The thorax is about 0·7 mm. long, and the post-abdomen is very short (fig. 3). The branchial aperture is distinctly 6-lobed.

The mantle has the majority of the muscle fibres running longitudinally; there are a few transverse bundles on the thorax. Atrial languet either very small or absent.

The branchial sac has both transverse and inter-stigmatic vessels very narrow (fig. 5), and the stigmata remarkably wide, the width being nearly half their length.

Tentacles about 12 in number, short and stout (fig. 4).

Endostyle thrown into a series of close lateral undulations (fig. 3).

Alimentary canal with a long, narrow œsophagus, and a stomach with about 6 longitudinal ridges, intestine thick-walled, rectum thinner, with oval black pellets of fæcal matter.

Gonads in short post-abdomen, just below loop of intestine. Both spermatic vesicles and well-developed ova were present, and there were large tailed larvæ in the peribranchial cavity.

Locality.—Port Jackson; one colony.

Psammaplidium lobatum, Herdman,† Pl. Pcl. V., figs 6—12.

Colony large, irregularly-lobed, slightly branched, and erect, the

* "Revision," 1891, p. 620.

† "Revision," 1891, p. 620.

branches ending in rounded knobs (fig. 6); attached by a small but flat and slightly expanded base (fig. 7). Ascidiozooids visible on surface, but no arrangement in systems seen. Surface closely encrusted with sand grains all over. Colour sandy grey. Length about 13 cm., breadth of colony about 4 cm., thickness of a branch about ·5 cm.

Test not very brittle, but containing much imbedded and encrusting foreign matter, so as to be perfectly opaque. Outer layer of test rather firmer than the rest. No bladder cells, no pigment cells, and no vessels visible. Small test cells numerous (fig. 10).

Ascidiozooids about 3 mm. long. Thorax about 1 mm, abdomen longer, and post-abdomen very short (fig. 8).

Mantle rather corrugated and opaque, both longitudinal and transverse muscle bundles are present.

Branchial sac with about 8 rows of stigmata. Stigmata narrow, much narrower than the inter-stigmatic vessels. Transverse vessels moderately wide, and containing muscle fibres (fig. 11).

Endostyle conspicuous and convoluted.

Dorsal lamina represented by a number of closely-set languets. They are rather large and widen at their bases (fig. 9).

Tentacles 10 or 12, of two sizes, placed alternately.

Alimentary canal with a short œsophagus leading to an oval, opaque, smooth-walled stomach (fig. 8). Intestine narrow, rectum wider, and full of black fæcal pellets.

Gonads consisting of a mass of spermatic vesicles. No ova were seen; but the peribranchial cavity contained many tailed larvæ, which rather points to a protogynous condition. The larva has rather a short tail, three adhering papillæ in front, and a single plano-convex black sense organ placed far back in the body (fig. 12).

Locality.—Port Jackson; several colonies and fragments.

Psammaplidium fragile, Herdman,* Pl. Pcl. VI., figs. 10—14.

Colony massive, being an irregularly-lobed, rather brittle mass (fig. 10), closely encrusted and permeated with sand, except in the centre. Ascidiozooids visible on the surface, but not in systems, and no common cloacal cavities seen. Surface irregular, but rather smooth. Colour sandy grey. Length 10 cm., breadth 4 cm., thickness from 5 mm. to 10 mm.

Test. A narrow axial band of test in the centre of the colony, and posterior to the bodies of the Ascidiozooids, contains scarcely any sand, and is of a dark bluish grey colour (fig. 11). No pigment cells, bladder

* "Revision," 1891, p. 620.

cells, nor vessels are visible. Many small, round test cells are present in the matrix. The outer layer is, as usual, firmer than the rest.

Ascidiozooids about 3 mm. long, set at right angles to the surface. Thorax 1 mm. long, abdomen nearly twice as long, post-abdomen very short (fig. 12).

Mantle very thick, opaque, contracted. Most of the muscle bundles on the thorax are longitudinal, only a few feebler ones run transversely. The branchial aperture is distinctly 6-lobed; the atrial aperture has no perceptible languet.

Branchial sac rather opaque in its contracted state. Stigmata about as wide as the inter-stigmatic vessels; they get much smaller towards the ventral edge of the sac (fig. 13). Muscle fibres run along the transverse vessels.

Tentacles, 20; 5 larger, with 3 smaller ones alternating with each larger (fig. 14).

Alimentary canal with a narrow œsophagus leading to an oval, thick-walled, but smooth stomach. The intestine is narrow where it leaves the stomach, but soon widens. It is narrower again at the posterior end, where it turns anteriorly; and then widens to become the rectum, which passes along the ventral edge of the stomach, and then crosses the œsophagus to end on the dorsal edge of the thorax (fig. 12).

The gonads lie in the very short post-abdomen, and have both ova and spermatic vesicles. There are large tailed larvæ in the peribranchial cavity.

Locality.—Port Jackson; one colony and a fragment.

Psammaplidium incrustans, Herdman,* Pl. Pcl. VI., figs. 1—6.

Colony thin and encrusting, with a few irregular lobes arising from its surface (fig. 1). No Ascidiozooids on the lower attached surface, which is covered with fragments of foreign bodies. Upper surface sandy, while a middle layer of test between is free from sand, and of a blue grey colour (fig. 4). Surface of colony rough with sand; colour, sandy grey. Length about 8 cm., breadth about 3·5 cm., thickness about ·5 cm.

Test with much imbedded sand on the upper and lower surfaces. Numerous small test cells are present, but no pigment cells, bladder cells, nor vessels.

Ascidiozooids about 3 mm. long, placed at right angles to the surface. Abdomen rather longer than thorax, and post-abdomen much shorter (fig. 5), in some cases practically absent.

* "Revision," 1891, p. 620.

Mantle very strong and opaque in its contracted state.

Branchial sac opaque and corrugated; stigmata difficult to see; they are small, and of about the same width as the vessels between them. Strong muscle bundles run along the transverse vessels (fig. 2).

Dorsal lamina represented by languets, which are not numerous, nor large; they are set about their own length apart (fig. 3).

Tentacles 10 in number, of two sizes.

The dorsal tubercle has a simple circular opening in this and other species of *Psammaplidium*.

The alimentary canal is rather shorter than usual. A wide œsophagus passes into a smooth-walled, ovate stomach, followed by a thin intestine with no differentiation into regions (fig. 5), and containing oval black pellets of fæcal matter. The rectum crosses the œsophagus to reach the dorsal edge of the thorax.

Gonads formed of masses of globular spermatic vesicles, with a long, thick-walled vas deferens running up the dorsal edge of the abdomen (see fig. 5). No ova are visible. Tailed larvæ are present in the peribranchial cavity. They have a single crescentic, pigmented sense organ, and 3 adhering papillæ (fig. 6).

Locality.—Port Stephen; one colony and some fragments.

Psammaplidium pedunculatum, Herdman,*

Pl. Pcl. VI., figs. 7—9.

Colony in the form of small, sandy, club-shaped masses, consisting of a stalk, with a flattened expansion at its free end (fig. 7). These little clubs are often joined in pairs by the bases of their stalks. The flattened fan-like head consists chiefly of test, with imbedded and encrusting sand grains. The Ascidiozooids do not reach to the free end of the colony in the preserved condition, and lie chiefly in the upper part of the stalk. The colour is sandy grey, the upper end being rather lighter than the stalk. Length 1·3 cm., breadth 4 mm., width of stalk 2 mm.

Test small in amount, and very much occupied with sand. There are no bladder cells, pigment cells, nor vessels. The fusiform and spherical test cells are rather large.

Ascidiozooids about 7 mm. long, and placed parallel to the length of the peduncle. Thorax not so long as abdomen, and post-abdomen very long, in some cases as long as thorax and abdomen together (fig. 8).

* "Revision," 1891, p. 620.

Mantle strong, and opaque in the contracted state. The muscle fibres run longitudinally over the thorax.

Branchial sac rather contracted and opaque. Stigmata rather long, about same width as inter-stigmatic vessels, and about seven times as long (fig. 9).

Dorsal lamina represented by rather short, thick, dark languets, which are placed one on each transverse vessel (fig. 9).

Tentacles about 20, of two sizes. There are 6 larger ones alternating with smaller ones, which are placed about two together; they are all rather small.

Alimentary canal with a small, simple stomach, and a thin-walled undifferentiated intestine (fig. 8).

Gonads, with many masses of spermatic vesicles in the post-abdomen, and a very large and conspicuous brown-coloured vas deferens.

Locality.—No label, probably Port Jackson; about 20 small colonies.

[The following Polyclinidæ have also been recorded from Australian seas:—

Sigillina australis, Sav., Port Jackson.
Atopogaster aurantiaca, Herdm., Bass Str.
Polyclinum fungosum, Herdm., Port Jackson.
P. depressum, Herdm., Torres Str.
P. glabrum, Sluiter, Amboina.
P. hospitale, Sluiter, Thursday Is.
Amaroucium albidum, Herdm., Bass Str.
A. Ritteri, Sluiter, Thursday Is.
Psammaplidium spongiforme, Herdm., Port Jackson.
Ps. ovatum, Herdm., Torres Str.
Ps. pyriforme, Herdm., N. Australia.]

Family III. **DIDEMNIDÆ**, Giard, 1872.

Colony usually flat, thin, and encrusting, rarely thick and massive, never pedunculated.

Systems complicated and irregular, inconspicuous, or absent. Common cloacal apertures usually conspicuous.

Ascidiozooids rather small, divided into two regions—thorax and abdomen. Branchial aperture 6-lobed; atrial plain, or provided with an atrial languet.

Test gelatinous or cartilaginous, usually containing stellate calcareous spicules. Ectodermal processes well-developed and provided with muscle fibres so as to form retractor muscles.

Branchial sac small and not well-developed. Rows of stigmata few, usually three or four (rarely six).

Alimentary canal united to thorax by a narrow neck. Stomach usually smooth-walled.

Gonads placed alongside the intestinal loop. Ovary simple; ova large. Male system consisting of a single large testis, around which the first part of the vas deferens is coiled spirally.

Gemmation from the pyloric region; thorax and abdomen of the new Ascidiozooid formed from separate buds. Embryonic blastogenesis rudimentary only.

The Didemnids in the collection seem to require the formation of the three following new species—all belonging to the large cosmopolitan genus *Leptoclinum*.

Leptoclinum, M. Edw., 1841.

For characters, and list of existing species, see "Revision," p. 630.

Leptoclinum incanum, n. sp., Pl. Did. II., figs. 1—6.

The colonies are small, rounded or cylindrical masses, attached to various branches and other parts of sea-weeds and Polyzoa and other Ascidians (fig. 1). They are very white, opaque, hard, rather smooth, and encrusting. Branchial apertures of Ascidiozooids visible and slightly prominent, and stellate. Occasional irregularly-shaped cloacal apertures are also visible (fig. 3). Length varying, usually from 1 to 2 cm.; breadth, on the average, about 5 mm.

Test very densely crowded with an immense number of small, regular, sharp-pointed stellate calcareous spicules (fig. 2). These spicules are especially numerous on the surface and around the Ascidiozooids (fig. 6). No vessels and no bladder cells are visible. The spicules are smaller in this species than in the two following species of *Leptoclinum*, but are far more numerous, and consequently the colony is harder, and of a whiter colour.

The Ascidiozooids are numerous, and vertically placed. There is no regularity in their arrangement. The body is divided into thorax and abdomen. The atrial aperture has a long languet.

The mantle has strong branchial sphincters, and longitudinal muscle bundles on the thorax. There are retractor muscles from the anterior end of the thorax.

The branchial sac has 4 rows of stigmata, with 6 or 7 in a row. The stigmata are small and rounded, and are about the same width as the vessels between (fig. 4). The transverse vessels have muscle fibres.

The dorsal lamina is represented by a few long and slender languets.

The tentacles are 10 in number—one larger dorsal and 9 very small ones.

The dorsal tubercle is a small circular opening immediately behind the largest tentacle (fig. 6).

The alimentary canal has a thick-walled œsophagus opening into an oval stomach, with very thick walls and no folds (fig. 5).

Gonads, both ova and the usual spermatic vesicle, with spirally coiled vas deferens, are present. No larvæ were present.

Locality.—Port Jackson. A number of small colonies growing over other marine animals and sea-weeds.

Leptoclinum fimbriatum, n. sp., Pl. Did. I., figs. 1—8.

The colony is flat, encrusting and expanded, so as to be of considerable size (fig. 1). It is of a dirty white colour, approaching in places a lavender grey. The surface is even, but not smooth, as all the numerous openings of Ascidiozooids form minute roughnesses. Cloacal apertures are also present, and are ovate slits surrounded with a fringe of fine processes (fig. 2). Size of a colony about 5 cm. each way.

Test crowded with spicules, which are larger than those of the last species, but not so numerous and not so densely packed. Consequently the colony is not of such an opaque white tint. They become fewer in the deeper parts of the test (fig. 4), but are numerous again in the lower surface, which is hard and stony. There is a small dense clump of spicules at each side of the thorax of each Ascidiozooid. The test has numerous test cells, and a few vessel-like appendages (fig. 3).

The Ascidiozooids are numerous, closely placed, and rather large. They are distinctly visible on the surface, but there is no definite arrangement. The body is divided into thorax and abdomen (fig. 6).

The mantle has strong sphincter muscles at the branchial apertures, delicate longitudinal fibres over the thorax (fig. 7), and strong retractor muscles running into the test.

The branchial sac has 4 rows of rather large stigmata (fig. 8), and there may be a 5th row of much shorter ones. The stigmata are rather wider than the vessels between. There are 7 or 8 stigmata in a row.

The dorsal lamina is represented by a large languet on each transverse vessel (fig. 8).

Tentacles 8, with the 2 lateral ones larger than the other 6.

Dorsal tubercle with a simple oval opening.

Alimentary canal with a thick-walled œsophagus, leading to an oval, smooth-walled stomach. Pylorus narrow, intestine widens, runs along ventral edge of stomach, and then crosses œsophagus to become the thin-walled rectum (fig. 6).

Gonads. Masses of spermatic vesicles, with thick spiral vas deferens and a few ova.

Locality.—Port Jackson. One large and one small colony, apparently attached to a piece of wood (? part of a pier).

Leptoclinum patulum, n. sp., Pl. Did. II., figs. 7—12.

Colony large, flat, expanded over the test of a large Simple Ascidian; of a white colour, marbled over the surface with a network of grey-blue veins, which follow for the most part the course of the common cloacal cavities (fig. 7). Length of the colony, 8 cm.; breadth, 5 cm.

Test containing numerous calcareous spicules, which are larger but not nearly so numerous as in the case of *Leptoclinum incanum*. The test, for a short way round the branchial aperture, is almost free from spicules (fig. 9). There are many small circular and fusiform test cells (fig. 11). Occasional stellate cloacal apertures (fig. 8) are present.

Ascidiozooids arranged in lines alongside the branches of the common cloacal cavities. Body divided into thorax and abdomen.

Mantle with strong branchial sphincters, and longitudinal muscle bundles over thorax and abdomen.

Branchial sac with 4 rows of rather long, narrow stigmata (fig. 10). Muscles in the transverse vessels.

Dorsal lamina represented by a short, thick languet on each transverse vessel.

Tentacles 10. In some very minute intermediate ones also occur.

Dorsal tubercle with a small, circular opening.

Alimentary canal and gonads as usual, stomach globular (fig. 12). No larvæ were seen.

[The following Didemnidæ have also been recorded from Australian seas:—

Didemnum aurantiacum. Herdm., Bass Str.

Leptoclinum Jacksoni, Herdm., Port Jackson.

L. psammathodes, Sluiter, Thursday Is.

L. pantherinum, Sluiter, Amboina.

L. pustulosum, Sluiter, Amboina.
L. torresii, Sluiter, Thursday Is.
L. siphoniatum, Sluiter, Amboina.
L. asteropum, Sluiter, Amboina.

There are no Diplosomidæ in the collection, and the only one known from Australian seas is :—

Family IV. **DIPLOSOMIDÆ.**

Diplosoma Rayneri, Macd., Sydney.]

Section B. **HOLOSOMATA**, Sluiter,* 1895 (restricted Herdm., 1898).

Compound Ascidians, in which the body is short and compact, the alimentary and reproductive viscera being alongside the branchial sac. There are two families.

Family I. **POLYSTYELIDÆ**, Herdman, 1886.

Colony massive or encrusting, sessile, rarely pedunculated, or formed of small masses connected by stolons. No common cloacal cavities present.

Ascidiozooids large, and usually short-bodied, rarely with a distinct abdomen. Both apertures 4-lobed, and opening directly to the exterior.

Test firm and cartilaginous. Matrix generally fibrillated, test cells small and inconspicuous, bladder cells rarely or never present. Vessels abundant, branched, and provided with distinct terminal bulbs.

Branchial sac large and well-developed. Folds sometimes present. Internal longitudinal bars strong and fairly numerous.

Dorsal lamina in the form of a plain membrane.

Tentacles numerous, simple.

Alimentary canal usually placed alongside the branchial sac, rarely extending beyond it posteriorly.

Gonads in the form of polycarps, attached to or imbedded in the mantle, and projecting into the peribranchial cavity.

Gemmation effected by means of out-growths from the mantle, which later become connected with the vascular prolongations from the Ascidiozooids into the common test.

* I use Sluiter's term in the restricted sense as defined above. Sluiter would include also the Simple Ascidians.

Out of the six genera placed in this family in the Report on the "Challenger" Tunicata, only two are represented in the present collection; one being the "Challenger" genus *Chorizocormus*, of which there are three new species, and the other being the genus *Goodsiria*, to which one species is now added. The following table shows how the genera and species of this family may be briefly distinguished, and indicates the position of the new forms. For a discussion of the history and relations of the members of the family reference must be made to the "Challenger" Report.*

Polystyelidæ.

	Ascidiozooids projecting above the surface of the test	1
	Ascidiozooids completely imbedded in the test	2
1	Ascidiozooids with no abdomen *(Polystyela)*	*P. lemirri*, Giard.
1	With abdomen as long as thorax *(Thylacium)*	3
3	It is doubtful whether the two species are really distinct	*T. sylvani*, Car. *T. normani*, Ald.
2	Colony formed of small masses united by creeping stolons *(Chorizocormus)* ...	4
2	Colony continuous, not broken up ...	5
4	Branchial sac having rudimentary folds...	*C. reticulata*, Herdm.
4	Branchial sac with no rudimentary folds	6
6	Atrial tentacles more than 20 in number	*C. sydneyensis*, Herdm.
6	Atrial tentacles not more than 20 ...	7
7	16 branchial tentacles, 7 rows of stigmata	*C. leucophæus*, Herdm.
7	10 branchial tentacles, 10 rows of stigmata	*C. subfuscus*, Herdm.
5	Colony thick and massive *(Goodsiria)* ...	8
5	Colony thin and encrusting *(Synstyela)*...	9
8	Test encrusted with sand†	*G. lapidosa*, Herdm.
8	Not encrusted with sand	10
9	Flesh colour, marked with red	*S. variegata*, Ald.
9	Light grey, with bluish and pink tints ...	*S. incrustans*, Herdm.

* Part II., p. 323; and Part III., p. 144.

† The genus *Oculinaria* of Gray appears to be related here, but the description (Proc. Zool. Soc. L., 1868, p. 564), is not sufficient to determine the position with certainty see "Challenger" Report, Part II., p. 323.

10	Colony discoid, branchial sac folded ...	*G. placenta*, Herdm.
	Colony not discoid, branchial sac not folded	11
11	Colony elongated or irregular, not pedunculated	*G. coccinea*, Cun.
	Colony round or pyriform, pedunculated	*G. pedunculata*, Herdm.

Chorizocormus sydneyensis, Herdm.,* Pl. Pst. I., figs. 1—7.

External appearance. The colony consists of a number of small masses of test, in each of which one or several Ascidiozooids are imbedded, and which are united into straggling groups by thin extensions of the test, which may be called stolons (fig. 1). The whole is attached to and partly encrusts some slender algæ, with which it forms an irregular network. The stolons are light grey and rather transparent, but in the more massive parts of the colony the closely-placed Ascidiozooids give rise to a dark purplish brown colour.

The test is cartilaginous. It contains many vessels, which branch freely (fig. 2), and have terminal knobs of rounded and ovate forms filled with dark blood corpuscles. There are no bladder cells and no pigment cells. The ordinary test cells are very small.

The Ascidiozooids are about 4 mm. in length, and the same in breadth. The viscera lie on the left side of the branchial sac (fig. 5), so no separate abdomen is present.

The mantle has both a transverse and a longitudinal musculature. The muscle bands are rather irregularly arranged.

The branchial sac has internal longitudinal bars, but no folds. There are 8 rows of stigmata, and from 4 to 6 stigmata in a mesh (fig. 3). The stigmata are about six or seven times as long as wide.

The dorsal lamina is a plain, straight membrane.

The tentacles are rather short and thick. They are about 16 to 20 in number, and are of two sizes. There are from 5 to 7 large ones, with from 1 to 3 smaller ones between each pair of larger. There is considerable variability both in the number and the size of the smaller tentacles. At the base of the atrial siphon there are about 25 very small and slender atrial tentacles.

The dorsal tubercle has a simple circular opening (fig. 4).

The alimentary canal lies on the left side of the branchial sac. Its course is at first posteriorly and ventrally, then anteriorly, then dorsally and posteriorly, then dorsally and anteriorly. The directions are similar

* "Revision," p. 636.

to those in the alimentary canal of an *Ascidia*, but the first bend of the intestine is at a more acute angle than in the Simple Ascidian, and the second at a more obtuse angle. The dorsal end of the stomach is thrown into thick folds, and appears to be glandular. The remainder has smaller longitudinal folds. The usual system of fine tubules (fig. 6), ending in ampullæ, is found ramifying over the intestine, and opening by a common duct into the stomach.

The reproductive organs consist of rounded polycarps (fig. 7) imbedded in the mantle, and projecting slightly into the peribranchial cavity.

There are three colonies of this species from Port Jackson. The largest is about 15 cm. in length. All the four known species of *Chorizocormus* resemble one another closely in external appearance, although they differ markedly in internal structure. The present species (Pl. Pst. I., fig. 1) is rather like the "Challenger" *Ch. reticulata* in form, but is darker in colour. The common test in this species is highly vascular, and the terminal knobs are very numerous (fig. 2). The branchial sac has large, distinct meshes (fig. 3), and the stigmata are regularly arranged.

The Ascidiozooids form dark patches in the light-grey transparent test, which is dotted all over with the opaque terminal knobs of the vessels.

Chorizocormus subfuscus, Herdm.,* Pl. Pst. I., figs. 8—11.

External appearance. The colony is formed of a number of elongated and rounded masses, containing Ascidiozooids, and united by thinner portions of test, so as to form an irregular network, attached to several colonies of Polyzoa, of the genera *Retepora* and *Amathia* (fig. 8). The test is of a dull grey colour, while the bodies of the Ascidiozooids give a purplish brown colour.

The test contains many vessels, with the usual terminal knobs, filled with dark blood corpuscles (fig. 9). There are no bladder cells; the test cells are few and very small.

The Ascidiozooids measure about 3 mm. by 2·5 mm. No separate abdomen is present.

The mantle is delicate, with greenish brown pigment cells. The larger muscle fibres run longitudinally; there are only a very few fine transverse ones.

The branchial sac has internal longitudinal bars. There are at least

* "Revision," p. 636.

10 rows of stigmata, and from 3 to 5 stigmata in a mesh (fig. 9), but the series next the endostyle on each side have 6 stigmata.

The dorsal lamina is a plain straight membrane.

The tentacles are of two sizes, 5 long and 5 short (fig. 10, *tn.*). There are about 16 small atrial tentacles.

The dorsal tubercle has a circular aperture.

The alimentary canal resembles that of the last species, and has the same form of stomach.

The reproductive organs consist of pear-shaped polycarps (fig. 11), imbedded in the mantle. Some contain ova, and others spermatic vesicles.

Locality.—Port Jackson. One specimen is about 10 cm. in length, and one 15 cm. in length and about 7 cm. in breadth.

This species resembles the last in appearance, but differs from it in the tentacles (Pl. Pst. I., fig. 10), which are only 10 in number.

The colony, as a whole, is more opaque and browner in colour than that of *C. sydneyensis*, and the Ascidiozooids are less conspicuous.

Chorizocormus leucophæus, Herdm.,* Pl. Pst. II., figs. 1—6.

External appearance. The colony consists of elongated sub-cylindrical masses, united to form an irregular network (fig. 1), the whole encrusting some brown Algæ. Where the Ascidiozooids are few the the colony is of a greyish yellow tint and transparent (the dark sea-weed showing through), but where the Ascidiozooids are numerous the colony is of a dark purplish and slatey hue. The largest colony measures 17 cm. long and 7 cm. broad.

The test is full of large, conspicuous vessels with terminal knobs. The blood corpuscles they contain are not so dark-coloured as in the preceding species. There are no bladder cells, and the test cells are few and inconspicuous.

The Ascidiozooids measure 2 to 2·5 mm. in length.

The mantle has rather a regular musculature (fig. 2). Muscle bands run longitudinally over the branchial sac, and are crossed by obliquely directed fibres.

The branchial sac has 4 internal longitudinal bars on each side, but no folds. There are 7 rows of stigmata, and generally 4 stigmata in a mesh (fig. 3). In the series next the endostyle there are 6 to 8 stigmata. The stigmata are regular and all of the same size.

* "Revision," p. 636.

The dorsal lamina is a plain membrane.

The tentacles are 16 in number (fig. 4). They are of two orders placed alternately, but the large ones are not all of the same size. There are also about 20 atrial tentacles (fig. 5).

The dorsal tubercle has a simple circular opening.

The alimentary canal has a short œsophagus leading to a stomach like that of the preceding species, with a corrugated glandular cardiac end and a series of longitudinal folds (about 8 on each side). The intestine is at first narrow, then slightly dilated, and then narrows to form the rectum (fig. 6). The alimentary canal lies with its longitudinal axis antero-posteriorly, and not transversely, as in *Ch. sydneyensis*. Its course is first ventral, then anterior, then dorsal, then posterior, and then dorsal. There is the usual system of glandular tubules branching over the intestine, and opening into the stomach by a single large duct.

The reproductive organs are in the form of rounded polycarps imbedded in the mantle.

Locality.—Port Jackson ; one large and six smaller specimens.

This species differs somewhat from the other species of *Chorizocormus* in external appearance, as here the stolons are not nearly so well-marked, and the masses of Ascidiozooids are almost continuous with one another (Pl. Pst. II., fig. 1). There seems in the three above-described species of *Chorizocormus* to be a rough correspondence between the number of branchial and of atrial tentacles. *Chorizocormus sydneyensis*, which has the most branchial tentacles, has also most atrial tentacles, *Ch. subfuscus* has fewest of both, and *Ch. leucophæus* is in an intermediate condition, as follows :—

	Branchial tents.	Atrial tents.
Chorizocormus sydneyensis	20 *(about)* ...	25
Ch. leucophæus	16 ...	20
Ch. subfuscus	10 ...	16

There are apparently always more atrial than branchial tentacles.

Goodsiria, Cunningham, 1871.

This genus was only known previously from the South Atlantic and the Strait of Magellan. The Museum collection has added a new species, obtained at Port Jackson. It differs from the other members of the genus in having the test sandy.

Goodsiria lapidosa, Herdm.,* Pl. Pst. III., figs. 1—12.

External appearance. The colony is a solid cake-like mass (fig. 2), in which the Ascidiozooids are closely placed and completely imbedded. There are distinct upper and lower surfaces, and the Ascidiozooids form a single layer, being placed side by side with their antero-posterior axes vertical, and their branchial apertures all on the same surface (fig. 1). The whole of the colony, both upper and lower surfaces, is closely encrusted with sand grains and shell fragments. The colour is a stone grey, slightly darker in places.

The test is firm and cartilaginous, and is stiffened on the surface by the imbedded sand. The colour in the interior is a light grey. Vessels are present, but they are few in number and very small. There are no bladder cells, and the ordinary test cells are small (fig. 3). The Ascidiozooids are so large that there is comparatively little test present in the colony, only from 1 mm. to 0·5 mm. between each pair (see fig. 1).

The Ascidiozooids are about 1·5 cm. in length and 0·4 cm. in breadth. They are not divided into thorax and abdomen. The apertures are distinctly 4-lobed.

The mantle is very delicate and thin over the branchial sac. Both longitudinal and transverse muscles are present (fig. 5), but they are arranged irregularly.

The Branchial sac is large and well developed. There are 4 branchial folds on each side between the endostyle and the dorsal lamina, but the first or dorsalmost of these is rudimentary, and consists only of 3 or 4 internal longitudinal bars placed close together without forming a projection. The rest have generally about 9 bars each, and form well-marked projections (see figs. 6 and 7). In the interspace between each pair of folds there are 2 internal longitudinal bars, but between the dorsal lamina and the rudimentary fold there is only 1 such bar. The transverse vessels are wide. There are from 3 to 5 (generally 3) stigmata in a mesh, except in the series next the endostyle where there are 6 or 7. The stigmata are short and wide and very irregular, being in different positions and set at different angles. Sometimes 2 small ones, one above the other, take the place of one ordinary one; sometimes 1 large one is found instead of 2 or 3 of the usual size. Now and then one of the stigmata lies alongside a transverse vessel, and occasionally a transverse vessel splits into two and then unites again, leaving an elongated space between.

The dorsal lamina is a very narrow, plain membrane.

* "Revision," p. 637.

The tentacles are of 2 sizes (fig. 10) and are very numerous, about 60. The larger tentacles have a short, thick basal part (about quarter of their whole length), and the remainder is a flattened transparent expansion recurved like a sickle. There are about 16 small atrial tentacles.

The dorsal tubercle has a simple oval aperture.

The alimentary canal consists of a short wide œsophagus opening into an elliptical or ovate stomach (fig. 8) which is about 3 mm. in length and has about 7 longitudinal grooves on each side. On the anterior edge of the stomach is a rounded projection into which opens the duct from the system of branched tubules with dilated ends (fig. 9) which ramify over the intestine. The course of the alimentary canal is, first posterior, then ventral, then anterior, then dorsal, and finally anterior. The intestine is very long, about 7 mm. The intestine and rectum are the same width and are narrower than the œsophagus.

The reproductive organs are in the form of polycarps attached to the mantle and projecting into the peribranchial cavity. Each is about 2·5 mm. in length. They are hermaphrodite (fig. 11), and the spermatic vesicles are far more numerous than ova. All the ducts open into a common central duct (fig. 12).

Locality.—Port Jackson.

The first specimen I examined of this species is only part of a colony, not including the point of attachment. The specimen is a nearly square piece which has evidently been cut off, and measures about 6.5 cm. by 5·5 cm., and 2 cm. in thickness.

There has also been sent to me since an additional specimen found "on rocks, at low water, in Chouder Bay, colour brick red," which measures 7·5 cm. in length and about the same in greatest breadth. It is 2·2 cm. in thickness.

[The following Polystyelid has also been recorded from Australian seas :—

Synstyela incrustans, Herdm., Thursday Is.]

Family II. **BOTRYLLIDÆ,** Giard, 1872.

Colony usually thin and encrusting, sometimes in the form of thick fleshy masses.

Systems circular, elliptical, or forming branched lines. Common cloacal openings distinct, usually lobed.

Ascidiozooids short, and not divided into regions.

Test usually soft, traversed by numerous vessels, with large terminal knobs.

Branchial sac large and well-developed, internal longitudinal bars present. Stigmata numerous.

Dorsal lamina in the form of a plain membrane.

Tentacles simple, not more than 16 in number.

Alimentary canal placed alongside the posterior part of the branchial sac.

Gonads on both sides of the body.

Gemmation lateral from the bodies of the Ascidiozooids, and also stolonial, from the ectodermal processes or vessels in the test.

The Botryllids in the collection fall into the two closely allied genera *Botrylloides* and *Sarcobotrylloides*.

Botrylloides, M. Edw., 1842.

A new species and a variety are added to this genus.

Botrylloides leptum, n. sp., Pl. Bot. I., figs. 5—13.

Colony thin, encrusting, spreading to form irregular lobed sheets of a general light brown colour, with the Ascidiozooids darker. Specimens about 6 cm. in length.

Systems rather small, circular, elliptical, or short rows; round the edges of the colony meandering lines occur (fig. 5). Large areas of test are free from systems.

Test from 4 to 10 mm. in thickness; grey, with numerous small, closely-placed brown dots, which are the knobs on vessels. No bladder cells, and no pigment masses, but very many rather large branching vessels (figs 7 and 8). The test cells are small and numerous, and, in some places, the matrix shows delicate fibrillation.

Ascidiozooids 1 to 1·5 mm. long, with long axis parallel to surface. Viscera alongside thorax.

Mantle very thin and delicate, with many longitudinally running muscle fibres.

Branchial sac with 3 internal longitudinal bars on each side. The stigmata are short and wide (figs. 9 and 10), and are 3 or 4 in a mesh.

Dorsal lamina a plain membrane, rather narrow.

Tentacles 4 large and 4 small, placed alternately (fig. 12).

Dorsal tubercle a circular opening in middle of prebranchial zone.

Alimentary canal on left side of branchial sac, with 10 well-marked

folds on the stomach. The usual intestinal gland opens into stomach about its middle (fig. 11).

Gonads one on each side. Ovaries only in the young Ascidiozooids (fig. 6).

Locality.—Port Jackson; about a dozen colonies.

This species has some systems that are almost as small and as circular as those of a typical *Botryllus*, but others again form long lines (Pl. Bot. I., fig. 5).

Botrylloides leptum, variety, Pl. Bot. I., figs. 1—4.

Two colonies in the same bottle with those last described differ in a few particulars, but I hesitate to form a new species for them until we know more as to the range of individual variation. They measure about 7 cm. by 4 cm., and one is shown on Pl. Bot. I., fig. 1. The Ascidiozooids are more distinctly in lines, which meet to form a network. The knobs on vessels in the test are bulb-shaped (fig. 2), in place of globular (figs. 7 and 8), and have the narrower distal end dark with blood corpuscles. These are very abundant round the edges of the colony. The Ascidiozooids are rather darker in colour, and that is due to scattered pigment masses (fig. 3) in the delicate mantle. The tentacles are in some cases at least 16 in number, 4 larger with 3 smaller between each pair, but some of the small ones are very minute. In other particulars these colonies agree with the other specimens of *Botrylloides leptum*. A piece of the branchial sac is shown in fig. 4.

Sarcobotrylloides, von Drasche, 1883.

I have placed the thicker, more fleshy colonies in this genus, but they really differ very little from species of *Botrylloides*. There are 4 new species.

Sarcobotrylloides Jacksonianum, Herd.,* Pl. Bot. II., figs. 1—8.

Colony formed of quadrangular flattened masses rising from a narrow base (fig. 1); of a dull brownish grey colour, lighter in some places than in others; surface smooth; size about 5 cm., by 4 cm., by 7 mm.

Systems vary from almost circular or short elliptical forms to long parallel lines, often branching to form a network. The systems are so closely placed that very little test is left between them. The Ascidiozooids stand out as lighter brown spots on the dark grey test. The

* See "Revision," p. 609.

common cloacal apertures can be seen under a low power of the microscope (40 diameters) as elongated apertures, along the edges of which a membrane, slightly folded, stands out like a frill (fig. 2).

Test has large test cells and a system of irregularly branching and anastomosing vessels (fig 3), which give off large elongated knobs (fig. 4), in some of which ova and young buds are found, as well as blood corpuscles (fig. 5). Some of these knobs are much swollen in size.

Ascidiozooids placed at right angles to the surface, and form a layer not more than 2 mm. thick below the surface. The centre of the colony is formed of dark grey test, with no Ascidiozooids. The viscera are placed alongside the thorax, and there is a long atrial aperture reaching to about ·5 mm. (fig. 7).

Mantle very delicate. Most of the muscle fibres run transversely.

Branchial sac long and narrow, with three internal longitudinal bars on each side (fig 6). The number of stigmata in the rows of meshes is as follows:—Dor. Lam.—4—3—2—3—Endost. The stigmata are short and regular.

Dorsal lamina a plain, straight, wide membrane (fig. 6).

Tentacles 16; 4 large alternating with 4 smaller, and then, nearer the branchial aperture, there are 8 exceedingly short ones alternating with the other 8 (fig. 8).

The *Stomach* has 10 longitudinal folds. The anus is about one-third of the way up the branchial sac (fig. 7).

There is a *Gonad* on each side of the body. The terminal knobs of the vessels of the test also contain ova and developing buds. Whether the buds are formed there, or have become secondarily connected with the vessels, as Ritter finds is the case in *Goodsiria*, is still doubtful.

Locality.—Port Jackson; two colonies.

The massive lobes rising from a small base of attachment (Pl. Bot. II., fig. 1) show that this is a *Sarcobotrylloides*.

Sarcobotrylloides anceps, Herdm.,* Pl. Bot. II., figs. 9—13.

Colony an irregularly pyriform mass attached to several of the branches of an erect Ctenostomatous Polyzoon (fig. 9). Colour from dark purple to pink. Very little of the light grey test seen, as almost the whole surface is covered by dark Ascidiozooids. Surface smooth and soft. Length 3·5 cm., breadth 2 cm.

Systems numerous and close, forming branching lines.

* See "Revision," p. 609.

Test, numerous branching vessels (fig. 12), with rather small terminal knobs, which are few and light-coloured. Small test cells, no pigment.

Ascidiozooids about 1·5 to 2 mm. long. The branchial apertures show as white dots on the surface of the colony.

Mantle very thin. Muscle fibres almost hidden in masses of dark purple pigment cells (fig. 11).

Branchial sac very long and narrow. There are at least 11 rows of stigmata, and about 12 stigmata in each row. There are 3 internal horizontal bars on each side, and from 2 to 4 stigmata in a mesh. The stigmata are short and regularly placed.

Dorsal lamina a narrow membrane (fig. 10).

Tentacles 16; 4 large, 4 about half the length of the last, and 8 very small ones regularly alternating (fig. 10).

Dorsal tubercle a small circular opening placed just outside the peripharyngeal band.

Alimentary canal. The stomach differs from that of our former Botryllidæ in being quite globular, and in having two cæca, a small anterior one, which the duct from the intestinal gland enters, and a longer vermiform posterior cæcum, which lies just to the left of the pylorus (fig. 13, *cæ.*). The usual intestinal gland is present. The stomach has well-marked folds running from intestine to œsophagus. The rectum widens out so as to have an everted rim at the anus.

No *gonads* were found, but young buds were very abundant in this colony.

Locality.—Port Jackson, with *Chorizocormus subfuscus.*

Sarcobotrylloides purpureum, Herdm.,*Pl. Bot. III., figs. 6—10.

Colony massive, irregularly lobed, from pink to purple in tint. Surface smooth. No terminal bulbs of vessels visible, nor cloacal apertures. Length 7 cm., breadth 5 cm., thickness 5 mm.

Systems irregular, chiefly in branching lines (figs. 8 and 10).

Test with no bladder nor pigment cells. Vessels numerous, with many small ovate terminal knobs, seen in sections (fig. 9). Test easily tears, and Ascidiozooids fall out.

Ascidiozooids about 5 mm. long and 1 mm. broad at most, with long axis parallel to surface. Branchial apertures show as white dots on the surface of the colony.

Mantle thin, muscle fibres slight and distant, running longitudinally. A few purple pigment masses.

* See "Revision," p. 609.

Branchial sac very long and narrow, at least 14 to 16 rows of stigmata, with 10 or 12 stigmata in a row. There are 3 internal longitudinal bars on each side, and from 2 to 4 stigmata in a mesh.

Dorsal lamina a narrow membrane.

Tentacles 16; 4 larger with 3 smaller between each pair, of which the middle one may be longer than its neighbours.

Alimentary canal. Stomach rather globular, with a long vermiform cæcum (fig. 6, *cæ.*), enlarged a little at the end, and with about 10 longitudinal grooves (fig. 7).

Gonads. 9 or 10 masses of spermatic vesicles, forming a gonad on each side of the body.

Locality.—Port Jackson; about a dozen masses (fig. 10). Port Stephen; one colony (fig. 8). Many buds are present in the latter specimen.

Sarcobotrylloides pannosum, Herd.,* Pl. Bot. III., figs. 1—5.

Colony formed of long, fleshy lobed masses branching irregularly so as to give a ragged appearance (fig. 1). Colour a grey slatey brown. Surface smooth. Size of colony about 15 cm. by 3 cm. by 1·5 cm.

Systems very irregular, can only be traced at the edges of the colony.

Test light grey, closely crowded with Ascidiozooids. The Ascidiozooid appears under a lens as a brown mass with the branchial aperture as a dark dot surrounded by a faint white line. The common cloacal apertures very inconspicuous. Vessels small and not numerous in the test, but bearing many terminal bulbs. No pigment cells or bladder cells are present, and the test cells are small.

Ascidiozooids about 2 mm. in length, set at right angles to the surface (fig. 2).

Mantle thin, transparent.

Branchial sac long and narrow, with about 14 rows of stigmata, and 10 or 12 in a row. There are 3 internal longitudinal bars on each side. In some cases the stigmata between the dorsal lamina and the first bar are very irregular (see fig. 3). The stigmata are rather short and wide (fig. 4). There are from 2 to 4 in a mesh.

Dorsal lamina a plain narrow membrane (fig. 5).

Tentacles 8, large and small alternately.

Dorsal tubercle. A simple rounded aperture outside the peripharyngeal band (see fig. 5, *d. t.*).

* See "Revision," p. 609.

Alimentary canal. The stomach is a wide oval, nearly globular, and has 10 longitudinal grooves. It has a small anteriorly placed cæcum, into which the duct from the intestinal gland opens. The long vermiform cæcum of *Sarcobotrylloides purpureum* and *S. anceps* is not present. There is a narrow, well-marked lip running round the anal aperture.

The *Gonads* on each side of the thorax contained ova only, in the Ascidiozooids examined.

Locality.—Port Stephen; four colonies.

The species comes very near to *Sarcobotrylloides purpureum*, and *S. anceps*, but appears to be distinct. It differs in appearance of colony and slatey colour. The Ascidiozooids are not so large nor conspicuous (see Pl. Bot. III., figs. 1, 8 and 10).

[The following Botryllidæ have also been recorded from the Australian seas :—

Botryllus (? Symplegma) racemosus, Q. and G.

? Distomus violaceus, Q. and G.].

THE TUNICATE FAUNA OF AUSTRALIAN SEAS.

The rich Tunicate Fauna of the Australian seas was first exploited by Quoy and Gaimard who, in their account of the animals collected during the voyage of the "Astrolabe," named, figured, and briefly diagnosed 18 new species collected at various points on the coast of Australia and New Zealand. Since then fresh instalments of new species have been added by Stimpson, Macdonald, Heller, Sluiter, and Herdman ("Challenger" collection), so that now the known Tunicate Fauna of Australia is probably larger than that of any other area of equal size in other parts of the world. The "Challenger" found 43 species in what may fairly be regarded as Australian waters. Since then collections have been made by Haddon, Willey, Semon, and others, in addition to the important local collection of the Australian Museum described in the previous pages.

In the following list I have endeavoured to give a complete record of the Tunicate Fauna of the Australian seas so far as it is known to me. The sixty-three species described and figured for the first time in the present catalogue are marked with an asterisk. I have added the localities, and, in the case of previously described species, some reference to where a description or figure will be found. In the case of species described in this work I have added the page after the word Catalogue, so that the list may serve also as a classified index to these species.

LIST OF AUSTRALIAN TUNICATA.

ASCIDIACEA.

ASCIDIÆ SIMPLICES.

Family I. Molgulidæ.

**Ascopera nana*, Herdm., Port Jackson.—Catalogue, p. 57.

**Molgula mollis*, Herdm., Port Jackson.—Cat., p. 54.

M. Forbesi, Herdm., Port Jackson, 2—10 faths.—"Chall." Rep. I., p. 78, Pl. V., figs. 8—11.

**M. sydneyensis*, Herdm., Sydney Harbour.—Cat., p. 55.

**M. recumbens*, Herdm., Port Jackson.—Cat., p. 56.

M. inconspicua, Stimp., Port Jackson.—P. Acad. N.S., Philad., July, 1855, p. 387.

Caesira (? *Molgula*) *parasitica*, Macd., King George's Sound.—Tr. Linn. S., XXII., p. 367.

C. (? *Molgula*) *ficus*, Macd., Shark Bay.—Loc. cit., p. 368.

C. (? *Molgula*) *pellucida*, Macd., Shark Bay.—Loc. cit., p. 369.

Ascidia (? *Ctenicella*) *tumulus*, Quoy & Gaimard, Port Western.—Voyage "Astrolabe," III., p. 607.

A. (? *Molgula*) *sabulosa*, Quoy & Gaimard, Port Western.—"Astrolabe," III., p. 613.

Family II. Cynthiidæ.

Sub-family *Boltenineæ*.

Boltenia pachydermatina, Herdm., Port Jackson, &c.—"Chall." Rep. I., p. 89, Pl. VII., figs. 6—8.

**B. tuberculata*, Herdm., Port Jackson and Port Stephen.—Cat., p. 17.

B. gibbosa, Heller (? = *Ascidia spinifera*, Q. & G.), Bass Strait.—Sitz. Akad. Wien., 1878.

B. australis (Q. & G.), Port Jackson, Port Western, &c.—"Astrolabe" III., p. 616.

Sub-family *Cynthineæ*.

Microcosmus affinis, Heller, Australia.—Sitz. Akad. Wien, 1878.

M. polymorphus, Heller, Bass Str., 40 faths.—"Chall." Rep. I., p. 133, Pl. XIV., figs. 6—7.

M. Helleri, Herdm., Torres Straits and Amboina.—"Chall." Rep. I., p. 131, Pl. XIV., figs. 1—4.

M. propinquus, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 132, Pl. XIV., figs. 5—6.

M. Julinii, v. Dr., Sydney.—Denks. Akad. Wien., XLVIII., p. 371.

M. distans, Heller, New South Wales.—Sitz. Akad. Wien., 1878.

**M. Draschii*, Herdm., Port Jackson and Port Stephen.—Cat., p. 20.

**M. australis*, Herdm., Port Jackson.—Cat., p. 23.

**M. Ramsayi*, Herdm., Port Jackson.—Cat., p. 25.

Rhabdocynthia† *complanata*, Herdm., Port Jackson, 6 faths.—"Chall." Rep. I., p. 145, Pl. XVII., figs. 1—9.

R. tenuis (?), Herdm., Amboina.—Jenais. Denk. VIII., p. 184.

R. sp. (?), Sluit., Thursday Is.—Loc. cit., p. 185.

Cynthia præputialis, Heller, Port Jackson.—Sitz. Akad. Wien, 1878.

C. arenosa, Herdm., Torres Str., 1—8 faths.—"Chall." Rep. I., p. 140, Pl. XVI., figs. 6—9.

C. formosa, Herdm., Torres Str., 3—11 faths.—"Chall." Rep. I., p. 139, Pl. XVI., figs. 1—5.

C. cerebriformis, Herdm., Port Jackson, 30 faths.—"Chall." Rep. I., p. 136, Pl. XV., figs. 5—7.

C. irregularis, Herdm., Port Jackson, 2—10 faths.—"Chall." Rep. I., p. 141, Pl. XVI., figs. 10—12.

C. fissa, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 137, Pl. XV., figs. 8—11.

C. arcuata, Heller, New South Wales.—Sitz. Akad. Wien., 1878.

C. grandis, Heller, Sydney.—Sitz. Akad. Wien., 1878.

C. hispida, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 146, Pl. XVI., figs. 1—4.

**C. molguloides*, Herdm., Port Jackson.—Cat., p. 27.

**C. solanoides*, Herdm., Port Jackson.—Cat., p. 29.

**C. multiradicata*, Herdm., Port Stephen.—Cat., p. 30.

**C. cataphracta*, Herdm., Port Jackson.—Cat., p. 31.

**C. spinifera*, Herdm., Port Jackson.—Cat., p. 32.

**C. crinitistellata*, Herdm., Port Jackson.—Cat., p. 34.

C. dumosa, Stimp., Port Jackson.—P. Acad. N.S., Philad., 1855, p. 207.

C. sabulosa, Stimp., Port Jackson.—Loc. cit., p. 387.

C. lævissima, Stimp., Port Jackson.—Loc. cit., p. 387.

†I know of three other new species of *Rhabdocynthia* from the north of Australia, but they are not yet described. They are in the collection brought home from Torres Straits by Professor A. C. Haddon.

? *Ascidia aurora*, Q. & G., Port Western.—"Astrolabe," III., p. 605.
? *A. reticulata*, Q. & G., King George Sd.—"Astrolabe, p. 606.
? *A. erythrostoma*, Q. & G., New Zealand.—"Astrolabe," p. 609.
? *A. ianthinostoma*, Q. & G., New Zealand.—"Astrolabe," p. 610.
? *A. cærulea*, Q. & G., New Zealand.—"Astrolabe," p. 611.
? *A. spinosa*, Q. & G., King George Sd.—"Astrolabe," p. 615.

Sub-family *Styelinæ*.

Styela radicosa, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 163, Pl. XXIV., figs. 6, 7; and "Chall." Rep. II., p. 410, Pl. XLIX., figs. 9, 10.
S. humilis, Heller, New Zealand.—Sitz. Akad. Wien., 1878.
S. captiosa, Sluit., Amboina.—Jen. Denk., VIII., p. 181.
S. palinorsa, Sluit., Amboina.—Jen. Denk. VIII., p. 181.
S. exigua, Herdm., Port Jackson.—"Chall." Rep. I., p. 157, Pl. XIX., figs. 5, 6.
S. bythia, Herdm., South of Australia, 2,600 faths.—"Chall." Rep. I., p. 151, Pl. XVIII., figs. 1, 6—8.
S. squamosa, Herdm., South of Australia, 2,600 faths.—"Chall." Rep. I., p. 152, Pl. XVIII., figs. 1—5.
S. plicata, Les. (= *S. gyrosa*, Heller), Port Jackson, &c.—"Chall." Rep. I., p. 155.
S. phaula, Sluit., Thursday Is.—Jen. Denk., VIII., p. 182.
S. solvens, Sluit., Thursday Is.—Jen. Denk., VIII., p. 182.
**S. pinguis*, Herdm., Port Jackson.—Cat., p. 37.
**S. Etheridgii*, Herdm., Port Jackson and Port Stephen.—Cat., p. 38.
**S. Whiteleggii*, Herdm., Port Jackson and Port Stephen.—Cat., p. 40.
**S. personata*, Herdm., Port Jackson.—Cat., p. 41.
**S. stolonifera*, Herdm., Moreton Bay.—Cat., p. 42.
Polycarpa tinctor, Q. & G., Port Jackson, &c.—"Chall." Rep. I., p. 170, Pl. XXI., figs. 1—6.
P. aurata, Q. & G. (= *P. sulcata*, Herdm. = *P. pneumonodes*, Sluit.), Port Jackson.—"Chall." Rep. I., p. 179, Pl. XXIII., figs. 9—13.
P. radicata, Herdm., Port Jackson and Twofold Bay, 120 faths.—"Chall." Rep. I., p. 181, Pl. XXIV., figs. 3—5.
P. viridis, Herdm., Port Jackson and Port Stephen.—"Chall." Rep. I., p. 168, Pl. XXI., figs. 7—14.
P. pedunculata, Heller, Bass Str.—Sitz. Akad. Wien., 1878.
P. elata, Heller, ? Austr. or New Zealand.—Sitz. Akad. Wien., 1878.
P. Stimpsoni, Heller, Sydney.—Sitz. Akad. Wien., 1878.

P. obscura, Heller, Bass Str.—Sitz. Akad. Wien., 1878.
P. nebulosa, Heller, ? Austr. or New Zealand.—Sitz. Akad. Wien., 1878.
P. pilella, Herdm., Port Jackson.—Cat., p. 50.
P. rigida, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 175, Pl. XXIII., figs. 1, 2.
P. longisiphonica, Herdm., Port Jackson, &c.—"Chall." Rep. I., p. 176, Pl. XXIII., figs. 3—6.
P. bassi, Herdm., Bass Str.—"Chall." Rep. II. App., p. 413, Pl. XLIX., figs. 1—3.
P. molguloides, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 172, Pl. XXII., figs. 5—7.
**P. fungiformis*, Herdm., Moreton Bay.—Cat., p. 43.
**P. stephenensis*, Herdm., Port Stephen.—Cat., p. 45.
**P. Sluiteri*, Herdm., Port Jackson.—Cat., p. 46.
**P. sacciformis*, Herdm., Port Jackson.—Cat., p. 48.
**P. Jacksoniana*, Herdm., Port Jackson.—Cat., p. 50.
**P. attollens*, Herdm., Port Jackson.—Cat., p. 53.

Family III. Ascidiidæ.

Sub-family *Cioninæ*.

Ciona intestinalis, Linn., off Cockatoo Is., Port Jackson.—Cat., p. 9.
Rhodosoma (*Pera*) *huxleyi*, Macd. (? = *Peroides*, Macd., also), Bellona reefs.—Jour. Linn. S., VI., p. 78.

Sub-family *Ascidiinæ*.

? *Ascidia diaphana*, Q. & G., Hobart Town.—"Astrolabe," III., p. 612.
A. cylindracea, Herdm., Twofold Bay, 120 faths.—"Chall." Rep. I., p. 216, Pl. XXXIII., figs. 7—9.
A. pyriformis, Herdm., Port Jackson, 6 faths.—"Chall." Rep. I., p. 219, Pl. XXXIV., figs. 1—6.
A. succida, Stimp., Port Jackson, low tide.—Acad. Philad., 1855, p. 388.
A. sydneiensis, Stimp., Port Jackson, low tide.—Loc. cit., p. 387.
A. bifissa, Sluit., Amboina.—Jen. Denk., VIII., p. 176.
A. empheres, Sluit., Amboina.—Loc. cit,, p. 177.
A gemmata, Sluit., Amboina.—Loc. cit., p. 177.
A. kreagra, Sluit., Amboina.—Loc. cit., p. 178.
**A. incerta*, Herdm., Port Jackson, 6—8 faths.—Cat., p. 11.
**A. phallusioides*, Herdm., Port Jackson, 6—8 faths.—Cat., p. 12.

Pachychlæna oblonga, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 221, Pl. XXIX., figs. 1—9.

P. obesa, Herdm., Bass Str., 40 faths.—"Chall." Rep. I., p. 223, Pl. XXVIII., figs. 1—5.

Abyssascidia wyvillii, Herdm., South of Australia, 2,600 faths.—"Chall." Rep. I., p. 194, Pl. XXVII.

Family IV. Clavelinidæ.

Perophora hutchisoni, Macd., King George's Sound.—Tr. Linn. S., XXII., p. 377.

[? *Chondrostachys* sp., Macd., Bass Str., 10—12 faths.]

**Podoclavella meridionalis*, Herdm., Port Jackson, Amboina, Thursday Is.—Cat., p. 4.

**Stereoclavella australis*, Herdm., Vaucluse, Port Jackson, low tide.—Cat., p. 6.

**S.* sp. ?, Broughton Ids.—Cat., p. 8.

Ecteinascidia euphues, Sluit.—Jen. Denk., VIII., p. 49.

E. psammodes, Sluit.—Loc. cit., p. 50.

Rhopalopsis crassa, Herdm., Ki Is., 129 faths.—"Chall." Rep. I., p. 240, Pl. XXXVI., figs. 12—14.

R. fusca, Herdm., Banda, 17 faths.—"Chall." Rep. I., p. 241, Pl. XXXVI., figs. 7—11.

ASCIDIÆ COMPOSITÆ.

I. MEROSOMATA.†

Family I. Distomidæ.

Colella pedunculata, Q. & G., Port Western, &c.—"Astrolabe," III., p. 626.

C. pulchra, Herdm., Torres Str., 6 faths.—"Chall." Rep. II., p. 106, Pl. XV., figs. 1—13.

C. elongata, Herdm., Port Jackson, 30 faths.—"Chall." Rep. II., p. 110, Pl. XVI., figs. 1—7.

C. Murrayi, Herdm., S.E. Australia, 120 faths., and Port Jackson.—"Chall." Rep. II., p. 115, Pl. XVI., figs. 1—11.

Do., var. *rubida*, Bass Str., 38 faths.—"Chall." Rep. II., p. 119, Pl. XVII., figs. 12—14.

**C. plicata*, Herdm., (?= *C. cerebriformis*, Q. & G.), Port Jackson, South Australia.—Cat., p. 62.

† Modified from Sluiter's classification, and including those families of Compound Ascidians which are related to the Clavelinidæ, and in which the body is divided into regions, such as the Distomidæ and the Polyclinidæ.

**C. tenuicaulis*, Herdm., Port Jackson and Port Stephen.—Cat., p. 64.

**C. claviformis*, Herdm., Port Jackson.—Cat., p. 67.

**C. cyanea*, Herdm., Port Jackson.—Cat., p. 69.

Distoma deerata, Sluit., Thursday Is., Torres Str.—Jen. Denk., VIII., p. 167.

? *Chondrostachys* sp., Macd., Bass Str., 10—12 faths.—Ann. N. H., 1858, p. 40.

? *Polyclinum cylindricum*. Q. & G., Port Western.—"Astrolabe," p. 618.

Family II. Polyclinidæ.

Sigillina australis, Sav., Port Jackson [Whitelegge].—Mém. Anim. s. Vert., p. 179.

Atopogaster aurantiaca, Herdm., Bass Str., 40 faths.—"Chall." Rep. II., p. 168, Pl. XXIII., figs. 7—13.

Polyclinum fungosum, Herdm., Port Jackson, 6—15 faths.—"Chall." Rep. II., p. 190, Pl. XIV., figs. 15—23.

P. depressum, Herdm., Torres Str., 3—11 faths.—"Chall" Rep. II., p. 193, Pl. XXVI., figs. 5—7.

P. glabrum, Sluit., Amboina.—Jen. Denk., VIII., p. 168.

P. hospitale, Sluit., Thursday Is.—Loc. cit., p. 169.

**P. clava*, Herdm., Port Jackson.—Cat., p. 77.

**P. giganteum*, Herdm., Port Jackson.—Cat., p. 79.

**P. globosum*, Herdm., Port Jackson.—Cat., p. 80.

**P. complanatum*, Herdm., Port Jackson.—Cat., p. 81.

**P. fuscum*, Herdm., Port Jackson.—Cat., p. 82.

**P. prunum*, Herdm., Port Jackson.—Cat., p. 83.

**P. nigrum*, Herdm., Naucluse, Port Jackson.—Cat., p. 84.

Amaroucium albidum, Herdm., Bass Str., 40 faths.—"Chall." Rep. II., p. 234, Pl. XXVI., figs. 11, 12.

A. Ritteri, Sluit., Thursday Is.—Jen. Denk., VIII., p. 170.

**A. rotundatum*, Herdm., Port Jackson.—Cat., p. 71.

**A. protectans*, Herdm., Port Jackson.—Cat., p. 73.

**A. distomoides*, Herdm., Port Jackson.—Cat., p. 75.

**A. anomalum*, Herdm., Sydney Harbour (? = *Polyclinoides* sp., Macd.).—Cat., p. 76.

Psammaplidium spongiforme, Herdm., Port Jackson, 7 faths.—"Chall." Rep. II., p. 239, Pl. XXXII., figs, 1—5.

Ps. ovatum, Herdm., Torres Str., 3—11 faths.—"Chall." Rep, II., p. 246, Pl. XXXI., figs. 13—16.

Ps. pyriforme, Herdm., North Australia, 8 faths.—"Chall." Rep. II., p. 419.

**Ps. solidum*, Herdm., Port Jackson.—Cat., p. 85.
**Ps. lobatum*, Herdm., Port Jackson.—Cat., p. 85.
**Ps. fragile*, Herdm., Port Jackson.—Cat., p. 86.
**Ps. incrustans*, Herdm., Port Stephen.—Cat., p. 87.
**Ps. pedunculatum*, Herdm., ? Port Jackson.—Cat., p. 88.

Family III. Didemnidæ.

Didemnum aurantiacum, Herdm., Bass Str., 38 faths.—"Chall." Rep. II., p. 264, Pl. XXXIII., figs. 1—8.
Leptoclinum Jacksoni, Herdm., Port Jackson, 6—15 faths.—"Chall." Rep. II., p. 303, Pl. XXXVIII., figs. 19—22.
L. psammathodes, Sluit., Thursday Is.—Jen. Denk., VIII., p. 171.
L. pantherinum, Sluit., Amboina.—Loc. cit., p. 172.
L. pustulosum, Sluit., Amboina.—Loc. cit., p. 173.
L. torresii, Sluit., Thursday Is.—Loc. cit., p. 173.
L. siphoniatum, Sluit., Amboina.—Loc. cit., p. 174.
L. asteropum, Sluit., Amboina.—Loc. cit., p. 175.
**L. incanum*, Herdm., Port Jackson.—Cat., p. 90.
**L. fimbriatum*, Herdm., Port Jackson.—Cat,, p. 91.
**L. patulum*, Herdm., Port Jackson.—Cat., p. 92.

Family IV. Diplosomidæ.

Diplosoma Rayneri, Macd., Sydney Harbour (?)—Tr. Linn. S., XXII., p. 373.

II. HOLOSOMATA.†

Family I. Polystyelidæ.

Synstyela incrustans, Herdm., Thursday Is.—"Chall." Rep. II., p. 342, Pl. XLVI., figs. 9—14.
**Goodsiria lapidosa*, Herdm., Port Jackson.—Cat., p. 99.
**Chorizocormus sydneyensis*, Herdm., Port Jackson.—Cat., p. 95.
**C. subfuscus*, Herdm., Port Jackson.—Cat., p. 96.
**C. leucophæus*, Herdm., Port Jackson.—Cat., p. 97.

Family II. Botryllidæ.

Botryllus (? *Symplegma*) *racemosus*, Q. & G., New Zealand.—"Astrolabe," III., p. 620.

† Modified from Sluiter's classification, and including those families of Compound Ascidians which are related to the Cynthiidæ, and in which the compact body is not divisible into regions, viz., the Polystyelidæ and the Botryllidæ.

? *Distomus violaceus*, Q. & G., Port Western.—"Astrolabe," p. 622.
**Botrylloides leptum*, Herdm., Port Jackson.—Cat., p. 101.
**Do.*, variety, Herdm., Port Jackson.—Cat., p. 102.
**Sarcobotrylloides Jacksonianum*, Herdm., Port Jackson.—Cat., p. 102.
**S. anceps*, Herdm., Port Jackson.—Cat., p. 103.
**S. purpureum*, Herdm., Port Jackson and Port Stephen.—Cat., p. 104.
S. pannosum, Herdm., Port Stephen.—Cat., p. 105.

ASCIDIÆ SALPIFORMES.

Family Pyrosomidæ.

Pyrosoma sp. (?), Bondi and Coogee.—Whitelegge, R. Soc. N. S. W., 1889, p. 134.
P. giganteum, Lesueur, S. of Australia.—"Chall." Rep. III.

THALIACEA.

Family Doliolidæ.

Doliolum denticulatum, Q. & G., off Port Jackson, &c.—"Astrolabe," III., p. 599.
D. Ehrenbergi, Krohn, between Sydney and New Zealand.—"Chall." Rep. III., p. 46.

Family Salpidæ.

Salpa democratica-mucronata, Forsk., off Port Jackson, &c.—"Chall." Rep. III., p. 79.
S. cylindrica, Cuv., Amboina.—"Chall." Rep. III., p. 72.
S. scutigera-confoederata, Cuv.-Forsk., Amboina.—"Chall." Rep. III., p. 84.
S. costata-tilesii, Q. & G.-Cuv., between Sydney and New Zealand.—"Chall." Rep. III., p. 60.
S. cordiformis-zonaria, Q. & G.-Pallas, between Sydney and New Zealand.—"Chall." Rep. III., p. 70.

LARVACEA.

Family Appendiculariidæ.

Appendicularia, sp. (?), Port Jackson.—Whitelegge, R. Soc. N. S. W., 1889, p. 134.

The above list comprises 183 species*—a greater number than that (about 176) known from the shores of North-Western Europe, a nearly corresponding area of coast in the northern hemisphere, and the one which has been most exhaustively worked up. But even this large number of species does not complete the Australian Tunicate Fauna, as I have seen from a preliminary examination of the large collections brought back from Australian seas by Professor A. C. Haddon and by Dr. A. Willey, that they each contain some additional undescribed species. This great abundance of species in these southern seas agrees with the view I expressed in the "Challenger" Report, that Ascidians "attain their greatest numerical development in southern temperate regions," and bears out especially the remark made long before by Quoy and Gaimard, "La Nouvelle-Hollande, dans sa partie sud, et la Nouvelle-Zélande, sont les lieux de prédilection des Ascidies en général."

* Thirty-six of these were recorded by Mr. Thomas Whitelegge in his "List of the Marine and Fresh-Water Invertebrate Fauna of Port Jackson and Neighbourhood," read before the Royal Society of New South Wales, July 3rd, 1889.

INDEX.

LIST OF PLATES,

IN THEIR ORDER.

Plates A, B, C (Diagrammatic).

Plate Clav. I.	Clavelinidæ.	Plate Mol. I.	Molgulidæ
Plate Clav. II.			
		Plate Dist. I.	
Plate Asc. I.	Ascidiidæ.	Plate Dist. II.	Distomidæ.
Plate Asc. II.		Plate Dist. III.	
Plate Cyn. I.	Cynthiidæ.	Plate Pcl. I.	Polyclinidæ.
Plate Cyn. II.		Plate Pcl. II.	
Plate Cyn. III.		Plate Pcl. III.	
Plate Cyn. IV.		Plate Pcl. IV.	
Plate Cyn. V.		Plate Pcl. V.	
Plate Cyn. VI.		Plate Pcl. VI.	
Plate Cyn. VII.			
Plate Cyn. VIII.		Plate Did. I.	Didemnidæ.
Plate Cyn. IX.		Plate Did. II.	
Plate Cyn. X.			
Plate Cyn. XI.		Plate Pst. I.	Polystyelidæ.
Plate Cyn. XII.		Plate Pst. II.	
Plate Cyn. XIII.		Plate Pst. III.	
Plate Cyn. XIV.			
Plate Cyn. XV.		Plate Bot. I.	Botryllidæ.
Plate Cyn. XVI.		Plate Bot. II.	
Plate Cyn. XVII.		Plate Bot. III.	
Plate Cyn. XVIII.			
Plate Cyn. XIX.			
Plate Cyn. XX.			

EXPLANATION OF THE PLATES.

S. 1., S. $\frac{1}{4}$, &c., indicate which of Swift's objectives were used in making the drawings.

Plates A, B, and C illustrate the structure and life-history of typical Simple and Compound Ascidians. (See Introduction, p. xiv., *et seq.*)

Plate A.

Fig. 1. An *Ascidia*, from the right-hand side, nat. size.
Fig. 2. Diagrammatic transverse section through the atrial aperture, along line A—B in fig. 4.
Fig. 3. Part of wall of branchial sac, magnified.
Fig. 4. Diagrammatic longitudinal section along the line A—B in fig. 2.
Fig. 5. Diagram to show structure of mantle and test (body-wall).
Fig. 6. Diagram to show the relations of nerve ganglion, neural gland, duct, and dorsal tubercle.
Fig. 7. Front of dorsal edge of branchial sac, showing tentacles, dorsal tubercle, languets, &c., magnified.

Plate B.

Fig. 1. Colony of *Colella Quoyi* (Distomidæ).
Fig. 2. Colony of *Leptoclinum neglectum* (Didemnidæ).
Fig. 3. Colony of *Pharyngodictyon mirabile* (Polyclinidæ).
Fig. 4. Colony of *Botryllus Schlosseri* (Botryllidæ).
(All nat. size, after Herdman, "Chall." Report).
Fig. 5. Diagrammatic section of a Compound Ascidian colony, showing parts of two Ascidiozooids and a common cloacal aperture, magnified.
Fig. 6. Ascidiozooid from a Botryllid colony.
Fig. 7. Ascidiozooid from a Distomid colony.
Fig. 8. Ascidiozooid from a Polyclinid colony.
(All from right side, magnified).

Fig. 9. Section of test of *Ascidia*, to show "vessels" and "bladder-cells," magnified.

Fig. 10. Diagram showing Ascidian from left side, in correct morphological position for comparison with Vertebrates, to illustrate the course of the circulation, &c.

Plate C.

Fig. 1. Ovum and spermatozoon.
Fig. 2. Segmentation stage of embryo.
Fig. 3. Early gastrula stage.
Fig. 4. Later gastrula stage.
Fig. 5. Embryo showing notochord and neural canal.
Fig. 6. Later embryo showing body and tail, &c.
Fig. 7. Transverse section of tail of larva.
Fig. 8. A young tailed larva.
Fig. 9. An older tailed larva.
Fig. 10. Larva attaching itself to a stone.
Fig. 11. Tail, &c., of larva degenerating.
Fig. 12. Metamorphosis of larva into
Fig. 13. Young Ascidian.

Plate Clav. I.

Fig. 1. Large colony of *Stereoclavella australis*, Herdman, nat. size.
Fig. 2. Colony cut in section to show stolonial tubes and buds, nat. size.
Fig. 3. Group of Ascidiozooids, nat. size.
Fig. 4. Ascidiozooid removed from test, right side; enlarged.
Fig. 5. The same, left side; enlarged.
Fig. 6. Part of surface of test showing spines. S. $\frac{1}{4}$.
Fig. 7. Section through deeper part of test. S. $\frac{1}{4}$.
Fig. 8. Part of mantle. S. 1.
Fig. 9. Small part of branchial sac. S. 1.
Fig. 10. Dorsal edge of branchial sac showing languets. S. 1.
Fig. 11. Section through basal part of test showing vessels and buds. S. 1.

Plate Clav. II.

Fig. 1. *Podoclavella meridionalis*, n. sp., nat. size.
Fig. 2. Body removed from test showing thorax and abdomen, nat. size.

Fig. 3. Transverse section of the peduncle of same. S. 1.
Fig. 4. Part of the branchial sac from the inside. S. 1.
Fig. 5. *Stereoclavella sp.* (? n. sp.), nat. size.
Fig. 6. Part of the mantle. S. 1.
Fig. 7. Part of the branchial sac, from inside. S. 1.
Fig. 8. Some of the dorsal languets. S. 1.

Plate Asc. I.

Fig. 1. *Ciona sp.* (probably *C. intestinalis*, L.) from back of *Macippe spinosa*.
Fig. 2. Body removed from test, nat. size.
Fig. 3. *Ciona intestinalis*, L. (?), from off Cockatoo Id.; body removed from test, left side, nat size.
Fig. 4. Dorsal tubercle of same. S. 1.
Fig. 5. *Ascidia incerta*, n. sp.
Fig. 6. Part of branchial sac from inside. S. 1.
Fig. 7. Part of dorsal lamina. S 1.
Fig. 8. Dorsal tubercle and tentacles. S. 1.

Plate Asc. II.

Fig. 1. *Ascidia phallusioides*, n. sp., specimen B., half nat. size, from the right side.
Fig. 2. Part of wall of branchial sac. S. 1.
Fig. 3. Section of test showing vessels. S. 1.
Fig. 4. Part of the same. S. $\frac{1}{4}$.
Fig. 5. Tentacles and dorsal tubercle. S. 1.
Fig. 6. Part of dorsal lamina. S. 1.
Fig. 7. Dissection of the nerve ganglion and neural gland, showing the numerous secondary openings, slightly enlarged.
Fig. 8. Part of the surface of the neural gland, showing the openings into the atrium. S. 1.
Fig. 9. Part of surface of test, slightly enlarged.
Fig. 10. Part of surface of test in deeply pigmented form (No. 12), under a Coddington lens.

Plate Cyn. I.

Fig. 1. Group of 14 specimens of *Boltenia pachydermatina*, Herdm., adhering together by the base of their stalks, slightly less than half nat. size.

Fig. 2. Small piece of branchial sac, to show spicules. S. $\frac{1}{4}$.
Fig. 3. Dorsal tubercle of adult *B. pachydermatina*. S. 1.
Fig. 4. Dorsal tubercle of *B. gibbosa*, Heller. S. 1.

Plate Cyn. II.

Fig. 1. *Boltenia tuberculata*, Herdm., nat. size.
Fig. 2. Branchial and atrial apertures of another specimen, showing many lobes.
Fig. 3. Branchial aperture of a specimen, showing four chief lobes and many smaller.
Fig. 4. Specimen removed from test and cut open to show folds of branchial sac, compound tentacles, dorsal tubercle, &c., slightly enlarged.
Fig. 5. Small part of the branchial sac from the inside, to show spicules. S. $\frac{1}{4}$.
Fig. 6. *Boltenia tuberculata* adhering to *Styela Whiteleggii*, n. sp.
Fig. 7. Four specimens of *Boltenia tuberculata*, nat. size, along with two specimens of *Styela Whiteleggii*, n. sp., nat. size.

Plate Cyn. III.

Fig. 1. *Microcosmus Draschii*, Herdm., from the left side, about half nat. size.
Fig. 2. Diagram of longitudinal section through the animal to show the relation in size between the test and contained body, reduced.
Fig. 3. The body removed from the test, from left side, nat. size.
Fig. 4. Section through the test near the apertures, to show the irregular outer surface, nat. size.
Fig. 5. Part of the mantle, highly magnified, to show the arrangement and appearance of the calcareous spicules.

Plate Cyn. IV.

Fig. 1. Specimen of *Microcosmus Draschii* attached to a large *Ascidia phallusioides*, and having one specimen of *Polycarpa Sluiteri* (P^1.) and three specimens of *Molgula Forbesi*, Herdm., (P^2.) attached to its surface, nat. size.
Fig. 2. *Microcosmus Draschii* cut open to show the folds of the branchial sac, the opening of the œsophagus, the dorsal languets, the tentacles, and the dorsal tubercle.
Fig. 3. Part of the back of the branchial sac to show the longitudinal and transverse rows formed by the spicules.

Fig. 4. Part of the inside of the branchial sac, showing parts of two folds and an interspace. S. 1.

Fig. 5. The dorsal tubercle, slightly enlarged with a hand lens.

Plate Cyn. V.

Fig. 1. A "combination" figure (see text, p. 24) of *Microcosmus australis*, n. sp.

Fig. 2. Cluster of specimens, nat. size.

Fig. 3. Another specimen, nat. size.

Fig. 4. The invaginated test that lines the branchial siphon. S. 1. *sc.*—zone of scales, *cor.*—zone of corrugations, *tn.*—zone of minute simple tentacles.

Fig. 5. Part of branchial sac from inside. S. 1.

Fig. 6. Plan of the transverse vessels of the branchial sac.

Plate Cyn. VI.

Fig. 1. *Microcosmus Ramsayi*, n. sp., large specimen from right side, nat. size.

Fig. 2. Clump of four specimens adhering, nat. size.

Fig. 3. A smaller specimen from left side, nat. size.

Fig. 4. Part of branchial sac from inside. S. 1.

Fig. 5. Branchial siphon, dorsal tubercle, and tentacles, enlarged with lens.

Fig. 6. *Microcosmus affinis*, Heller, nat. size.

Fig. 7. Part of branchial sac. S. 1.

Fig. 8. Dorsal tubercle. S. 1.

Fig. 9. *Molgula recumbens*, n. sp., from left side, nat. size.

Fig. 10. Same species, with test removed, from right side, nat. size.

Fig. 11. From left side, nat. size.

Fig. 12. Part of branchial sac from inside. S. 1.

Fig. 13. The dorsal tubercle. S. 1.

Plate Cyn. VII.

Figs. 1—3, *Cynthia præputialis*, Heller.

Fig. 1. *Cynthia præputialis*, Heller, specimen B, one-third nat. size.

Fig. 2. The same, specimen A, one-third nat. size.

Fig. 3. The same, specimen C, one-half nat. size, with part of test cut out to show cavity in which body lies and pad-like fold at anterior end.

Figs. 4—10, *Cynthia molguloides*, n. sp.

Fig. 4. *Cynthia molguloides*, n. sp., from the right side, nat. size.
Fig. 5. The same, test removed, nat. size.
Fig. 6. Part of branchial sac. S. 1.
Fig. 7. The dorsal languets. S. 1.
Fig. 8. The dorsal tubercle, enlarged with lens.
Fig. 9. Alimentary canal and left gonad, a little enlarged.
Fig. 10. The right gonad, a little enlarged.

Plate Cyn. VIII.

Fig. 1. *Cynthia solanoides*, n. sp., right side, nat. size.
Fig. 2. Some of the small tentacles on the test at the inner end of the branchial siphon. S. 1.
Fig. 3. Some of the spines on the test near the outer end of the branchial siphon. S. ¼.
Fig. 4. Part of a section of the test showing vessels. S. 1.
Fig. 5. The body with the test removed, nat. size.
Fig. 6. Part of the branchial sac from the inside. S. 1.
Fig. 7. The dorsal tubercle, a little enlarged.

Plate Cyn. IX.

Fig. 1. *Cynthia multiradicata*, n. sp., from left side, attached to a large *Styela Whiteleggii*, n. sp., nat. size.
Fig. 2. Part of branchial sac from inside. S. 1.
Fig. 3. Dorsal tubercle, enlarged with lens.
Fig. 4. Dorsal languets. S. 1.
Fig. 5. The spines in lining of branchial siphon. S. ¼.
a, in situ; *b*, a spine isolated; *c*, in profile.
Fig. 6. *Cynthia crinitisteliata*, n. sp., branchial aperture, slightly enlarged.
Fig. 7. Stellate hairs on the test of *Cynthia crinitistellata*, in profile. S. 1.

Plate Cyn. X.

Fig. 1. *Cynthia spinifera*, n. sp., from right side, nat. size.
Fig. 2. The same from posterior end, to show base of attachment.
Fig. 3. Body after removal of test, nat. size.
Fig. 4. Part of branchial sac, from inside. S. 1.
Fig. 5. Dorsal tubercle.
Figs. 6, 7, and 8. Branched spines from the surface of the test. S. 1.

Fig. 9. Spine from test of *Cynthia villosa*, Stimps., from Puget Sound.
Fig. 10. Spine from test of *Cynthia echinata*, L., from British seas.
Fig. 11. Tentacle of *C. spinifera.*
Fig. 12. Same in lateral view.
Fig 13. *Cynthia crinitistellata*, n. sp., nat. size.

Plate Cyn. XI.

Fig. 1. *Cynthia cataphracta*, n. sp., between two specimens of *Styela personata*, n. sp., nat. size.
Fig. 2. Small specimen of *Cynthia cataphracta*, nat. size.
Fig. 3. Thin section of surface layer of test, showing globular spicules *in situ.* S. 1.
Fig. 4. Isolated spicules, showing development. S. $\frac{1}{4}$.
Fig. 5. Small part of branchial sac from inside. S. 1.
Fig. 6. Dorsal tubercle, tentacle, and dorsal languets, enlarged with lens.
Fig. 7. Partial diaphragm at base of atrial siphon.
Fig. 8. *Cynthia crinitistellata*, n. sp., dorsal languets. S. 1.
Fig. 9. Part of branchial sac of same species. S. 1.
Fig. 10. Surface view of test of same species, showing the stellate hairs. S. 1.

Plate Cyn. XII.

Fig. 1. *Styela pinguis*, n. sp., nat. size.
Fig. 2. Other specimens of same species, nat. size.
Fig. 3. Section of test, showing vessels, &c. S. 1.
Fig. 4. Spines on test in branchial siphon. S. $\frac{1}{4}$.
Fig. 5. Part of branchial sac. S. 1.
Fig. 6. Part of dorsal lamina. S. 1.
Fig. 7. Dorsal tubercle, enlarged with lens.
Fig. 8. The alimentary canal, nat. size.
Fig. 9. The gonads on the right side, nat. size.
Fig. 10. Some of the spermatic vesicles. S. 1.

Plate Cyn. XIII.

Fig. 1. Specimen of *Styela Etheridgii*, n. sp., from the left side, nat. size.
Fig. 2. Part of the branchial sac. S. 1
Fig. 3. Dorsal tubercle of one specimen. S. 1.
Fig. 4. Another of the same. S. 1.

Fig. 5. Another of the same. S. 1.
Fig. 6. Another of the same. S. 1.
Fig. 7. Another of the same. S. 1.
Fig. 8. Dissection to show the alimentary and reproductive viscera, about nat. size. *at.*, atrial aperture; *e.*, endocarp of connective tissue; *i.*, intestine; *l.g.*, left gonad; *r.g.*, right gonad; *st.*, stomach.

Plate Cyn. XIV.

Fig. 1. *Styela Whiteleggii*, n. sp., from right side, nat. size.
Fig. 2. Another specimen, reduced to half nat. size to show shape and large roots.
Fig. 3. Part of branchial sac from inside. S. 1.
Fig. 4. Dorsal tubercle and tentacles, slightly enlarged with lens
Fig. 5. Part of surface of dorsal tubercle, magnified to show scattered openings. S. 1.
Fig. 6. Dissection to show rectum and reproductive organs, slightly enlarged. *a*, anus; *At*, atrial aperture; *e*, gelatinous pads of connective tissue; *g*, gonad, and *d*, one of its ducts; *r*, rectum.

Plate Cyn. XV.

Fig. 1. *Styela personata*, n. sp., nat. size.
Figs. 2 and 3. Outlines of two other specimens, nat. size.
Fig. 4. Part of branchial sac. S. 1.
Fig. 5. Tentacles of same species, showing the three sizes. S. 1.
Fig. 6. Dorsal tubercle. S. 1.
Fig. 7. Dorsal tubercle of another specimen.
Fig. 8. *Styela stolonifera*, n. sp., nat. size.
Fig. 9. Dissection of posterior end of test, nat. size.
Fig. 10. Dorsal tubercle.
Fig. 11. Part of branchial sac.

Plate Cyn. XVI.

Fig. 1. *Polycarpa fungiformis*, n. sp., nat. size
Fig. 2. Body of same, from other side, nat. size.
Fig. 3. The same, with test removed, nat. size.
Fig 4. Group of polycarps *in situ*, slightly enlarged.
Fig. 5. Two polycarps attached to the mantle, enlarged.
Fig. 6. Part of branchial sac from inside. S. 1.
Fig. 7. A few stigmata, to show muscle fibres. S. $\frac{1}{4}$.

Fig. 8. Part of branchial sac from outside, to show papillæ. S. 1.
Fig. 9. Part of dorsal lamina. S. 1.
Fig. 10. Dorsal tubercle. S. 1.

Plate Cyn. XVII.

Fig. 1. *Polycarpa stephenensis*, n. sp., from left side, nat. size.
Fig. 2. Part of branchial sac. S. 1.
Fig. 3. Dorsal tubercle and tentacles, slightly enlarged.
Fig. 4. Alimentary canal and polycarps of left side, nat. size.
Fig. 5. Polycarps of right side of mantle, nat. size.
Fig. 6. *Polycarpa Sluiteri*, n. sp. (see Pl. Cyn. IV., fig. 1, P^{1}), part of branchial sac. S. 1.
Fig. 7. The dorsal tubercle.
Fig. 8. Some of the tentacles.
Fig. 9. Polycarps from the mantle. S. $\frac{1}{4}$.

Plate Cyn. XVIII.

Fig. 1. Three specimens of *Polycarpa viridis*, Herdm., attached to a specimen of *P. rigida*, Herdm., nat size.
Fig. 2. Dorsal tubercle of *Polycarpa rigida*. S. 1.
Fig. 3. Another specimen of same. S. 1.
Fig. 4. Part of branchial sac and dorsal lamina of *P. rigida*. S. 1.
Fig. 5. Stalked sandy specimen of *P. viridis*, nat. size.
Fig. 6. Dorsal tubercle of *P. viridis*. S. 1.
Fig. 7. Another sand-encrusted *P. viridis*, nat. size.
Fig. 8. Small part of branchial sac, highly magnified, to show outgrowths from vessels and vesicular structure of bar. S. $\frac{1}{4}$.
Fig. 9. Tentacles of *P. viridis*. S. 1.
Fig. 10. Atrial tentacles. S. 1.

Plate Cyn. XIX.

Fig. 1. *Polycarpa sacciformis*, n. sp., left side, nat size.
Fig. 2. Part of branchial sac. S. 1.
Fig. 3. Dorsal tubercle. S. 1.
Fig. 4. Part of tentacular circlet, enlarged with lens.
Fig. 5. *Polycarpa longisiphonica*, Herdm., nat. size.
Fig. 6. Dorsal tubercle. S. 1.
Fig. 7. *Polycarpa Jacksoniana*, n. sp., right side, nat. size.
Fig. 8. Dorsal tubercle. S. 1.
Fig. 9. Part of branchial sac. S. 1.

Plate Cyn. XX.

Fig. 1. *Polycarpa aurata*, var. *plana*, nov., right side, nat. size.
Fig. 2. Part of branchial sac. S. 1.
Fig. 3. Tentacles and dorsal tubercle, slightly enlarged.
Fig. 4. Dorsal tubercle. S. 1.
Fig. 5. Some of atrial tentacles. S. 1.
Fig. 6. *Polycarpa attollens*, n. sp., right side, nat. size.
Fig. 7. Part of branchial sac. S. 1.
Fig. 8. Dorsal tubercle. S. 1.
Fig. 9. Dorsal tubercle of *Polycarpa tinctor*, Quoy and Gaimard. S. 1.

Plate Mol. I.

Fig. 1. *Molgula mollis*, n. sp., about nat. size.
Fig. 2. Body removed from test, from left side, nat. size.
Fig. 3. Part of branchial sac from inside. S. 1.
Fig. 4. Dorsal tubercle and enormous hypophysial gland. S. 1.
Fig. 5. *Molgula sydneyensis*, n. sp., nat. size.
Fig. 6. Body removed from test, from left side, nat. size.
Fig. 7. Body removed from test, from right side, nat. size.
Fig. 8. Part of branchial sac from inside. S. 1.
Fig. 9. Dorsal tubercle and tentacles, enlarged.
Fig. 10. *Ascopera nana*, n. sp., nat. size.
Fig. 11. Body removed from test, from left side, nat. size.
Fig. 12. Part of branchial sac from inside. S. 1.
Fig. 13. Dorsal tubercle. S. 1.
Fig. 14. A large tentacle. S. 1.

Plate Dist. I.

Fig. 1. *Colella tenuicaulis*, Herdm., nat. size.
Fig. 2. Group of four individuals of *C. tenuicaulis*, half nat. size.
Fig. 3. A small part of Ascidiarium of one of these, showing the arrangement of the Ascidiozooids, slightly enlarged.
Fig. 4. Four individuals of *C. tenuicaulis*, nat. size.
Fig. 5. Part of Ascidiarium of large specimen of *C. tenuicaulis*.
Fig. 6. Another of same.
Fig. 7. Part of peduncle and stolon of *C. tenuicaulis*.
Fig. 8. Another stolon of same, nat. size.
Fig. 9. Four individuals, reduced and part of peduncle omitted.
Fig. 10. Small individual of *C. tenuicaulis*.

Fig. 11. Group of five individuals, of which three are very young, reduced.
Fig. 12. Part of branchial sac. S. $\frac{1}{4}$.
Fig. 13. Dorsal languets.
Fig. 14. Part of section of test, showing an ectodermal process.
Fig. 15. Circle of tentacles and dorsal tubercle.
Fig. 16. Another circle of tentacles, in which 12 are present.

Plate Dist. II.

Fig. 1. Colony of *Colella plicata*, Herdm., nat. size.
Fig. 2. Another colony, with much-convoluted Ascidiarium
Fig. 3. Small colony, showing connection or junction at *c*.
Fig. 4. Fan-shaped colony, showing delicate membrane between the branches.
Fig. 5. Small part of last, enlarged to show arrangement of Ascidiozooids.
Fig. 6. Colony, showing junction at *c*.
Fig. 7. Two colonies, with distinct bases, joined at *c*.
Fig. 8. Small colony, with long, slender peduncle.
Fig. 9. Piece of small colony, showing two connections at *c*.
Fig. 10. Very irregular colony.
Fig. 11. Small massive colony.
Fig. 12. An Ascidiozooid of *C. plicata*, measuring 2 mm. in length and 0·5 mm. in breadth. S. 1.
Fig. 13. Part of section through peduncle, showing test and ectodermal vascular appendages, *v*.
Fig. 14. Part of section of test, showing bladder cells and pigment cells. S. $\frac{1}{4}$.
Fig. 15. Part of branchial sac, with dorsal languets.

Plate Dist. III.

Fig. 1. Group of colonies of *Colella claviformis*, Herdm.
Fig. 2. Another colony of unusual shape.
Fig. 3. Another colony, with Ascidiozooids more distinct.
Fig. 4. A colony in median, vertical section.
Fig. 5. Section of the test.
Fig. 6. Section of test of another colony, where yellow pigment cells are more abundant.
Fig. 7. Outline of long, slender Ascidiozooid, 5 mm. in length.

Fig. 8. Outline of shorter Ascidiozooid, 1 mm. in length, with two embryos in incubatory pouch.
Fig. 9. Outline of another similar Ascidiozooid, 3 mm. in length and 2 mm. in greatest breadth.
Fig. 10. Outline of another larger Ascidiozooid, with very long pedicle between thorax and abdomen.
Fig. 11. Piece of branchial sac.
Fig. 12. Piece of branchial sac of Ascidiozooid from another colony.
Fig. 13. One of the dorsal languets.
Fig. 14. Piece of an ectodermal vascular appendage, showing branching S. 1.
Fig. 15. End of another appendage, showing young branches growing out into test. S. 1.

Plate Pcl. I.

Fig. 1. *Amaroucium rotundatum*, n. sp., colony, reduced in size.
Fig. 2. Part of branchial sac.
Fig. 3. Three of the very long dorsal languets.
Fig. 4. An Ascidiozooid.
Fig. 5. *Polyclinum clava*, n. sp., colony, nat. size.
Fig. 6. An Ascidiozooid.
Fig. 7. Part of branchial sac.
Fig. 8. Some of the short, stout, close languets.
Fig. 9. *Polyclinum depressum*, colony, nat. size.
Fig. 10. An Ascidiozooid.
Fig. 11. Part of branchial sac.
Fig. 12. Some of the small tentacular languets.
Fig. 13. *Polyclinum* (?) *nigrum*, n. sp., colony, nat. size.
Fig. 14. An Ascidiozooid, showing especially the alimentary canal.
Fig. 15. Part of test.
Fig. 16. Part of branchial sac and dorsal languets.

Plate Pcl. II.

Fig. 1. *Polyclinum giganteum*, n. sp., colony, nat. size.
Fig. 2. Larger colony of the same species.
Fig. 3. *Polyclinum globosum*, n. sp., colony, slightly reduced, surface view.
Fig. 4. Another colony in section, to show Ascidiarium and peduncle and the position of the ascidiozooids, nat. size.

Fig. 5. Ascidiozooid from last colony, enlarged.
Fig. 6. Two of the tentacular dorsal languets.
Fig. 7. Small part of the branchial sac.
Fig. 8. A tailed larva from the colony.

Plate Pcl. III.

Fig. 1. *Polyclinum fuscum*, n. sp., colony, nat. size.
Fig. 2. Ascidiozooid of same, with larvæ in incubatory pouch. S. 1.
Fig. 3. Part of test, showing bladder cells containing crystals, and brown pigment masses.
Fig. 4. Part of branchial sac.
Fig. 5. Dorsal languets.
Fig. 6. Circlet of tentacles from the branchial sac.
Fig. 7. *Amaroucium protectans*, n. sp., colony on the back of a *Dromia*, nat. size.
Fig. 8. Ascidiozooid from same.
Fig. 9. Series of dorsal languets.
Fig. 10. Part of branchial sac.
Fig. 11. *Amaroucium anomalum*, n. sp., colony, nat. size.
Fig. 12. Some of the dorsal languets.
Fig. 13. Part of branchial sac.
Fig. 14. Ascidiozooid.
Fig. 15. Part of the branched gland from the intestine.
Fig. 16. Part of the test, showing the system of branched "vessels."

Plate, Pcl. IV.

Fig. 1. *Colella cyanea*, n. sp., one-half nat. size.
Fig. 2. Part of test.
Fig. 3. Ascidiozooid.
Fig. 4. Part of branchial sac.
Fig. 5. Dorsal languets.
Fig. 6. Circle of tentacles from the branchial siphon.
Fig. 7. *Amaroucium distomoides*, n. sp., nat. size.
Fig. 8. Section through edge of colony.
Fig. 9. Part of test, showing a vascular stolon.
Fig. 10. Masses of yellow pigment in mantle of post-abdomen.
Fig. 11. Ascidiozooid.
Fig. 12. Part of branchial sac and dorsal languets.
Fig. 13. Dorsal tubercle and tentacles.

Fig. 14. *Polyclinum prunum*, n. sp., nat. size.
Fig. 15. Ascidiozooid.
Fig. 16. Part of branchial sac and dorsal languets.

Plate Pcl. V.

Fig. 1. *Psammaplidium solidum*, n. sp., nat. size.
Fig. 2. Section of test of same. S. 1.
Fig. 3. An ascidiozooid.
Fig. 4. Three of the branchial tentacles.
Fig. 5. Part of the branchial sac.
Fig. 6. Small colony of *Psammaplidium lobatum*, n. sp.
Fig. 7. Large colony of *Psammaplidium lobatum*.
Fig. 8. An Ascidiozooid.
Fig. 9. Three of the dorsal languets.
Fig. 10. Part of the surface layer of test.
Fig. 11. Small part of the branchial sac.
Fig. 12. A tailed larva from the peri-branchial cavity.

Plate Pcl. VI.

Fig. 1. *Psammaplidium incrustans*, n. sp., nat. size.
Fig. 2. Part of branchial sac.
Fig. 3. Dorsal languets.
Fig. 4. Part of the colony seen in section, nat. size.
Fig. 5. An Ascidiozooid.
Fig. 6. A tailed larva from the peri-branchial cavity.
Fig. 7. *Psammaplidium pedunculatum*, n. sp., three colonies, nat. size.
Fig. 8. An Ascidiozooid.
Fig. 9. Part of the branchial sac and dorsal languets.
Fig. 10. *Psammaplidium fragile*, n. sp.
Fig. 11. Part of the colony in section, nat. size.
Fig. 12. An ascidiozooid.
Fig. 13. Part of branchial sac, ventral edge.
Fig. 14. Branchial aperture and circle of tentacles.

Plate Did. I.

Fig. 1. *Leptoclinum fimbriatum*, n. sp., colony, nat. size.
Fig. 2. A common cloacal aperture, enlarged with lens.
Fig. 3. Part of the test, showing spicules and an ectodermal process, magnified.
Fig. 4. Section through the colony, showing Ascidiozooids and spicules. S. 1.

Fig. 5. Calcareous spicules from the test, highly magnified.
Fig. 6. An Ascidiozooid, showing the course of the alimentary canal.
Fig. 7. Muscle bundles in the mantle over the thorax.
Fig. 8. Part of the branchial sac, from a section.

Plate Did. II.

Fig. 1. *Leptoclinum incanum*, n. sp., several colonies, nat. size.
Fig. 2. Calcareous spicules from the test, magnified.
Fig. 3. Part of the surface, showing two common cloacal apertures and a number of branchial apertures, enlarged with a lens.
Fig. 4. Part of the branchial sac, magnified.
Fig. 5. The alimentary canal.
Fig. 6. The anterior end of an Ascidiozooid in section showing tentacles, dorsal tubercle, dorsal languet, &c., magnified.
Fig. 7. *Leptoclinum patulum*, n. sp., colony, nat. size.
Fig. 8. Part of the surface showing the arrangement of the Ascidiozooids, enlarged with lens.
Fig. 9. Arrangement of the spicules around the branchial aperture of an Ascidiozooid.
Fig. 10. Small part of the branchial sac.
Fig. 11. Part of the test in section.
Fig. 12. The alimentary canal.

Plate Pst. I.

Fig. 1. Colony of *Chorizocormus sydneyensis*, Herdm., nat. size.
Fig. 2. Part of test.
Fig. 3. Part of branchial sac.
Fig. 4. Part of branchial siphon, to show dorsal tubercle.
Fig. 5. Alimentary canal.
Fig. 6. Part of wall of intestine, showing digestive tubules.
Fig. 7. Polycarps containing ova.
Fig. 8. Colony of *Chorizocormus subfuscus*, Herdm., nat. size.
Fig. 9. Part of section of same, showing branchial sac, &c.
Fig. 10. Branchial siphon from inside.
Fig. 11. A polycarp containing ova.

Plate Pst. II.

Fig. 1. Colony of *Chorizocormus leucophaeus*, Herdm., nat. size.
Fig. 2. Part of mantle.
Fig. 3. Part of branchial sac.

Fig. 4. Branchial siphon from inside.
Fig. 5. Atrial siphon from inside.
Fig. 6. Alimentary canal.

Plate Pst. III.

Fig. 1. Part of a colony of *Goodsiria lapidosa*, Herdm.
Fig. 2. Another colony of same.
Fig. 3. Part of test, showing vessels, test cells, and imbedded foreign bodies.
Fig. 4. Part of vessel from test.
Fig. 5. Part of mantle.
Fig. 6. Part of branchial sac.
Fig. 7. Graphic formula of branchial sac.
Fig. 8. Alimentary canal.
Fig. 9. Digestive tubules from wall of intestine.
Fig. 10. Tentacles and dorsal tubercle.
Fig. 11. Part of polycarp, showing ova and sperm sacs together.
Fig. 12. Group of sperm sacs and ducts, separated out.

Plate Bot. I.

Fig. 1. Colony of *Botrylloides leptum*, n. sp., variety, nat. size.
Fig. 2. Part of test of same, showing vessels and pigment cells. S. $\frac{1}{4}$.
Fig. 3. Part of mantle, showing muscle fibres and pigment cells. S. $\frac{1}{4}$.
Fig. 4. Part of branchial sac of same form. S. 1.
Fig. 5. Colony of *Botrylloides leptum*, nat. size.
Fig. 6. Part of very young Ascidiozooid occurring in a section and showing the ova, and the young longitudinal bars of the branchial sac. S. $\frac{1}{6}$.
Fig. 7. Section of the edge of the test. S. $\frac{1}{4}$.
Fig. 8. Section of another part of the test. S. $\frac{1}{4}$.
Fig. 9. Ventral edge of branchial sac, showing endostyle.
Fig. 10. Another part of branchial sac, near dorsal lamina.
Fig. 11. Alimentary canal of same species.
Fig. 12. Branchial siphon from the inside, showing the 4 large and 4 small tentacles and the dorsal tubercle, &c. S. $\frac{1}{6}$.
Fig. 13. Longitudinal section through stomach showing the folds. S. $\frac{1}{6}$.

Plate Bot. II.

Fig. 1. Colony of *Sarcobotrylloides jacksonianum*, n. sp.
Fig. 2. A common cloacal aperture from same colony. S. $\frac{1}{4}$.
Fig. 3. Section of test.

Fig. 4. Small part of section of test, highly magnified, showing the ova and young buds in the vessels. S. $\frac{1}{6}$.
Fig. 5. Young buds in vessels of test. S. $\frac{1}{6}$.
Fig. 6. Part of the branchial sac, from endostyle to dorsal lamina. S. 1.
Fig. 7. Ascidiozooid from left side.
Fig. 8. Branchial siphon from inside, to show tentacles.
Fig. 9. Colony of *Sarcobotrylloides anceps*, n. sp., adhering to colonies of Polyzoa.
Fig. 10. Part of the branchial sac and interior of branchial siphon. S. 1.
Fig. 11. Part of mantle, to show masses of purple pigment cells.
Fig. 12. Part of section of test.
Fig. 13. Alimentary canal. S. $\frac{1}{4}$.

Plate Bot. III.

Fig. 1. Colony of *Sarcobotrylloides pannosum*, n. sp., less than nat. size.
Fig. 2. Ascidiozooids of same, with alimentary canal showing through.
Fig. 3. Part of the branchial sac near the dorsal edge, showing irregular stigmata.
Fig. 4. More regular part of the branchial sac.
Fig. 5. Branchial siphon, &c., from the inside.
Fig. 6. Stomach in surface view, showing caecum and folds, in *Sarcobotrylloides purpureum*.
Fig. 7. Stomach of the same in oblique section, showing folds.
Fig. 8. Colony of *Sarcobotrylloides purpureum*, nat. size.
Fig. 9. Part of a section showing the vessels near the surface of the test. S. 1.
Fig. 10. Colony of *Sarcobotrylloides purpureum*, nat. size.

THE END.

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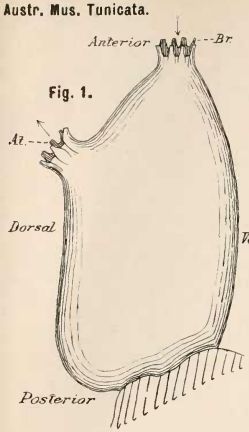

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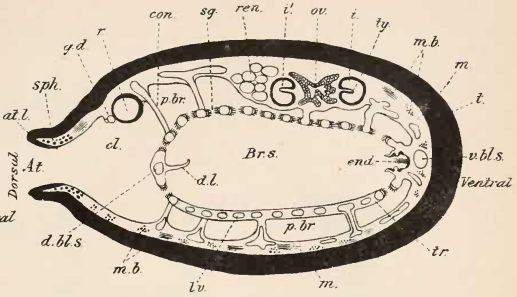

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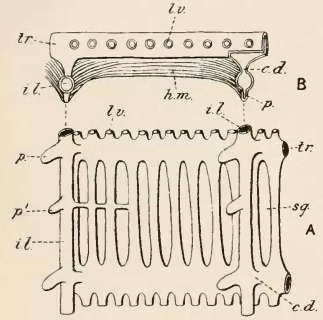

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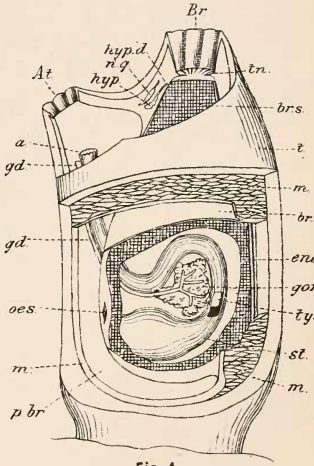

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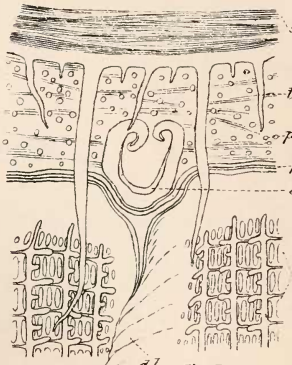

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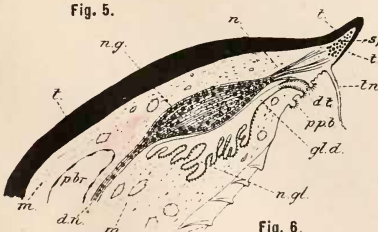


Fig. 6.

W.A.H. del.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

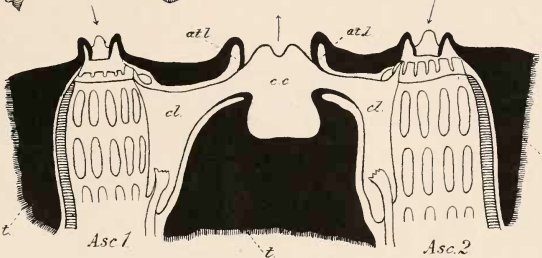
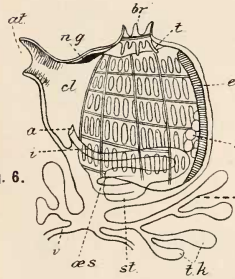
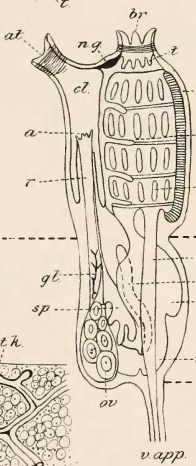


Fig. 6.





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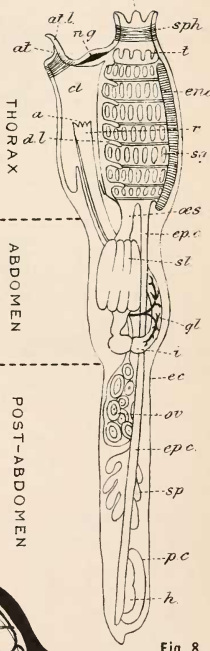

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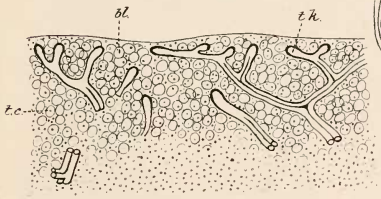

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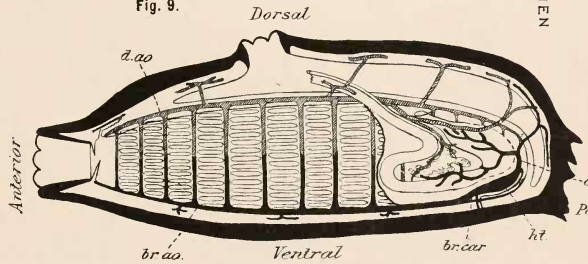


Fig. 10.

THORAX

ABDOMEN

POST-ABDOMEN

W.A.H. del.

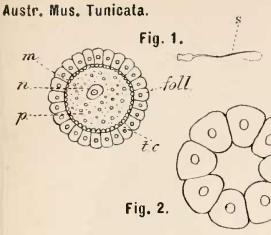
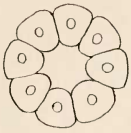


Fig. 1.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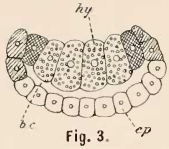

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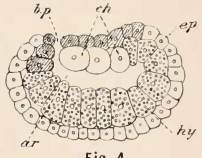

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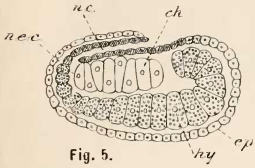

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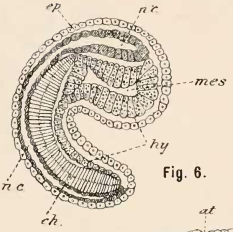

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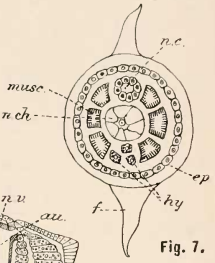

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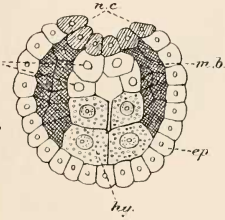

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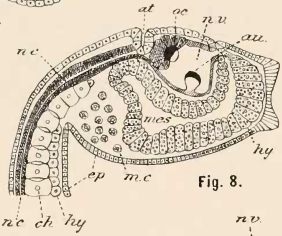

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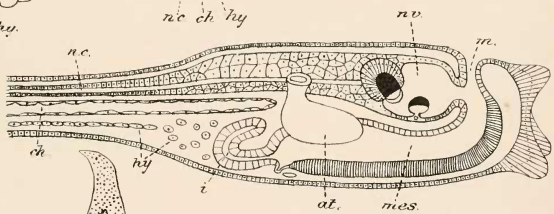
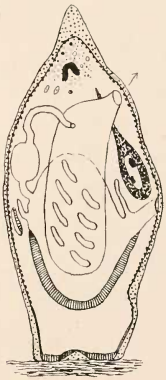


Fig. 9.


Fig. 10.


Fig. 11.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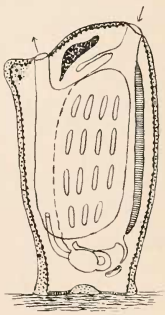


Fig. 13.

W.A.H. del.

Fig. 1.

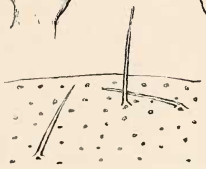
Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.



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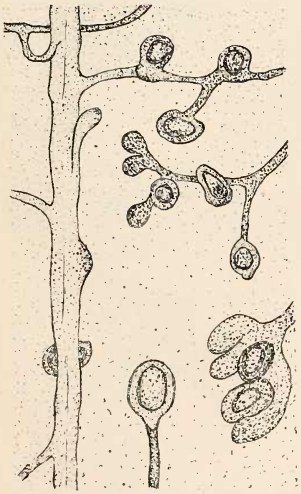

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Fig. 8.

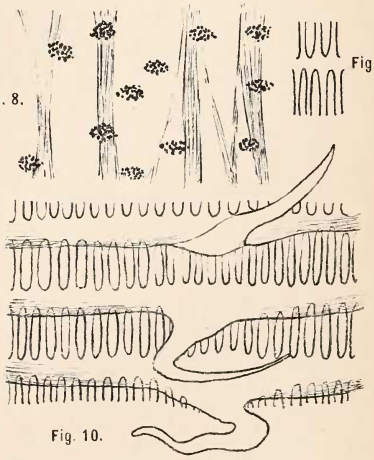


Fig. 9.

Fig. 10.

W.A.H. del.

STEREOCLAVELLA AUSTRALIS.

Fig. 1.

Fig. 2.

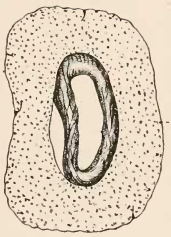


Fig. 3.

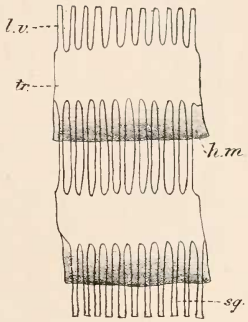


Fig. 4.

Fig. 5.

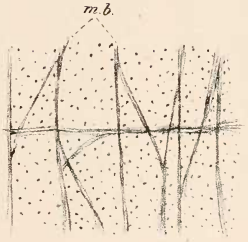
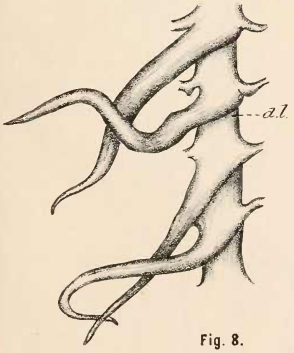


Fig. 6



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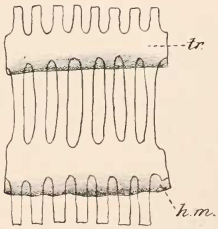


Fig. 7.

W.A.H. del.

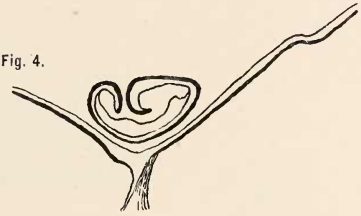
PODOCLAVELLA MERIDIONALIS, Herdm.
STEREOCLAVELLA SP.

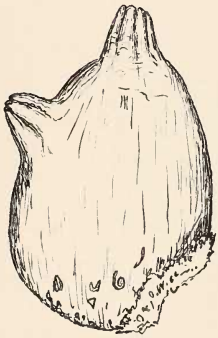
Fig. 1

Fig 2

Fig. 3.

Fig. 4.





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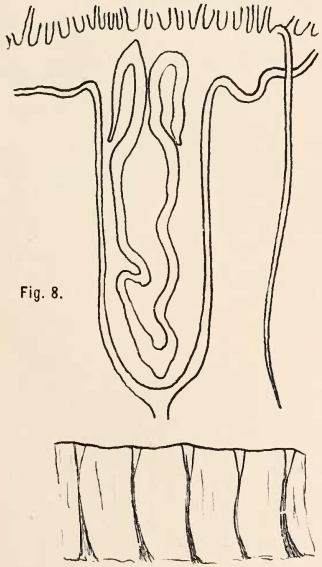

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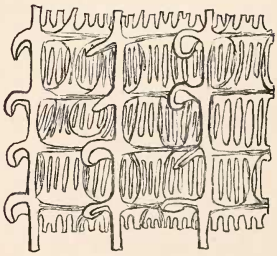
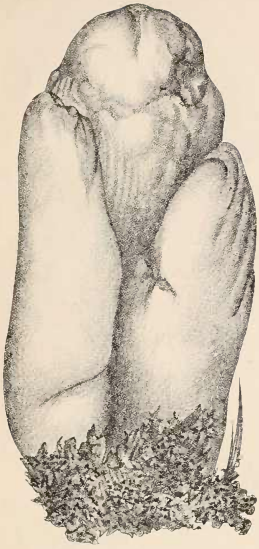


Fig. 6

Fig. 7.

W.A.H. del.

CIONA AND ASCIDIA



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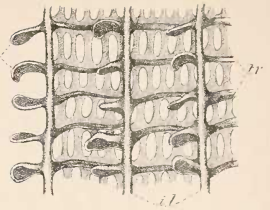

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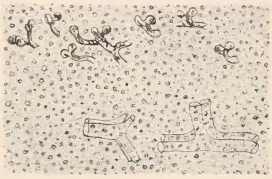


Fig. 3.

Fig. 4.

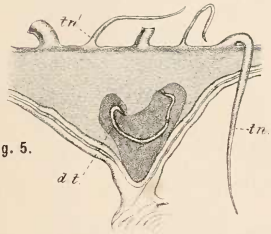
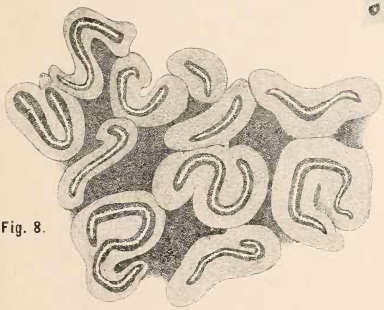


Fig. 5.

Fig. 7.

Fig. 6

Fig. 9.



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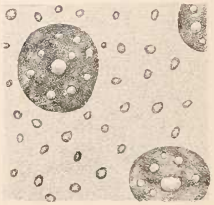


Fig. 10.

W.A.H. del.

ASCIDIA PHALLUSIOIDES, n. sp.

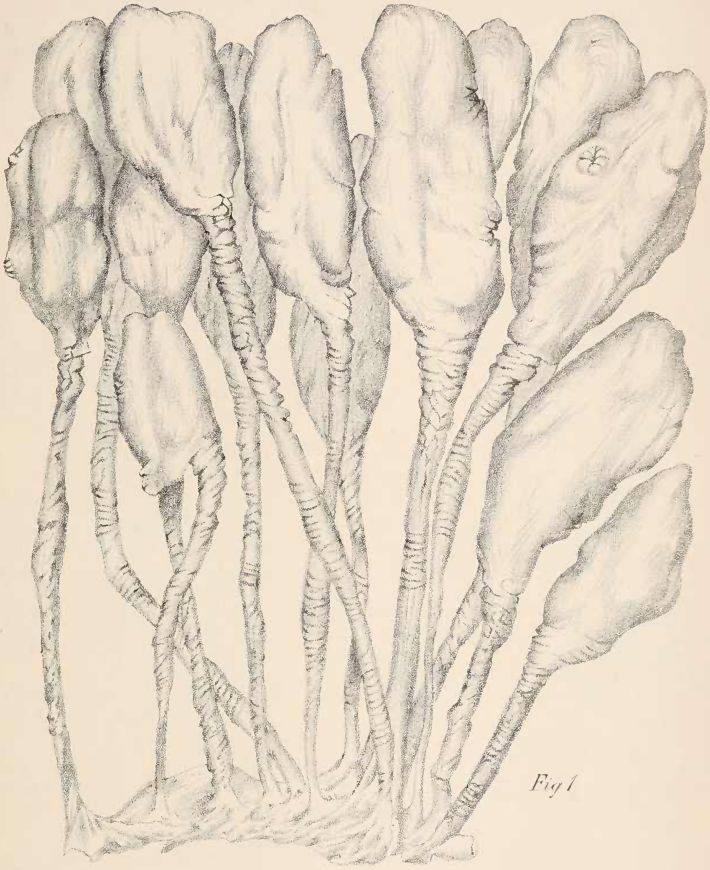


Fig 1

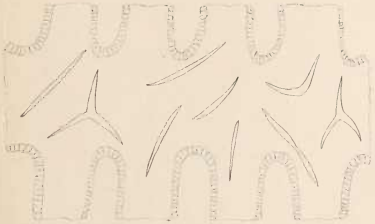


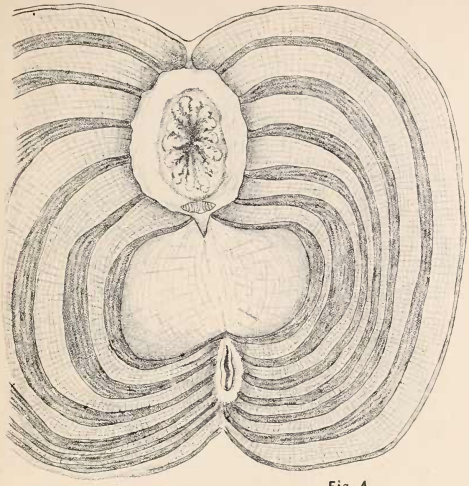
Fig 2

Fig 3.

Fig 4

W.A.H.del. S.B.sc.

BOLTENIA PACHYDERMATINA. Herdm.



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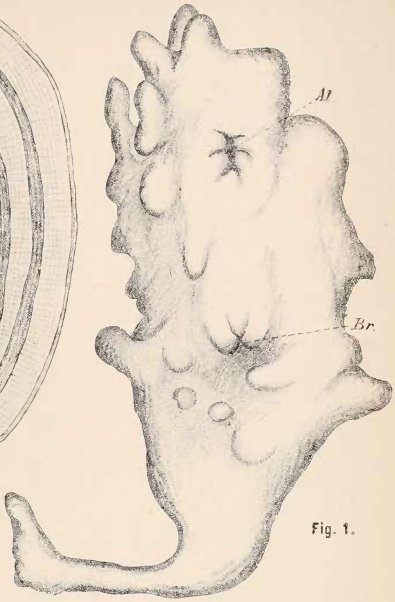

Fig. 1.

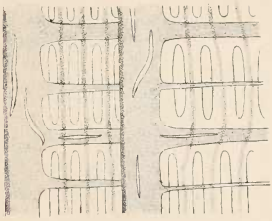

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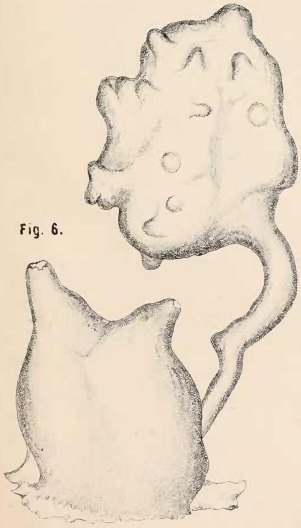
Fig. 2.

Fig. 3.



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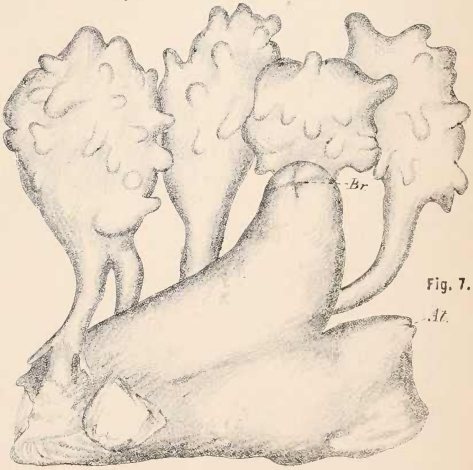


Fig. 7.

W.A.H. del.

BOLTENIA TUBERCULATA, Herdm.

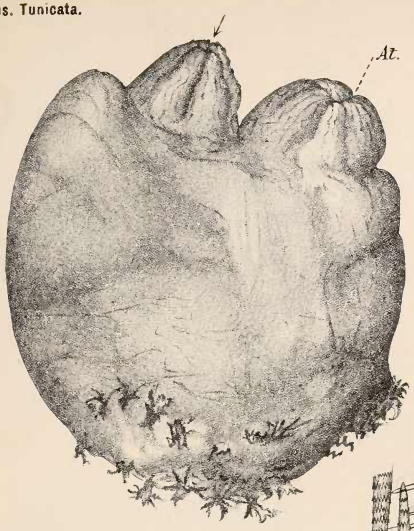
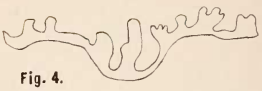


Fig. 1.



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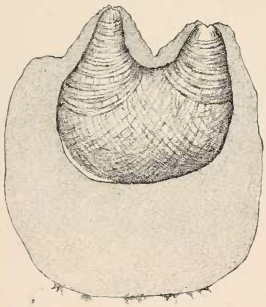

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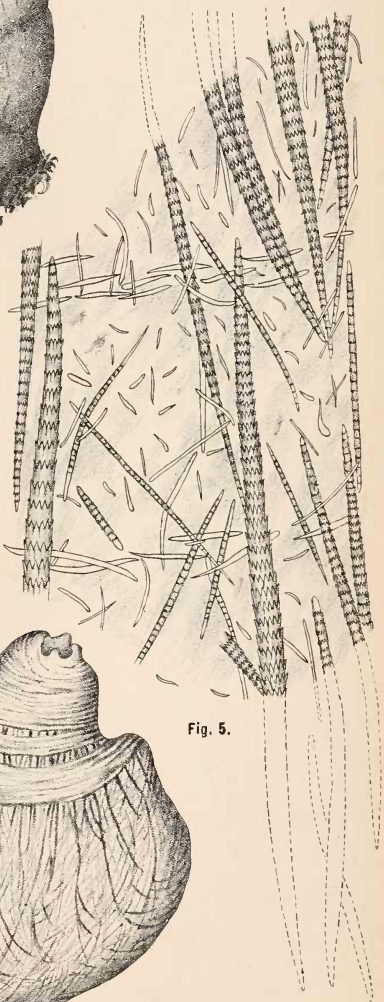

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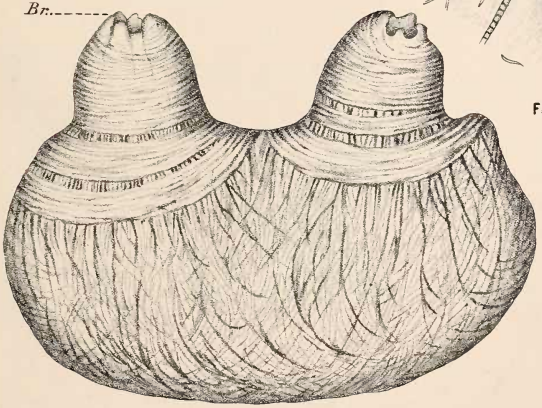


Fig. 3.

W.A.H. del.

MICROCOSMUS DRASCHII, Herdm.

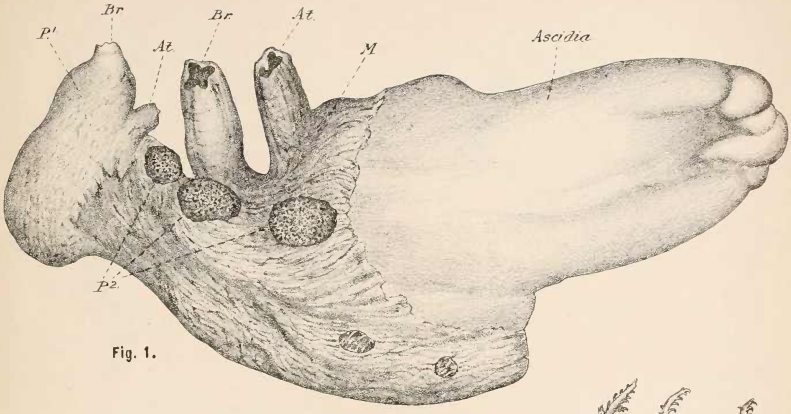
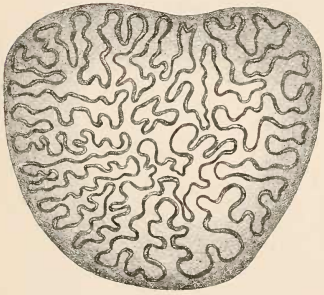


Fig. 1.



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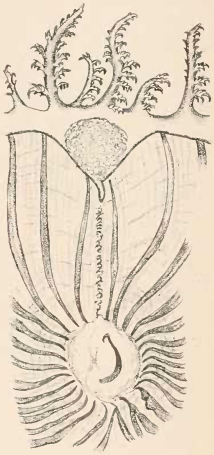

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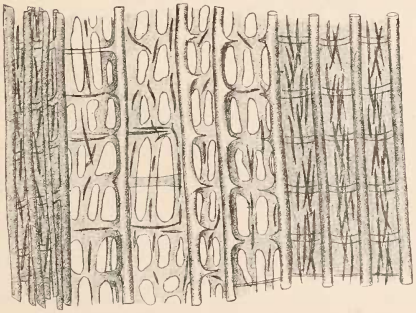

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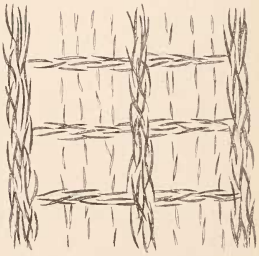

Fig. 3.

W.A.H. del.

MICROCOSMUS DRASCHII, Herdm.

Fig. 1.

Fig. 2.

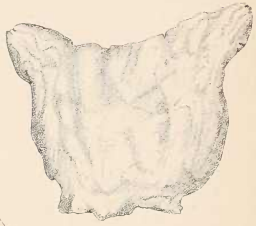

Fig. 3.

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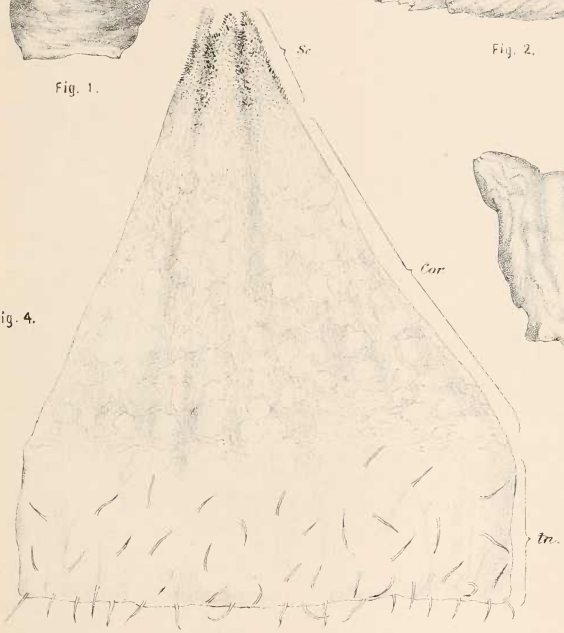

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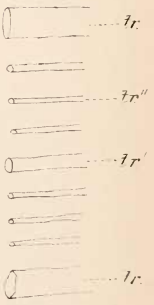


Fig. 6.

W.A.H. del.

MICROCOSMUS AUSTRALIS, n. sp.

Fig. 1.

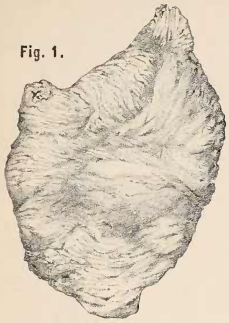


Fig. 2.

Fig. 3.

Fig. 8.

Fig. 6

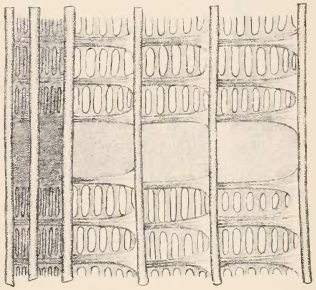


Fig. 4.

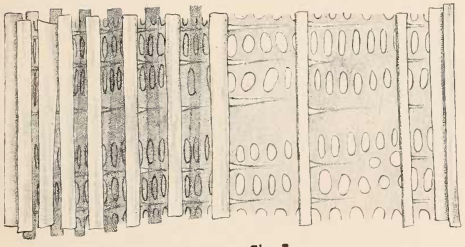
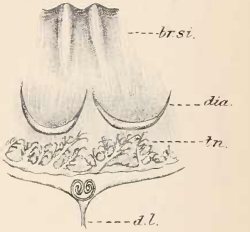


Fig. 7.



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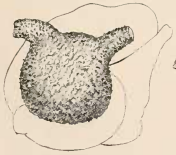


Fig. 9.

Fig. 10.

Fig. 11.

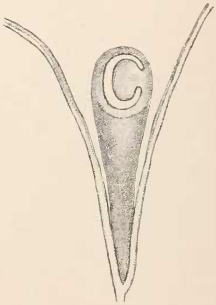
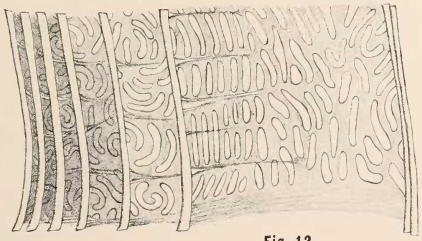


Fig. 13.



W.A.H del.

Fig. 12.

Figs. 1-5.—MICROCOSMUS RAMSAYI, n. sp.

Figs. 6-8.—MICROCOSMUS AFFINIS, Heller.

Figs. 9-13.—MOLGULA RECUMBENS, n. sp.

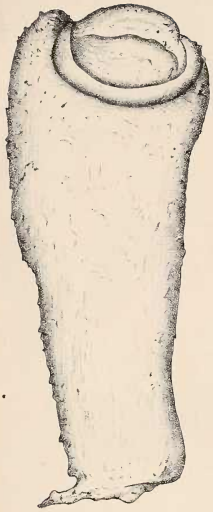


Fig. 1.

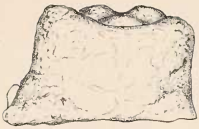


Fig. 2.

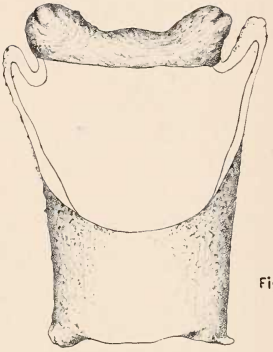


Fig. 3.

Fig. 8.

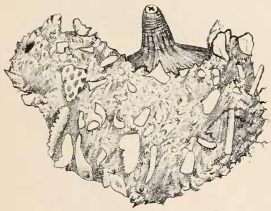


Fig. 4.

Fig. 9.

Fig. 5.

Fig. 10.

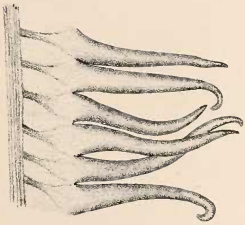


Fig. 7.

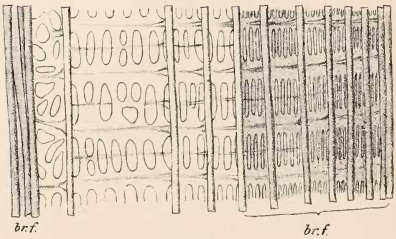


Fig. 6.

W.A.H del.

Figs. 1-3—CYNTHIA PRÆPUTIALIS, Heller.
Figs. 4-10—CYNTHIA MOLGULOIDES, n. sp.

Fig. 1.

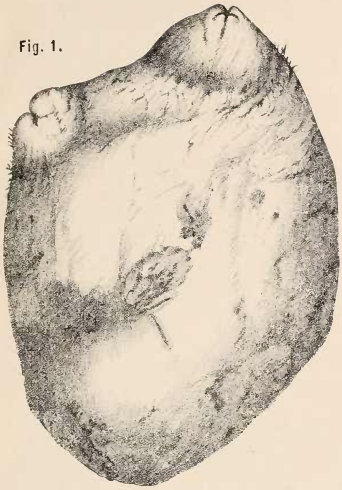


Fig. 2.

Fig. 3.

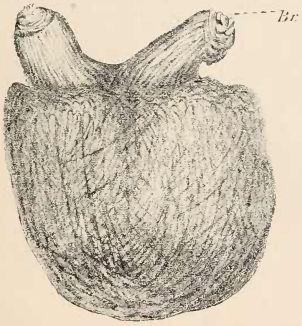


Fig. 5.

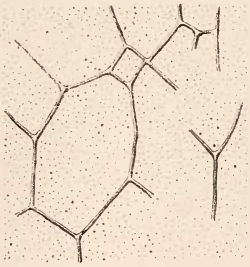


Fig. 4.

Fig. 7.

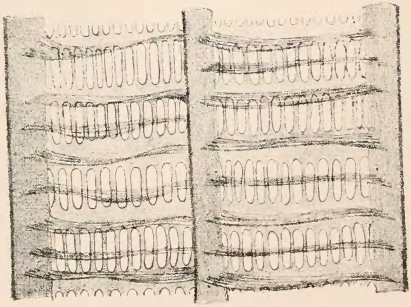


Fig. 6.

W.A.H. del.

CYNTHIA SOLANOIDES, n. sp.

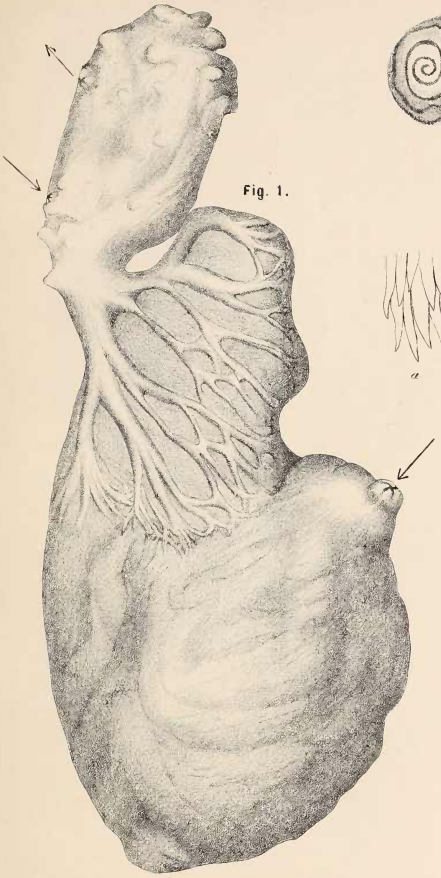


Fig. 1.

Fig. 3.

Fig. 4

Fig. 5.

Fig 6.

Fig. 7.

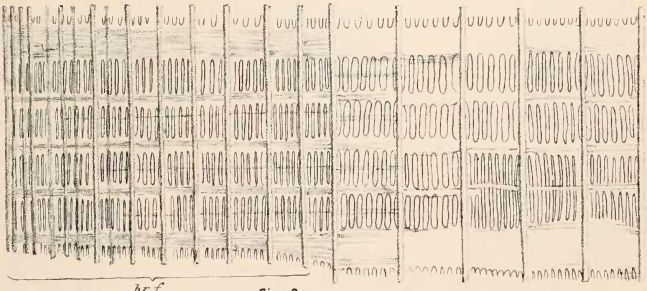


Fig. 2.

W.A.H. del.

Figs. 1–5. CYNTHIA MULTIRADICATA, n. sp.

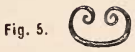
Figs 6–7. CYNTHIA CRINITISTELLATA, n. sp.

Fig 1.

Fig. 3.

Fig. 2.

Fig. 6



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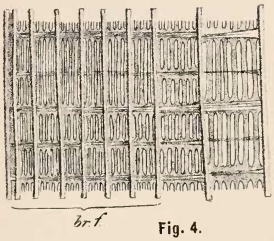


Fig. 4.

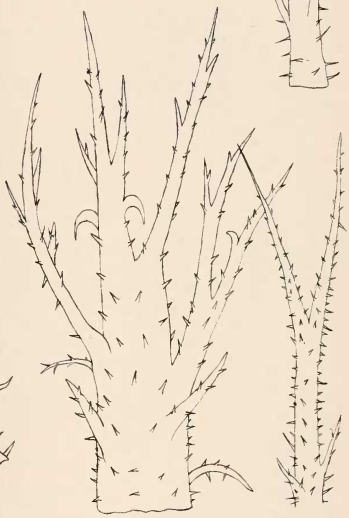


Fig. 8.

Fig. 7.

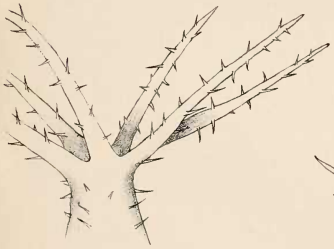


Fig. 10.

Fig. 9.

Fig. 13.

Fig. 12.

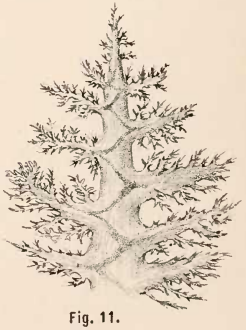


Fig. 11.

W.A.H. del.

CYNTHIA SPINIFERA, n. sp.

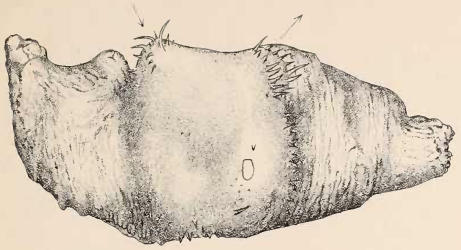


Fig. 1.

Fig. 2.

Fig. 6

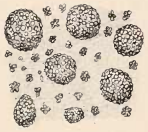


Fig. 3.

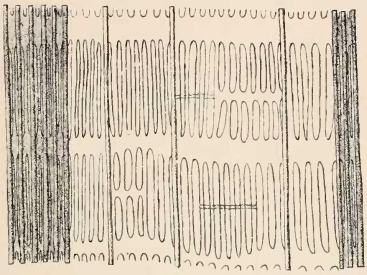
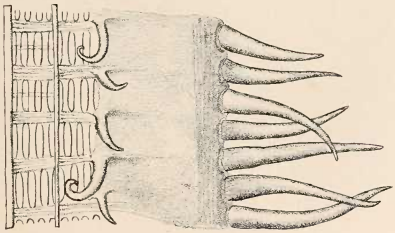


Fig. 5.

Fig. 4.



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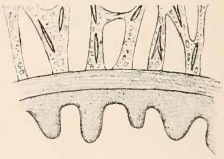
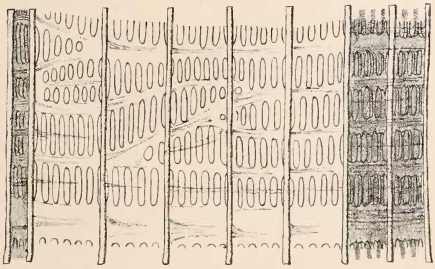


Fig. 7.



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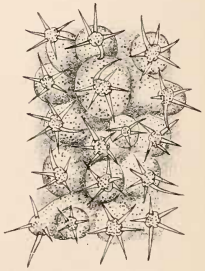


Fig. 10.

W.A.H del.

Figs. 1-7—CYNTHIA CATAPHRACTA, n. sp.
Figs. 8-10—CYNTHIA CRINITISTELLATA, n. sp.

Fig. 3.

Fig. 2.

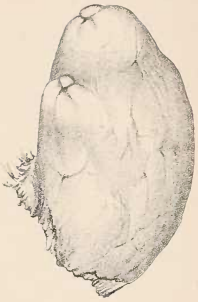


Fig. 1.

Fig. 4.

Fig. 9.

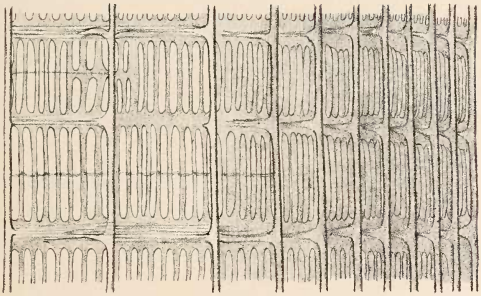


Fig. 5.

Fig. 10.

Fig. 6.

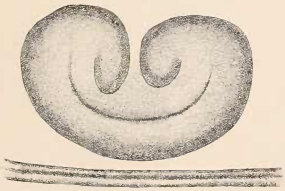


Fig. 7.

Fig. 8.

W.A.H. del.

STYELA PINGUIS, n. sp.

Fig. 6.

Fig. 5.

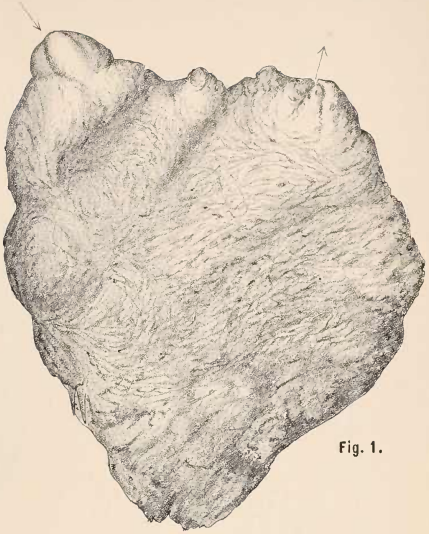
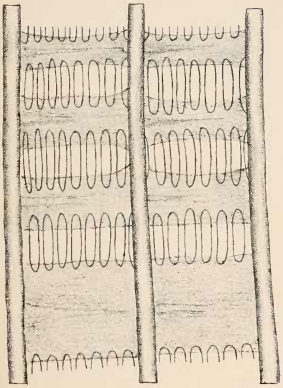


Fig. 1.



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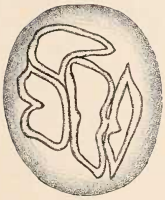
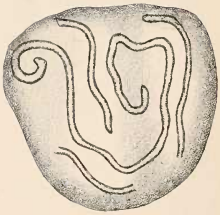


Fig. 3.



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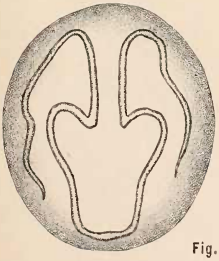


Fig. 7.

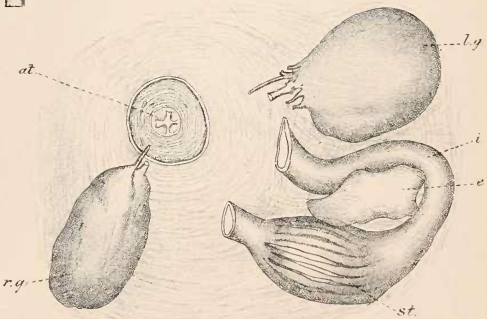


Fig. 8.

W.A.H. del.

STYELA ETHERIDGII, n. sp.

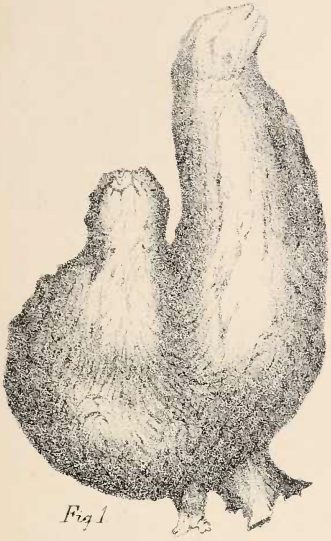


Fig 1

Fig 2

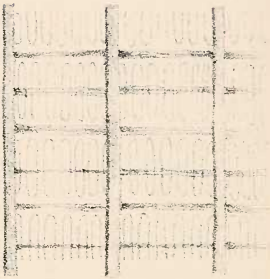


Fig 3.

Fig 4

Fig 5

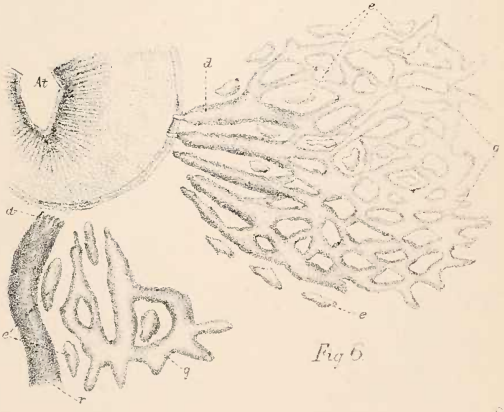


Fig 6

W.A.H. del

STYELA WHITELEGGII, n. sp.

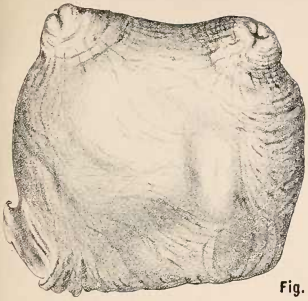
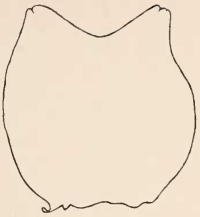


Fig. 1.



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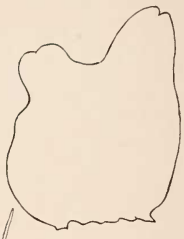
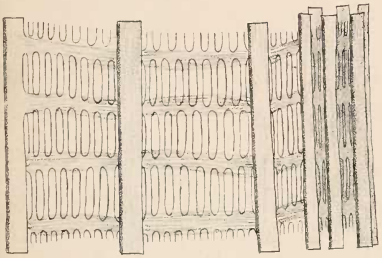


Fig. 3.



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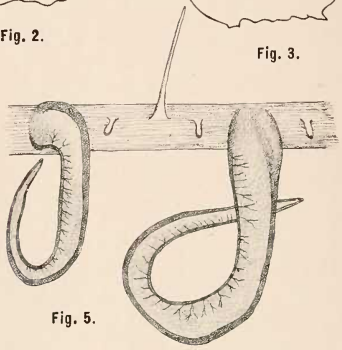


Fig. 5.

Fig. 6.

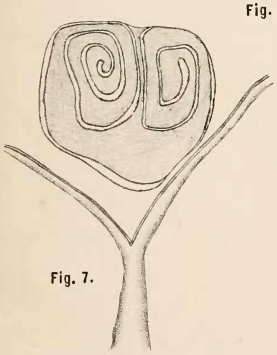
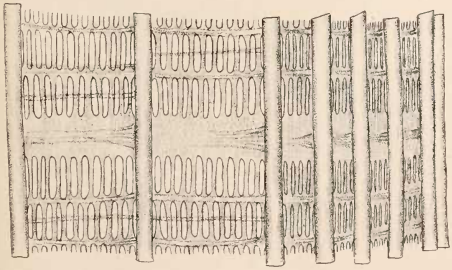


Fig. 7.

Fig. 9.

Fig. 10.

Fig. 11.



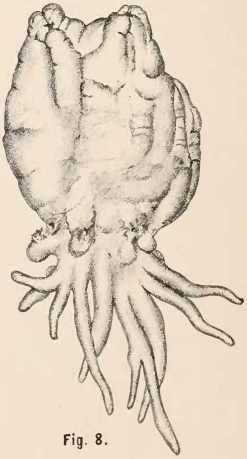


Fig. 8.

W.A.H del.

Figs. 1-7.—STYELA PERSONATA, n. sp.
Figs. 8-11.—STYELA STOLONIFERA, n. sp.

Fig. 1

Fig. 2.

Fig. 3.

Fig. 4.

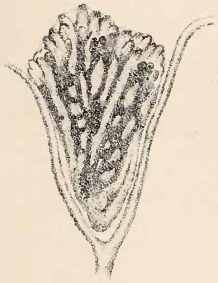
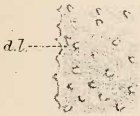


Fig. 10

Fig. 5.



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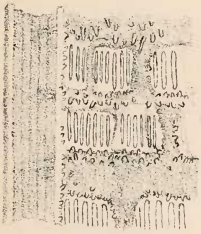


Fig. 6.

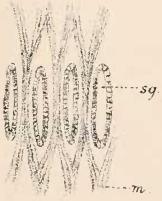


Fig. 7

Fig. 8.

W.A.H. del. S.B.sc

POLYCARPA FUNGIFORMIS, n. sp

Fig. 1.

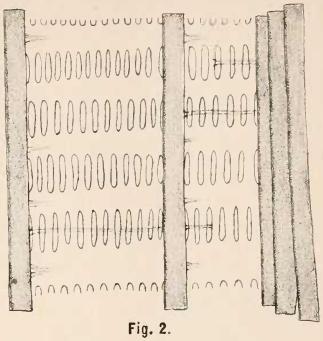


Fig. 2.

Fig. 3.

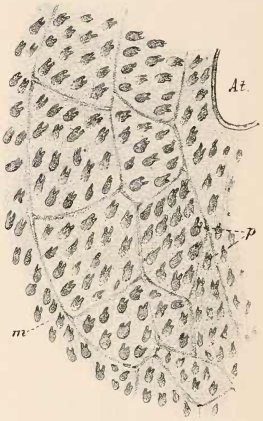


Fig. 5.

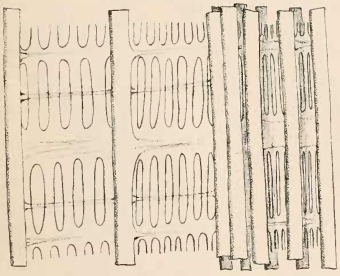


Fig. 6.

Fig. 7.

Fig. 8.

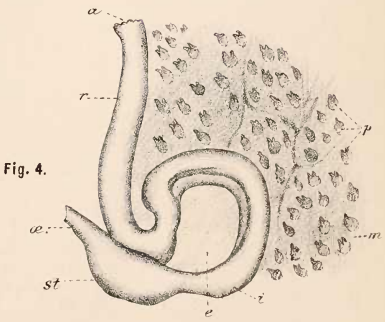
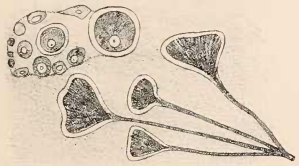


Fig. 4.

Fig. 9.



W.A.H del.

Figs. 1-5—POLYCARPA STEPHENENSIS, n. sp.
Figs. 6-9.—POLYCARPA SLUITERI, n. sp.

Fig. 2.

Fig. 3.

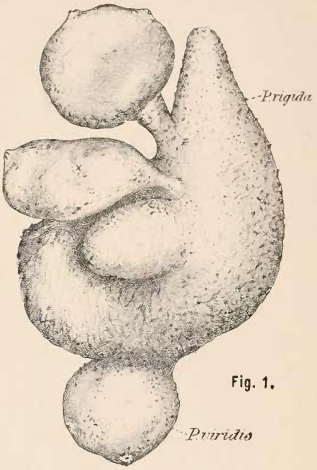


Fig. 1.

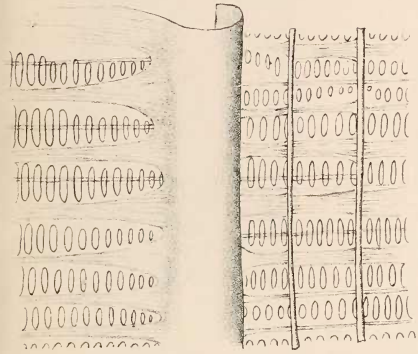


Fig. 4.

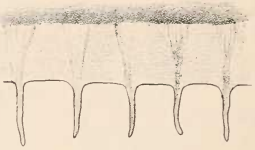
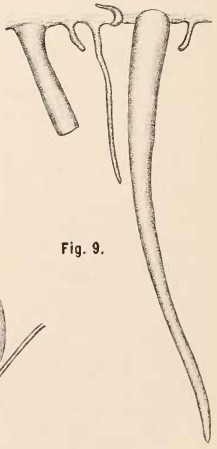


Fig. 10.

Fig. 7.

Fig. 5.



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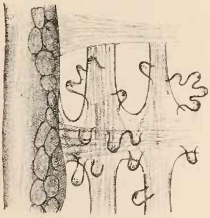

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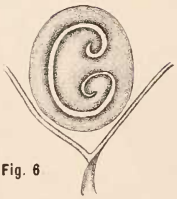


Fig. 6

W.A.H del.

Figs. 1-4.—POLYCARPA RIGIDA, Herdm.
Figs. 5-10.—POLYCARPA VIRIDIS, Herdm.

Fig. 1.

Fig. 3.

Fig. 4.

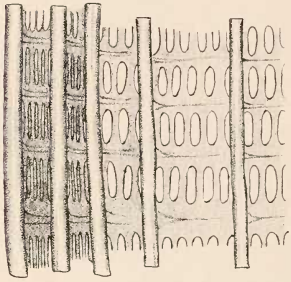


Fig. 9.

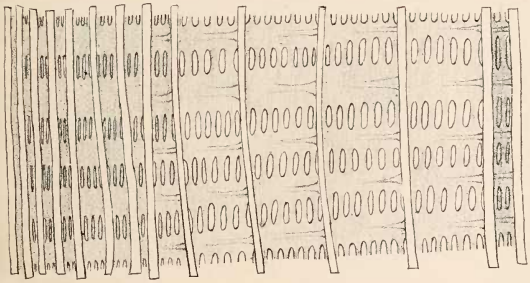


Fig. 2.

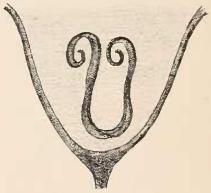


Fig. 8.

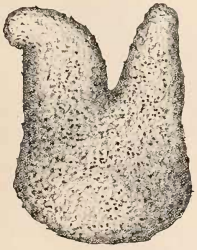


Fig. 5.

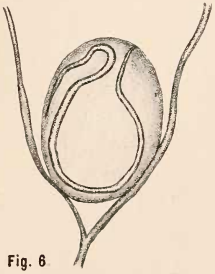


Fig. 6.

Fig. 7.

W.A.H del.

Figs. 1-4—POLYCARPA SACCIFORMIS, n. sp.
Figs. 5, 6.—POLYCARPA LONGISIPHONICA, Herdm.
Figs. 7-9.—POLYCARPA JACKSONIANA, n. sp.

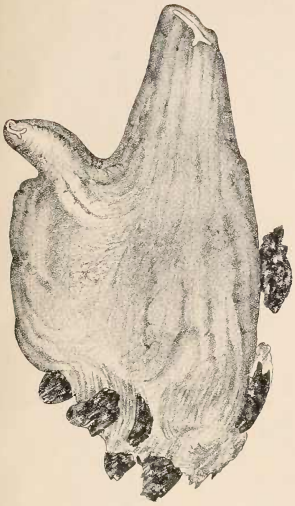


Fig. 1.

Fig. 3.

Fig. 2.

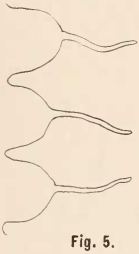
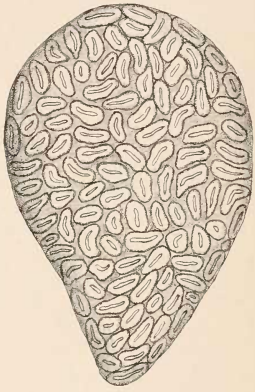


Fig. 5.



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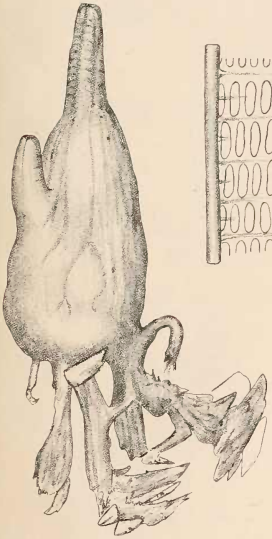

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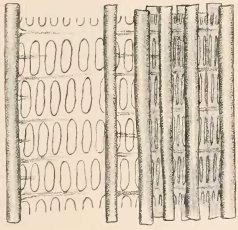


Fig. 7.

Fig. 9.

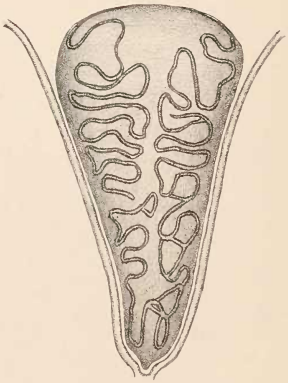


Fig. 8.

W.A.H del.

Figs. 1-5—POLYCARPA AURATA, var. plana.
Figs. 6-8.—POLYCARPA ATTOLLENS, n. sp.
Fig. 9.—POLYCARPA TINCTOR; Q. & G.

Fig. 1.

Fig. 2.

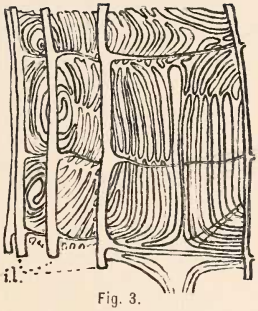


Fig. 3.

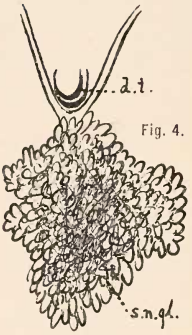


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

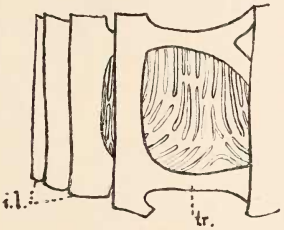


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

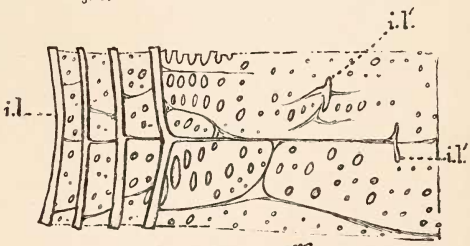


Fig. 12.

Fig. 13.

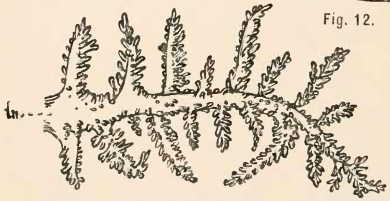


Fig. 14.

A.H. del.

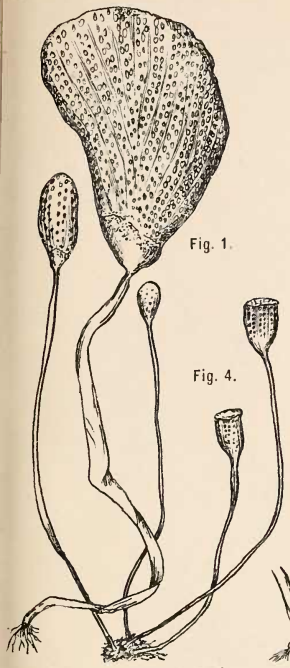


Fig. 1.

Fig. 4.

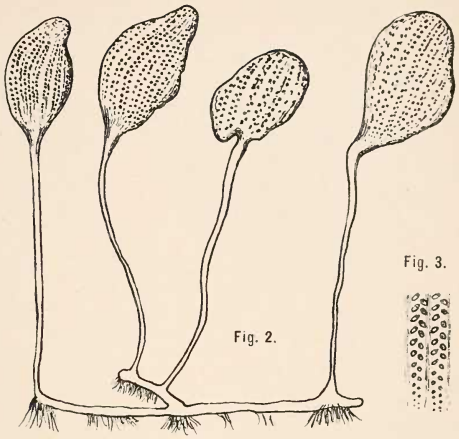


Fig. 2.

Fig. 3.

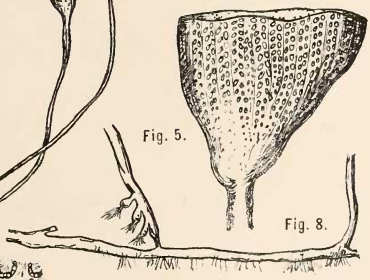


Fig. 5.

Fig. 8.

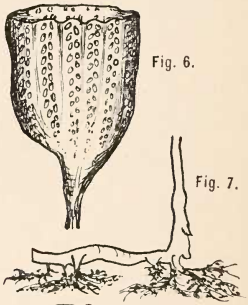


Fig. 6.

Fig. 7.

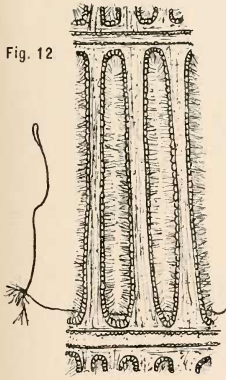


Fig. 12

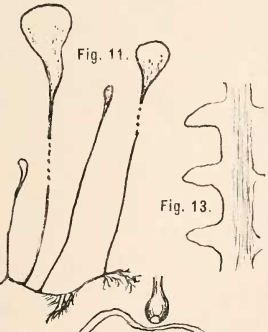


Fig. 11.

Fig. 13.

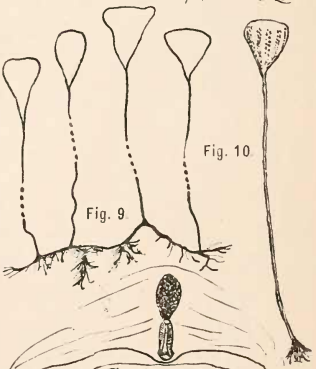


Fig. 9.

Fig. 10.

Fig. 14.

W.A.H. del.

Fig. 15.

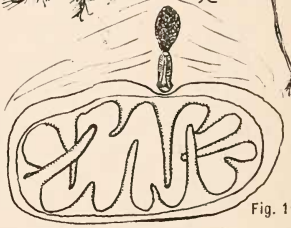
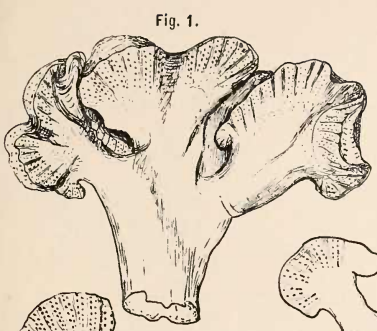
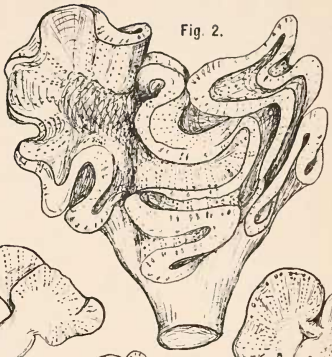
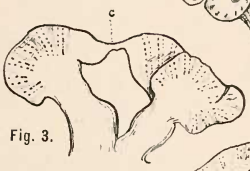


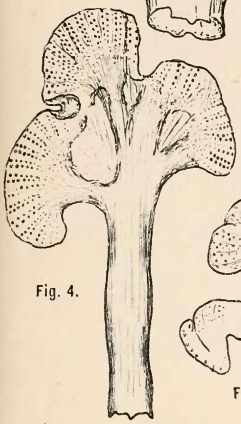
Fig. 16.

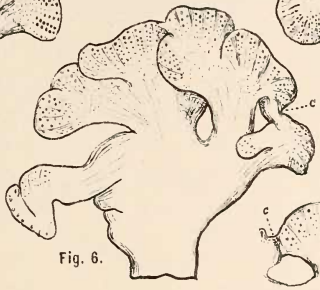
COLELLA.

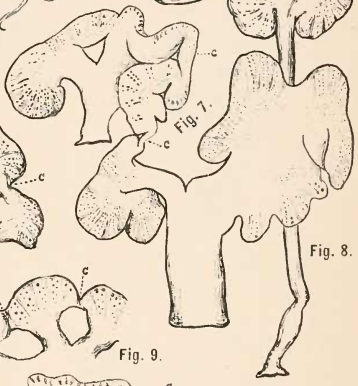


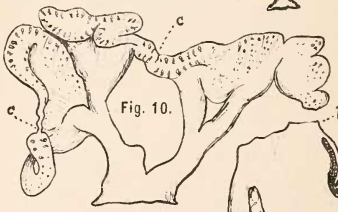


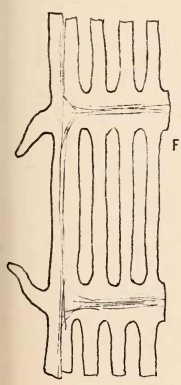


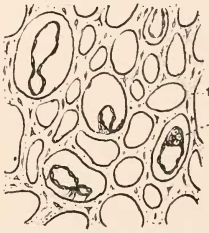


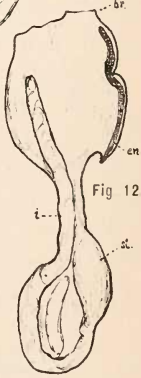












W.A.H. del.

COLELLA PLICATA, n. sp.

Fig. 4.

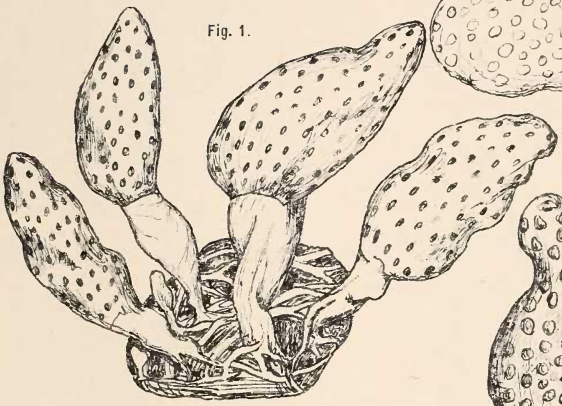


Fig. 1.

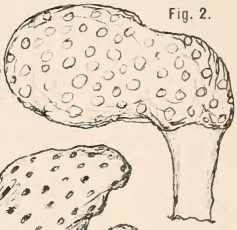
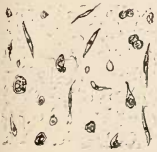


Fig. 2.

Fig. 3.



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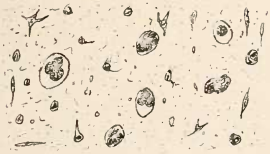

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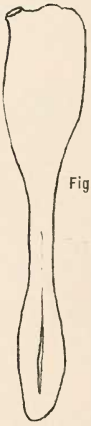


Fig. 7.

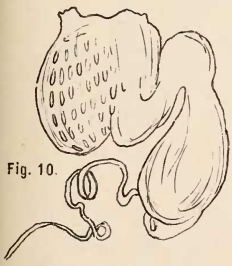


Fig. 10.

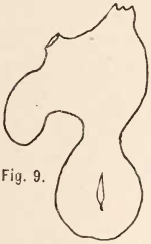
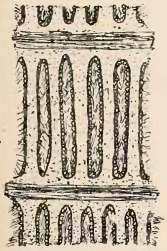


Fig. 9.

Fig. 8.



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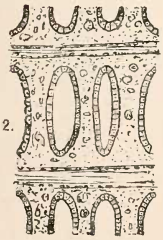


Fig. 12.

Fig. 13.

Fig. 14.

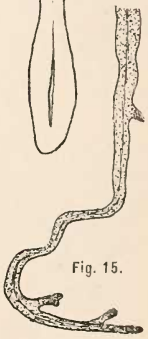


Fig. 15.

A.H. del.

COLELLA CLAVIFORMIS, n. sp.

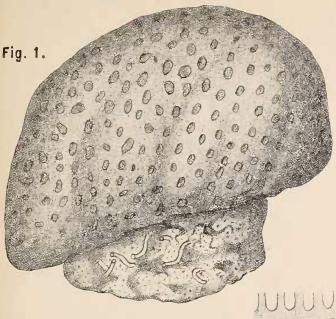


Fig. 1.


Fig. 2.

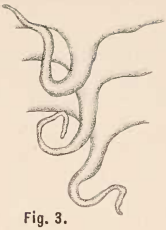


Fig. 3.

Fig. 4.

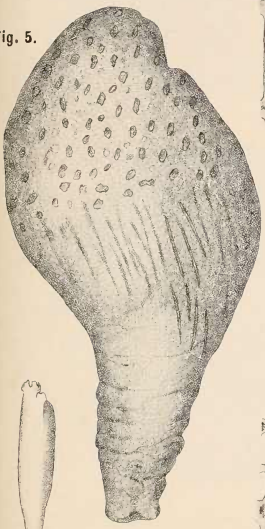


Fig. 5.

Fig. 10.


Fig. 7.

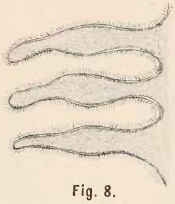


Fig. 8.


Fig. 12.

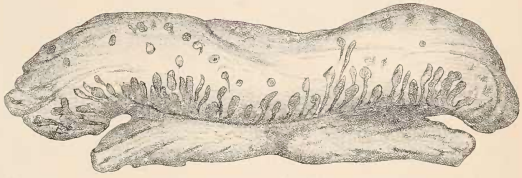


Fig. 9.


Fig. 15.


Fig. 6

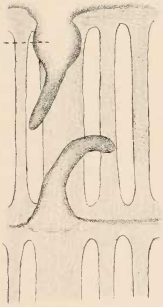


Fig. 16.


Fig. 14.


Fig. 11.


Fig. 13.

W.A.H. del.

Figs. 1-4 – AMAROUCIUM ROTUNDATUM, n. sp.
Figs. 5-8 – POLYCLINUM CLAVA, n. sp.
Figs. 9-12 – POLYCLINUM DEPRESSUM, n. sp.
Figs. 13-16 – (?) POLYCLINUM NIGRUM, n. sp.

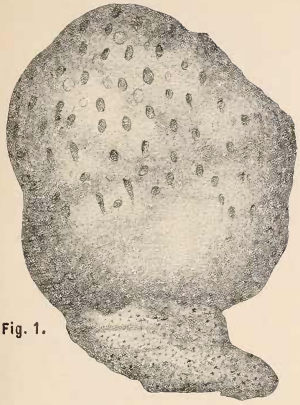


Fig. 1.

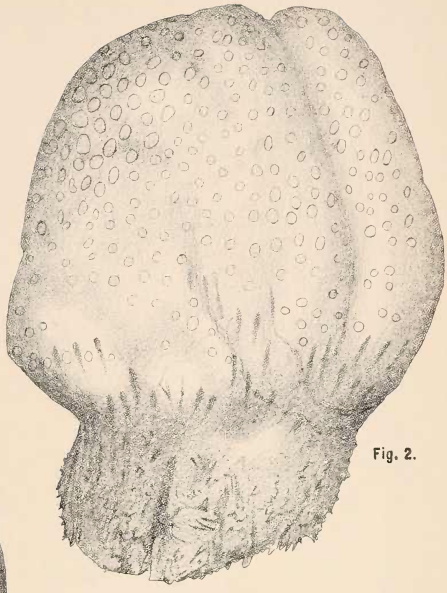


Fig. 2.

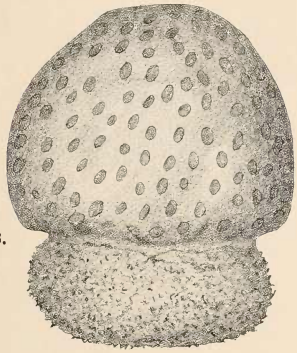


Fig. 3.

Fig. 5.

Fig. 6

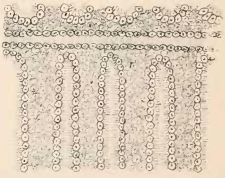


Fig. 7.

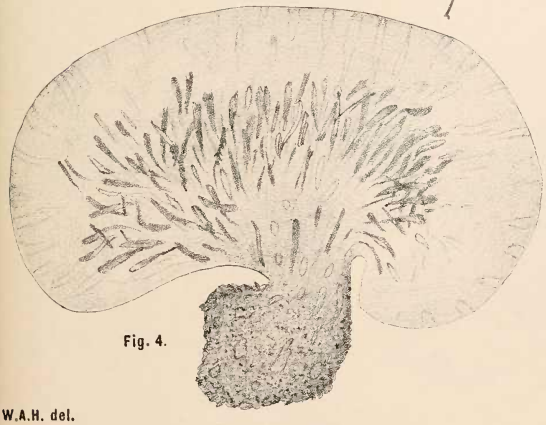


Fig. 4.

Fig. 8.

W.A.H. del.

Figs. 1-2 -POLYCLINUM GIGANTEUM, n. sp.
Figs. 3-8 -POLYCLINUM GLOBOSUM, n. sp.

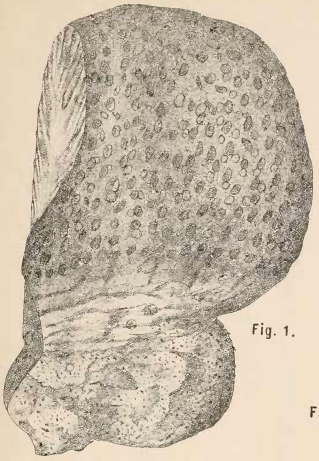


Fig. 1.

Fig. 2.

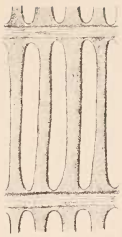


Fig. 4.

Fig. 5.

Fig. 6

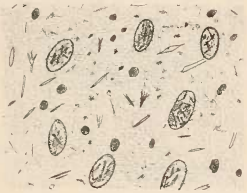


Fig. 3.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 11.

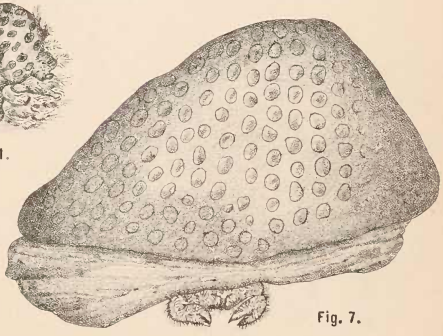


Fig. 7.

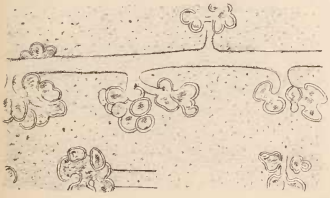


Fig. 16.

W.A.H. del.

Figs. 1-6—POLYCLINUM FUSCUM, n. sp.
Figs. 7-10—AMAROUCIUM PROTECTANS, n. sp.
Figs. 11-16—AMAROUCIUM ANOMALUM, n. sp.

Fig. 1.

Fig. 2.

Fig. 3.

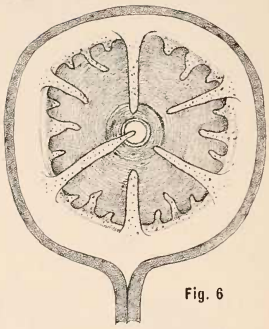


Fig. 6

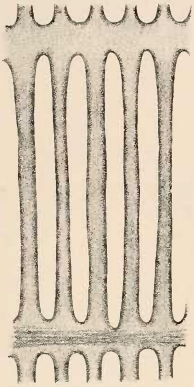


Fig. 4.

Fig. 5.

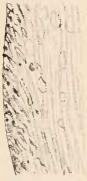


Fig. 8.

Fig. 11.

Fig. 7.

Fig. 10.

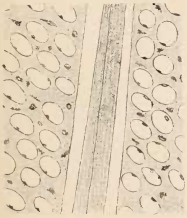


Fig. 9.

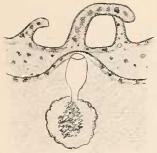


Fig. 13.

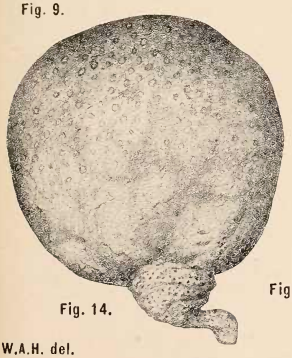


Fig. 14.

Fig. 15.

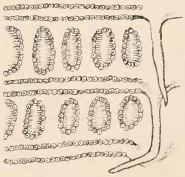


Fig. 16.

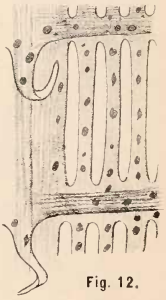


Fig. 12.

W.A.H. del.

Figs. 1-6—COLELLA CYANEA, n. sp.
Figs. 7-13—AMAROUCIUM DISTOMOIDES, n. sp.
Figs. 14-16—POLYCLINUM PRUNUM, n. sp.

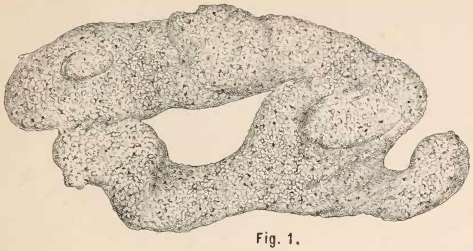


Fig. 1.

Fig. 2.

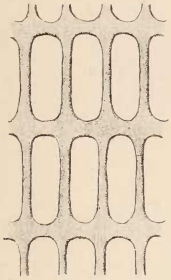


Fig. 5.

Fig. 4.

Fig. 3.

Fig. 6

Fig. 9.

Fig. 10.

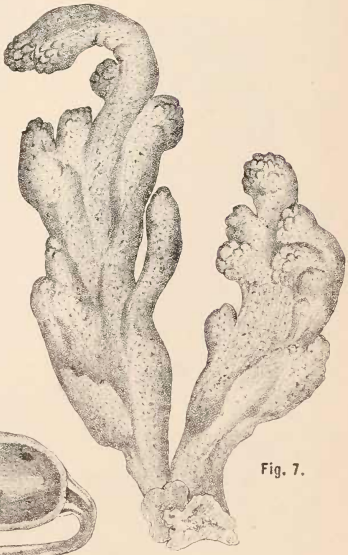


Fig. 7.

Fig. 8.

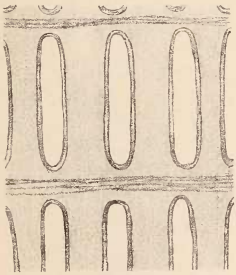


Fig. 11.

Fig. 12.

W.A.H. del.

Figs. 1-5—PSAMMAPLIDIUM SOLIDUM, n. sp.
Figs. 6-12—PSAMMAPLIDIUM LOBATUM, n. sp.

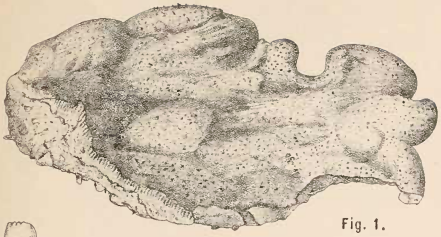


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 8.

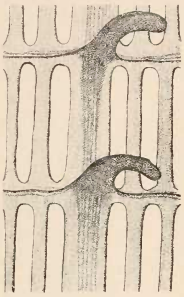


Fig. 9.

Fig. 4.

Fig. 6.

Fig. 5.

Fig. 7.

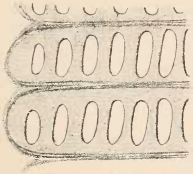


Fig. 13.

Fig. 12.

Fig. 10.

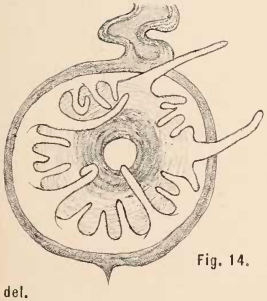


Fig. 14.

Fig. 11.

W.A.H. del.

Figs. 1-6—PSAMMAPLIDIUM INCRUSTANS, n. sp.
Figs. 7-9—PSAMMAPLIDIUM PEDUNCULATUM, n. sp.
Figs. 10-14 - PSAMMAPLIDIUM FRAGILE, n. sp.

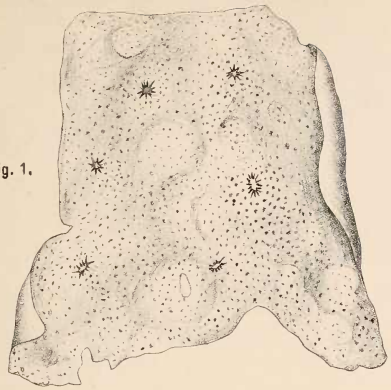


Fig. 1.

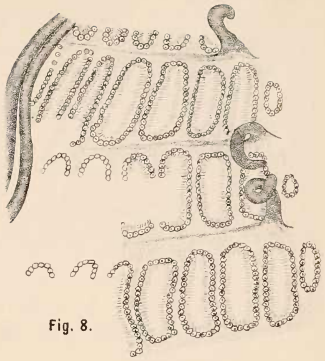


Fig. 8.

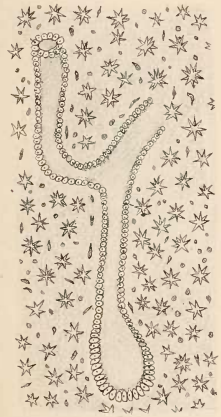


Fig. 3.

Fig. 2.

Fig. 7.

Fig. 6.

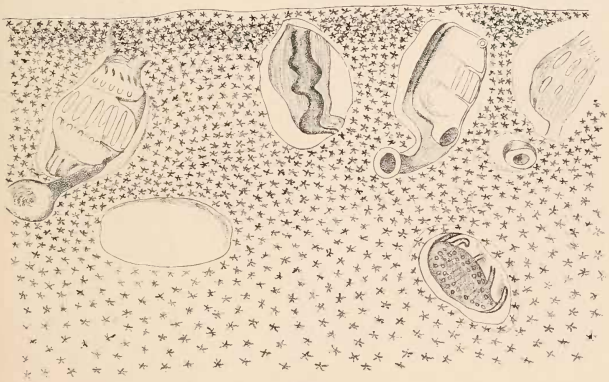


Fig. 4.

Fig. 5.

W.A.H. del.

LEPTOCLINUM FIMBRIATUM, n. sp.

Fig. 2.

Fig. 1.

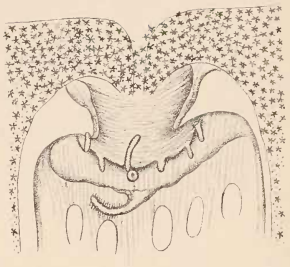


Fig. 6.

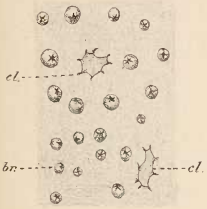


Fig. 3.

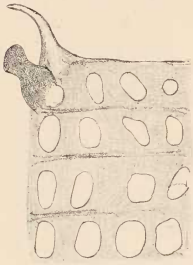


Fig. 4.

Fig. 5.

Fig. 9.

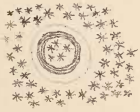


Fig. 8.

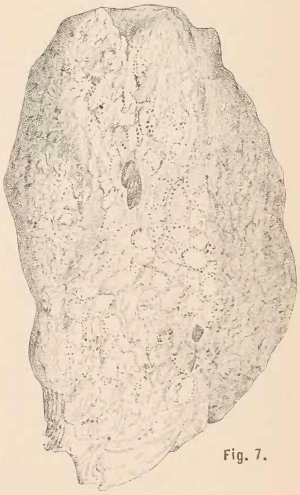


Fig. 7.

Fig. 10.

Fig. 12.

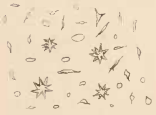


Fig. 11.

W.A.H. del.

Figs. 1-6—LEPTOCLINUM INCANUM, n. sp.
Figs. 7-12—LEPTOCLINUM PATULUM, n. sp.

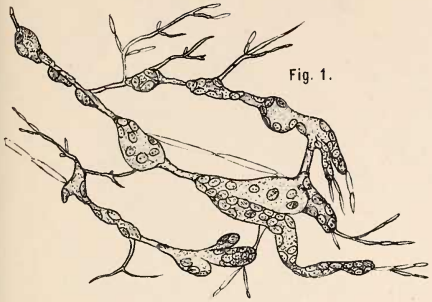


Fig. 1.

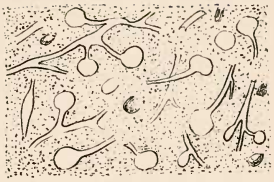


Fig. 2.

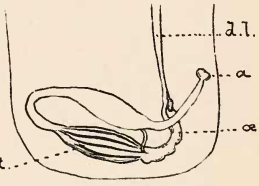


Fig. 5.

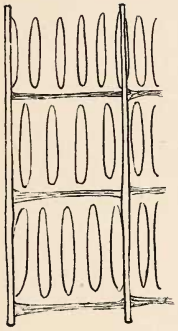
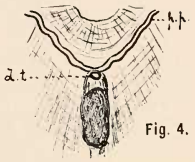


Fig. 3.



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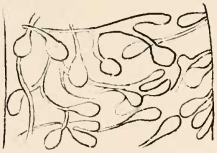
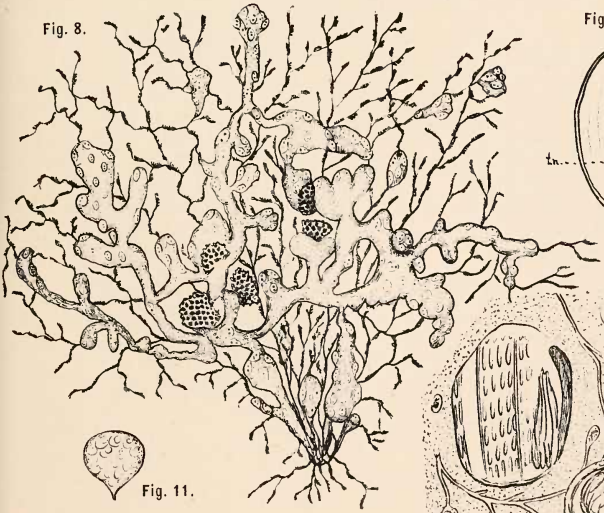


Fig. 6.

Fig. 7.



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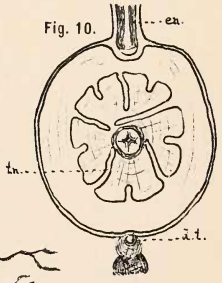

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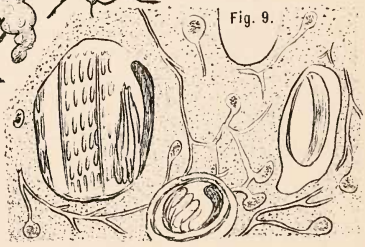
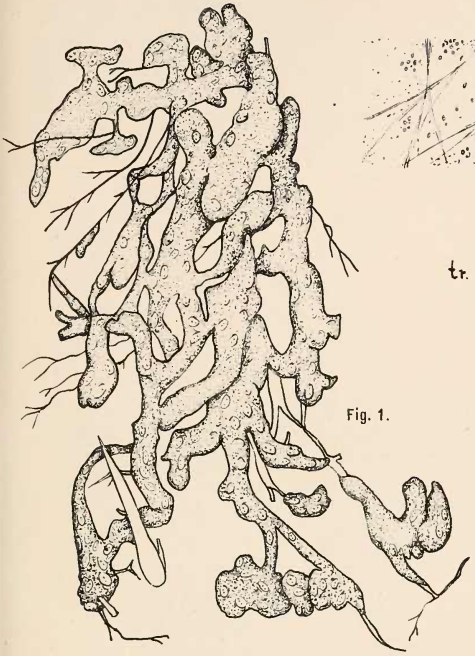


Fig. 9.

Fig. 11.

W.A.H. del.

CHORIZOCORMUS.



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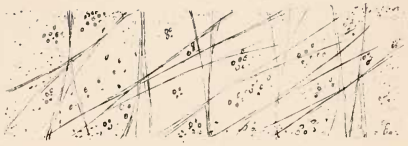

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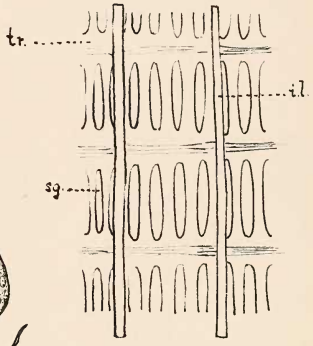

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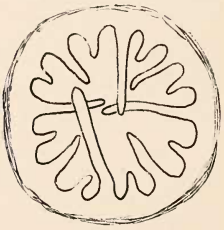

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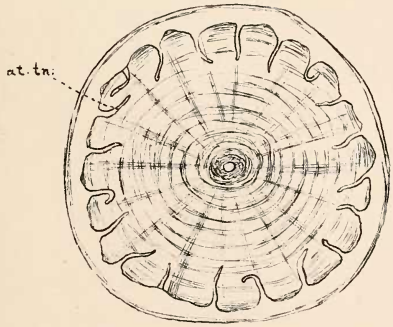

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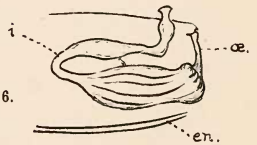

Fig. 6.

W.A.H. del.

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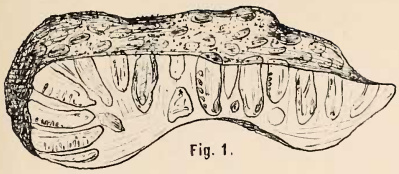

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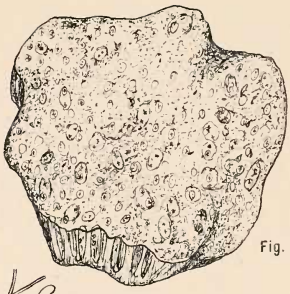

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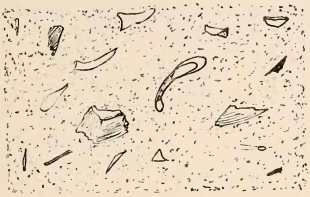

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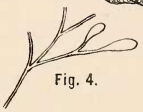
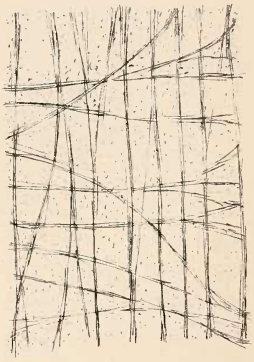
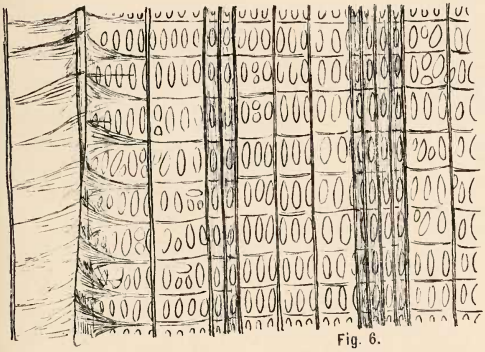


Fig. 4.

Fig. 5.





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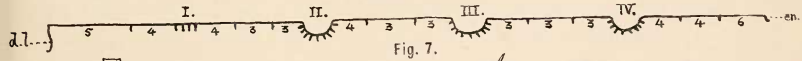

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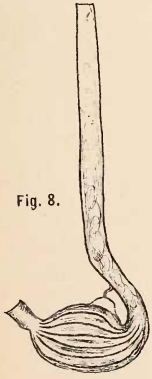

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Fig. 9.

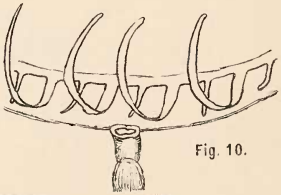


Fig. 10.

Fig. 11.

Fig. 12.

W.A.H. del.

GOODSIRIA.

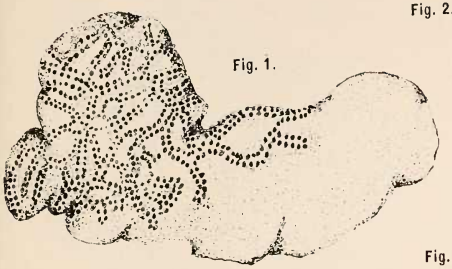
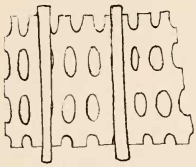


Fig. 1.

Fig. 2.

Fig. 3.



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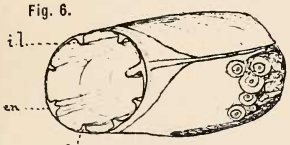

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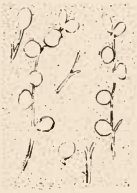

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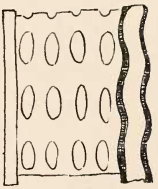

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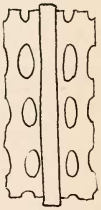

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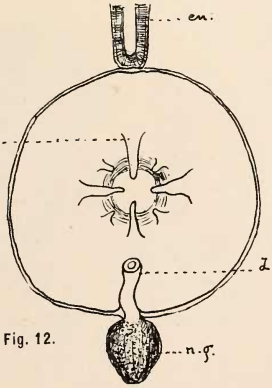

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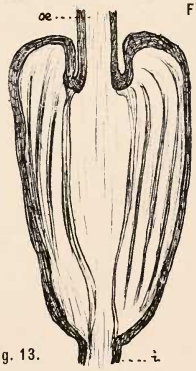

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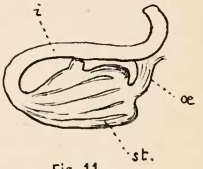
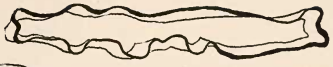


Fig. 11.

W.A.H. del.

BOTRYLLOIDES.



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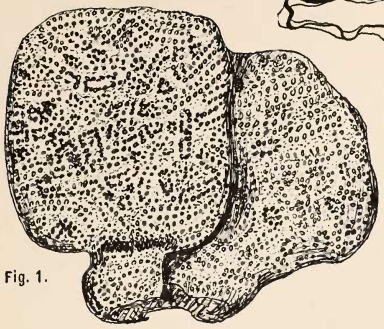

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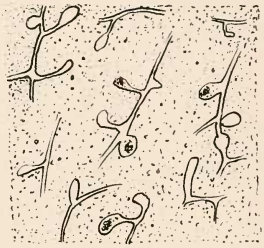

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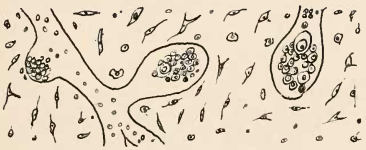

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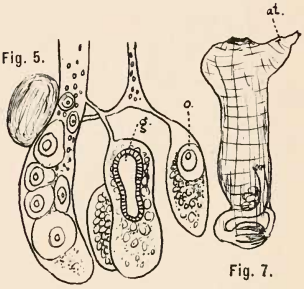

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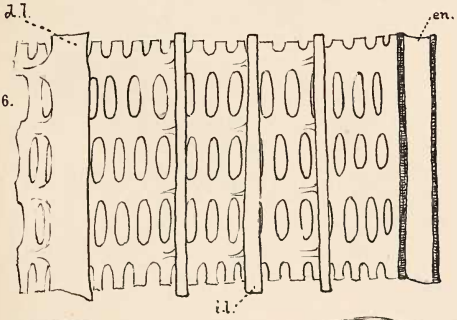


Fig. 6.

Fig. 8.

Fig. 9.

Fig. 13.

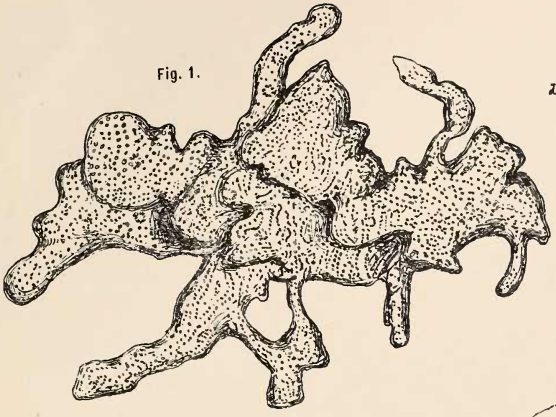
Fig. 10.

Fig. 11.

Fig. 12.

W.A.H. del.

SARCOBOTRYLLOIDES.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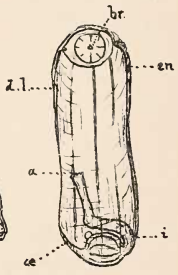

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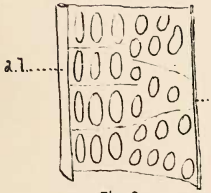

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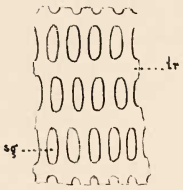

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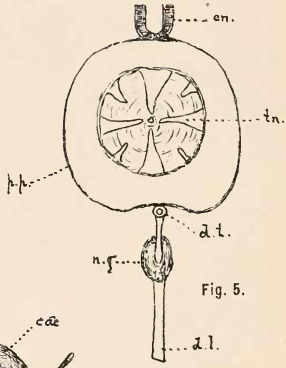

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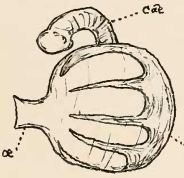

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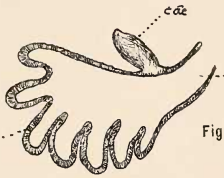

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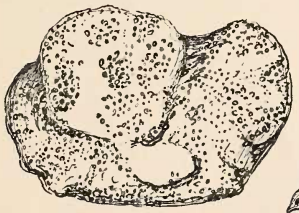
Fig. 8.

Fig. 9.


Fig. 10.

W.A.H. del.

SARCOBOTRYLLOIDES.