Some Additions to our Knowledge of the New Zealand Holothurians.

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(PLATES 11–14 and 3 Text-figures.)

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THE following pages contain an account of a collection of Holothurians brought from New Zealand by one of us some years ago, and may be regarded as a continuation of the "Observations on the Holothurians of New Zealand" published in the Linnean Society's Journal (Zoology) in 1897 (vol. xxvi. p. 22). Since that date only three species have been added to this section of the New-Zealand fauna, viz. *Cucumaria Filholi*, *Phyllophorus anatinus*, and *Caudina pulchella*, all of which are described by Professor Rémy Perrier in his memoir on the Antarctic Holothurians of the Natural History Museum of Paris *. It appears to us, however, to be very doubtful whether these three species can be maintained, and we incline to the belief that they are synonymous respectively with *Cucumaria alba* (Hutton), *Phyllophorus longidentis* (Hutton), and *Caudina coriacea* (Hutton). This question, however, need not be discussed at present.

We may also note in this place that a previously doubtful species of Hutton, *Cucumaria turbinata*, has been re-examined, from the type specimen, by Herdman and Pearson, and has been recorded from Ceylon. Pearson describes and figures the species in his paper on the Ceylon Holothurians †.

In this paper we venture to propose no less than six new species, viz., *Stichopus simulans*, *Phyllophorus dearmatus*, *Pseudocucumis bicolumnatus*, *Chirodota gigas*, *Chirodota geminifera*, and *Rhabdomolgus novæ-zealandiæ*; while *Holothuria difficilis*, Semper, is recorded from Norfolk Island. Of these by far the most remarkable is *Rhabdomolgus novæ-zealandiæ*. A description of this species was actually prepared by one of us in 1896, based on a single specimen, but was not published at the time because it was thought that the absence of spicules, characteristic of the genus *Rhabdomolgus*, might be due in the case of our specimen to the solvent action of the formalin in which the specimen was preserved. An experiment made on the spicules of *Chirodota dunedinensis* showed that the spicules of that species were dissolved in formalin (probably owing to the decomposition of the latter); therefore it was considered unsafe to rely upon formalin material,

* Annales des Sciences Naturelles, Zoologie, 1905, p. 1.

† Herdman's Pearl-Oyster Reports, Supp. No. 5, 1903.

and the manuscript was accordingly withheld from publication. Subsequently, however, one of us found this curious Holothurian in quantity at Kaikoura and was able to study it in the fresh condition, when it became evident that spicules are really absent and that the genus *Rhabdomolgus*, so long discredited by systematists, must be revived. Professor Ludwig * has lately (1905) come to the same conclusion from the study of specimens of Keferstein's original species (*Rhabdomolgus ruber*), rediscovered on the coast of Heligoland.

We cannot conclude this brief introduction without expressing our thanks to several friends in New Zealand for their great kindness in helping to get together the collection, especially Professor W. B. Benham, Professor H. B. Kirk, Mr. A. Hamilton, and Mr. Henry Suter.

STICHOPUS MOLLIS, *Hutton*, sp. (Plate 12, fig. 12.)

1872. *Holothuria mollis*, Hutton, Cat. Echinoderm. N.Z. p. 15.
1879. *Holothuria* (? *Stichopus*) *mollis*, Hutton, Trans. N.Z. Inst. vol. xi. p. 308.
1879. *Holothuria Robsoni*, Hutton, Trans. N.Z. Inst. vol. vi. p. 308.
1885. *Holothuria mollis*, Lampert, Die Seewalzen, p. 93.
1885. *Holothuria Robsoni*, Lampert, Die Seewalzen, p. 93.
1886. *Holothuria mollis*, Théel, Challenger Reports, vol. xiv. p. 239.
1886. *Holothuria robsoni*, Théel, Challenger Reports, vol. xiv. p. 239.
1886. *Stichopus sordidus*, Théel, Challenger Reports, vol. xiv. p 167.
1897. *Stichopus mollis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 46.
1897. *Holothuria Robsoni*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 48.
1897. *Stichopus mollis*, Whitelegge, Rec. Australian Museum, vol. iii. p. 50.
1898. *Stichopus mollis*, Ludwig, Hamburger Magalhaen. Sammelreise, Holothurien, p. 7.
1905. *Stichopus mollis*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 83.

Four specimens from Milford Sound, collected by Mr. D. Sutherland, and one specimen from Otago, collected by Prof. Benham at a depth of 20 fathoms, occur in the collection.

They vary in length from 7·0 cms. up to 13·4 cms. The smallest specimen is very dark brown in colour; it possesses a much thicker body-wall than the other specimens, probably owing to its being in a state of contraction. Three other specimens are brown in colour, but in addition have irregular, dirty-white markings. The largest example is almost white and has a remarkably thin body-wall, but, as it does not differ from *S. mollis* in any other characters, we consider it merely a variety of this rather variable species.

The general integument of this species contains no other spicules but the characteristic tables. The tube-feet and papillæ, however, contain two or three kinds of spicules.

Each tube-foot is supported at its extremity by a slightly irregular perforated end-plate, round which are arranged a number of perforated bilateral plates.

* Zoologischer Anzeiger, Bd. xxviii. No. 12.

The dorsal papillæ are supported by stout curved rods, with either simple or branching extremities.

We follow Ludwig in including *Holothuria Robsoni*, Hutton, in this species.

STICHOPUS SIMULANS, sp. n. (Plate **11.** fig. 5.)

1897. *Stichopus mollis*, Dendy (*pars*), Journ. Linn. Soc., Zool. vol. xxvi. p. 48.

A single specimen of this species was briefly described by one of us under the heading of *Stichopus mollis*. As we have now obtained another example, possessing the dichotomously foliaceous spicules, from Resolution Island, we feel justified in proposing a new specific name.

In the specimen now before us the body is rounded at both ends and exhibits pronounced dorsal and ventral surfaces, the latter being much narrower than the former. The specimen is 3·5 cms. in length and 1·9 cms. in greatest breadth. The integument is very much contracted and folded. The colour is brown on the dorsal surface and pale brown on the ventral; in addition, pale streaks occur on both lateral surfaces. Four bands of very large papillæ, each terminating in a sucker, run along the dorsal surface, these papillæ reaching as much as 0·7 cm. in diameter in the contracted state.

In its present condition the ventral surface is deeply corrugated transversely. A dirty-white stripe runs down the mid-ventral line, and brown spots are sparingly scattered over the pale brown background of this surface. Tube-feet appear to be quite absent from the ventral surface.

There are twenty bushy tentacles, of approximately equal size, arranged round the ventrally situated mouth. Surrounding the buccal depression, which contains the retracted tentacles, is a complete circle of the large conical papillæ ending in suckers.

The anus, as usual, is a round aperture at the posterior end of the body.

The body-wall is very thick and tough, resembling that of *S. mollis*, and the spicules in it are confined to the outer portion. Of these there are two kinds:—

(i) Large numbers of the characteristic tables, which have the spire supported by four rods, these rods being united by two diagonal cross-bars about halfway up from the base (Pl. **11.** fig. 5 *a*). These are identical both in form and size with those of *S. mollis*.

(ii) Large numbers of the small spicules (about ·03 mm. in length) which have been described as dichotomously foliaceous in form (fig. 5 *b*). These occur most abundantly in the depressions of the surface, where they form an almost continuous layer. They form such a definite character that there can be no doubt about the specific distinctness of this form.

The form of the calcareous ring appears to be identical with that of *Stichopus mollis*.

There are twenty tentacular ampullæ; a large Polian vesicle situated ventrally, and a madreporic canal dorsally.

The other contents of the body-cavity have been ejected; therefore we are unable to add any further observations on the anatomy.

HOLOTHURIA DIFFICILIS, *Semper*. (Plate **13**. figs. 19 *a*–19 *c*.)

1868. *Holothuria difficilis*, Semper, Holothurien, p. 92.
1880. *Mülleria parvula*, Haacke, in Möbius, Meeresfauna d. Inseln Mauritius u. d. Seychellen, p. 46.
1883. *Holothuria difficilis*, Ludwig, Ber. Oberh. Ges. f. Nat.- u. Heilkunde, vol. xxii. p. 173.
1885. *Holothuria difficilis*, Lampert, Die Seewalzen, p. 68.
1898. *Holothuria difficilis*, Bedford, Proc. Zool. Soc. 1898, p. 838.
1901. *Holothuria difficilis*, Sluiter, Holothurians of the 'Siboga' Expedition, p. 10.

Three specimens of this Holothurian were obtained by Mr. R. M. Laing off Norfolk Island.

The largest is 3·65 cms. in length and 1·4 cms. in greatest width. All the examples are dark brown in colour, but are somewhat lighter on the ventral surface than on the dorsal.

The tube-feet are almost restricted to the ventral surface, where they are very numerous.

The internal anatomy presents no peculiar features, but it is interesting to note that, although the specimens have been in spirit for at least ten years, the Cuvierian organs have not lost the adhesiveness and elasticity characteristic of them in the fresh condition—a fact which was noticed by Semper in the specimens that he examined.

Three kinds of spicules are found in the integument:—

(i) Tables, resembling those of *S. mollis*, consisting of a base with four columns supporting a spire, and two cross-bars uniting these columns (Pl. **13**. fig. 19 *c*).

(ii) Biscuit-shaped spicules, which are oval plates usually with six perforations arranged in two rows of three each, but there is considerable variation in the number of these perforations, as shown in fig. 19 *b*.

(iii) Irregular perforated plates occurring in the tube-feet (fig. 19 *a*).

CUCUMARIA ALBA, *Hutton*, sp.

1872. *Chirodota* (?) *alba*, Hutton, Cat. Echinoderm. N.Z. p. 17.
1879. *Echinocucumis alba*, Hutton, Trans. N.Z. Inst. vol. xi. p. 307.
1885. *Echinocucumis alba*, Lampert, Die Seewalzen, p. 167.
1886. *Echinocucumis* (?) *alba*, Théel, Chall. Reports, vol. xiv. p. 119.
1897. *Colochirus alba*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 35.
1898. *Cucumaria alba*, Ludwig, Hamburger Magalhaen. Sammelreise, Holothurien, p. 29

1903. *Cucumaria Filholi*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. ix. p. 144.
1904. *Cucumaria alba*, var. *Filholi*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. x. p. 367.
1905. *Cucumaria alba*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 85.
1905. *Cucumaria Filholi*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 88.

Nine examples of this species were obtained by Mr. Henry Suter, in Akaroa Harbour, at a depth of 4–8 fathoms.

The specimens vary in size from 1·2 cms. long and 0·35 cm. broad up to 3·4 cms. long and 0·8 cm. broad.

In all the specimens the two extremities are bent upwards, and, in addition, the posterior end is drawn out into a more or less pronounced caudal appendage. The ambulacral appendages are almost absent from the dorsal surface and are not very numerous on other parts of the body. They are concentrated towards the middle of the body, and here they show very little definite arrangement. Towards the extremities they are almost confined to the radii.

We have examined the calcareous ring in three examples, and find that the anterior processes of the radials have each a very narrow median cleft, giving them a bifid appearance. The same is the case in one of the specimens from Wellington Harbour previously studied by one of us. In none of these specimens, however, are the anterior ends of the inter-radials split.

We include *Cucumaria Filholi* under the heading of *C. alba*, as we do not think that Professor Perrier has adduced sufficient reasons for separating his specimens from the latter species. It is true that he describes the presence of a cleft in the anterior extremities of both radial and inter-radial plates; but we venture to doubt its existence in the latter, especially as a shallow groove runs up the middle of this process and produces an illusion of bifidity. Even if this cleft is present in Professor Perrier's examples, it constitutes but a very slight distinction. The tail is stated to be larger in *C. Filholi*; but our specimens vary so much in this character that we cannot attach any specific importance to it, and it probably depends very much on the state of contraction. Neither can we admit any specific difference in the arrangement of the tube-feet, such as Perrier attempts to demonstrate. The supposed differences in spiculation also appear to be trifling.

CUCUMARIA BREVIDENTIS, *Hutton*, sp.

1872. *Thyone brevidentis*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1886. *Thyone brevidentis*, Théel, Chall. Reports, vol. xiv. p. 141.
1897. *Colochirus calcarea*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 38.
1897. *Colochirus brevidentis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 40.
1898. *Colochirus brevidentis*, Ludwig, Hamburg. Magalhaen. Sammelreise, Holothurien, p. 30.
1898. *Colochirus brevidentis*, Ludwig, Zool. Jahrb., Suppl. iv. Part 2, p. 442.
1905. *Cucumaria brevidentis*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 110.

A large number of specimens of this animal were obtained from many

localities. It appears to be by far the most common Holothurian occurring in the New Zealand area. The examples that we possess were obtained from the following localities:—Waitangi, Chatham Islands (collected by Prof. H. B. Kirk); Ouenga, Chatham Islands (collected by one of ourselves); Akaroa Harbour (collected by Mr. Henry Suter); Great Barrier Island (collected by Mr. Chas. Cooper); Stewart Island (collected by Prof. H. B. Kirk).

The examples from Ouenga were found living underneath stones on the beach between tide-marks. They were clinging to the stones with the aid of their tube-feet.

The specimens vary in size from 0·85 cm. by 0·3 cm. up to as much as 2·4 cms. by 1·1 cms. There is a very marked difference in appearance between the large specimens and the small ones, the large possessing a much darker and rougher integument than the small animals. This latter feature is probably due to the fact that the large calcareous nodules, which are common in the integument of the large ones, only occur very sparingly in the small specimens.

This difference is at first sight so marked that it was thought necessary to erect a new species (*C. calcarea*) for the reception of the small specimens; but after subsequent examination we consider that there is not sufficient justification for this course. We therefore concur with Ludwig in including *C. calcarea* under *C. brevidentis*.

We also agree with Perrier in referring this species to the genus *Cucumaria*, though we must admit that the distinction between these two genera, *Cucumaria* and *Colochirus*, appears to us to be not very satisfactorily defined.

This species has also been recorded, by Ludwig, from Juan Fernandez, on the other side of the Pacific Ocean—a very interesting case of agreement between the marine fauna of New Zealand and that of South America.

CUCUMARIA OCNOIDES, *Dendy*, sp.

1897. *Colochirus ocnoides*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 36.
1898. *Cucumaria ocnoides*, Ludwig, Hamburg. Magalhaen. Sammelreise, Holothurien, p. 30.
1901. *Ludwigia ocnoides*, Reiffen, Zeitsch. f. wissench. Zool. vol. lxix. p. 598.
1904. *Cucumaria ocnoides*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. x. p. 13.
1905. *Cucumaria ocnoides*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 96.

There are in the collection six examples of this remarkable Holothurian from New Brighton, near Christchurch. They vary in length from 8·5 cms. up to 14 cms. In the larger specimens the tube-feet are entirely restricted to the three ventral radii, where they are arranged in four somewhat irregular longitudinal rows along each radius. In the specimens before us the dorsal surface exhibits neither tube-feet nor papillæ.

The integument of the middle of the body seems to have the power of

attaching foreign particles to itself, for in all our examples it is covered with sand.

The original account of this form given by one of us has been supplemented by both Reiffen and Perrier, so that the anatomy of the species is now very well known.

The species must be extremely abundant off the New Brighton beach, though seldom thrown up on the shore. On one occasion, however, after a storm, innumerable specimens were cast up at high-water mark together with immense quantities of other marine animals, as already described by one of us. "Probably I should be correct in saying that there were millions of this animal lying on the beach; they lay in heaps and might have been collected with a shovel."* They were associated with large numbers of *Caudina coriacea* and burrowing lamellibranchs, and probably live buried in the sand, out of reach of ordinary tidal influences.

PHYLLOPHORUS LONGIDENTIS, *Hutton*, sp. (Plate 13. figs. 18 *a*–18 *d*.)

1872. *Thyone longidentis*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1872. *Thyone caudata*, Hutton, Cat. Echinoderm. N.Z. p. 16.
1879. *Pentadactyla longidentis*, Hutton, Trans. N.Z. Inst. vol. xi. p. 307.
1886. *Thyonidium rugosum*, Théel, Chall. Reports, vol. xiv. p. 95.
1886. *Thyone longidentis*, Théel, Chall. Reports, vol. xiv. p. 141.
1886. *Thyonidium caudatum*, Théel, Chall. Reports, vol. xiv. p. 147.
1891. *Phyllophorus caudatus*, Ludwig, Bronn's Klass. u. Ordnung., Holothuroidea, p. 347.
1891. *Phyllophorus rugosus*, Ludwig, Bronn's Klass. u. Ordnung., Holothuroidea, p. 347.
1897. *Phyllophorus longidentis*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. p. 42.
1898. *Phyllophorus longidentis*, Ludwig, Hamb. Magal. Sammelreise, Holothurien, p. 49.
1903. *Thyonidium anatinum*, R. Perrier, Bull. Mus. d'Hist. Nat. vol. ix. p. 142.
1905. *Phyllophorus anatinus*, R. Perrier, Ann. Sc. Nat., Zool. 9e sér. i. (1905) p. 112.

Two examples of this species were obtained in Akaroa Harbour by Mr. Henry Suter.

Although these two specimens differ somewhat in external appearance, a careful examination has convinced us that they belong to the same species.

In the smaller specimen (length 1·8 cms., breadth 0·7 cm.) the body is curved upwards at both ends, while in addition the tip of the tail is slightly flexed towards the ventral surface. The ambulacral appendages are distributed somewhat sparingly over the surface, but are concentrated along the radii, especially towards the extremities. The small tail is without appendages.

In the larger specimen (length 2·5 cms., breadth 1 cm.) the body is almost straight and the tail is very obscure, apparently retracted. The ambulacral appendages are more numerous and appear irregularly scattered over the body.

* Dendy, "Notes on a Remarkable Collection of Marine Animals lately found on the New Brighton Beach, near Christchurch, New Zealand," Transactions of the New Zealand Institute, vol. xxx. 1897, p. 320.

In both specimens the tail is paler than the remainder of the body, which is brown in alcohol.

As the anatomy of this species has never been fully described, we append the following particulars :—

There are twenty tentacles, five pairs of large alternating with five pairs of small, the latter being internal to the former.

The pharynx is very long and is supported by a large calcareous ring composed of ten plates, each made up of a number of small polygonal pieces. This ring has already been figured in detail by one of us *. A distinction between radials and inter-radials is only obvious in the anterior third of the ring, where the radials are not only separate from the inter-radials, but are distinguished from them by the fact that their anterior ends are bifid and truncate, whilst those of the inter-radials are single and pointed. A median cleft runs up nearly to the anterior extremity of each radial. These clefts almost divide the whole ring into five separate but compound segments. Posteriorly each cleft runs down to the extremity of one of the five posterior prolongations of the ring, which, in the former paper by one of us, have been described as formed by the union of processes of the inter-radials. We can no longer maintain this interpretation, for the processes in question are undoubtedly radial in position, and would therefore be prolongations of the radials. The structure of the ring in *Phyllophorus dearmatus*, sp. n. (Pl. **11.** fig. 8) supports this view.

The water-vascular ring surrounds the œsophagus in contact with the ends of the posterior prolongations of the calcareous ring. There is a single long, thin Polian vesicle placed ventrally ; opposite to this is a long, thin madreporic canal ending in a small madreporite.

The alimentary canal resembles that of other species of the genus (e. g. *Phyllophorus dearmatus*, sp. n., described below).

The gonads are very feebly developed in the smaller specimen and are not well developed even in the larger one.

The spicules are perforated plates, each usually bearing a spine on its outer face. This spine is made up of two rods, which unite shortly above their origin (Pl. **13.** fig. 18 *d*). The plates are rather irregular in shape, but are frequently extended into four radiating arms, as already figured by one of us (*loc. cit.*). The dimensions of an average-sized spicule are :—length 0·35 mm., breadth 0·21 mm., height of spire 0·22 mm. ; but these dimensions are very variable. The spines are very frequently broken off, especially in the older animals. The development of these plates is shown in Pl. **13.** figs. 18 *a*–18 *c*, and needs no fuller explanation. In a few of the plates spines are not developed at all.

We feel fully justified in including *P. anatinus*, Rémy Perrier, under the

* Dendy, "The Holothurians of New Zealand," Journ. Linn. Soc., Zool. vol. xxvi. fig. 66.

heading of *P. longidentis*, for the characters which Perrier considers peculiar to the former are of very minor importance from a taxonomic point of view. The difference in shape probably depends to a large extent on the state of contraction, and is a very uncertain character. The difference in the arrangement of the tube-feet is very slight and can be explained by the assumption that Perrier's example was a young specimen, and therefore had not developed as many tube-feet as the adult animal.

As to the supposed distinction between two kinds of perforated plates, we cannot find any difference in this respect between our specimens of *P. longidentis* and Perrier's *P. anatinus*, and, moreover, the supposed difference is in itself so slight as to be of no specific importance. In fact differences in the size of perforations of the kind figured by Perrier were also figured by one of us in *P. longidentis* many years ago (*loc. cit.*).

We are no longer able to refer to Hutton's type slide, but in the specimen from the Dunedin Museum, referred to in Dendy's earlier paper, we find several reticulate plates without spines, as figured by Perrier for his *P. anatinus*, and such also occur in both our specimens. Perrier was unable to open his specimen, but as the animal had been cleared in cedar-wood oil he was able to state that the calcareous ring has a complicated structure, very analogous to that of *P. longidentis*.

PHYLLOPHORUS DEARMATUS, sp. n. (Plate **11.** figs. 7, 8; Plate **12.** fig. 15; Plate **13.** fig. 20.)

A single specimen of this species was obtained by Mr. H. Suter in Akaroa Harbour at a depth of six fathoms.

The body of the animal, as preserved in spirit, is roughly cylindrical, tapering at both ends (Pl. **11.** fig. 7). Its length is 6 cms. and its greatest transverse diameter is 2·05 cms. The anterior part of the body forms an introvert which bears the ring of tentacles at its extremity; in the specimen before us it is retracted, with the result that the tentacles are directed backwards and occupy the spacious pharynx.

The body bears numerous small, but well-developed tube-feet, which are abundantly scattered over both radial and inter-radial areas; towards the extremities they are less numerous and their radial arrangement is more obvious. The tube-feet are more abundant on the ventral than on the dorsal surface.

The mouth is a circular aperture situated at the end of the introvert. It is surrounded by a circle of twenty tentacles which are arranged in two series, five pairs of large tentacles externally, alternating with five pairs of small tentacles internal to them. The larger tentacles are arboriform, about 1·65 cms. long, and bear comparatively few branches. On the stem and branches of these larger tentacles are deep red-brown spots, which have retained their

colour in spite of the fact that they have been in spirit for more than ten years. These tentacles are arranged inter-radially, one pair to each interradius, and between the two which form the dorsal pair is situated the opening of the genital duct.

The inner ring of tentacles, arranged radially, exhibits a slight irregularity, which may be expressed by the accompanying diagram (fig. A).

Fig. A.

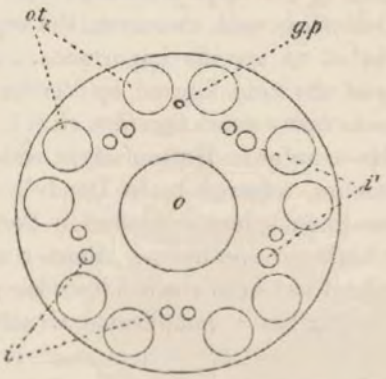


Diagram to show the size and arrangement of the tentacles in *Phyllophorus dearmatus*.—*g.p.*=genital pore; *i*= small tentacles of the inner ring; *i'*=two larger tentacles of the inner ring; *o* = oral aperture, *o.t.*= large tentacles of the outer ring.

It will be seen that on the right side the two tentacles of each inner pair are unequal in size, the lower one enlarged, while ventrally and on the left side they are equal. It is not likely, however, that this arrangement is constant, for in the allied genus *Pseudocucumis* there is considerable individual variation in this respect, as described by Bedford in his description of the Holothurians from Funafuti and Rotuma (P. Z. S. 1898, p. 844).

The eight smaller tentacles of the inner ring are thickly tufted arboriform structures each about 1 mm. in length. The two larger ones are each about 3 mm. long and resemble those of the outer ring in form.

The anus is situated at the base of a small depression at the posterior extremity of the body. It is surrounded by a circle of ten small papillæ which are probably modified tube-feet.

Spicules are absent from the body-wall itself, but are present in the tube-feet, at the end of each of which there is a large end-plate. These are slightly convex perforated plates usually about 0·35 mm. in diameter (Pl. **13.** fig. 20).

The internal anatomy seems quite typical of the genus *Phyllophorus* (Pl. **12.** fig. 15). The buccal cavity leads through the mouth into a spacious pharynx supported by a calcareous ring (Pl. **11.** fig. 8) of ten plates, five radial and five inter radial in position. The radial plates are each about 2 cms. long.

Anteriorly, each is produced into a process which is deeply cleft at its extremity; posteriorly, each is produced into two long and slender processes ending at the level of the circular canal. These two processes are closely approximated at their posterior ends, but in front the space between them widens out into a cleft which continues almost to the anterior end of the plate. The entire radial plate is formed by a number of roughly rectangular pieces, which form a single row down each process and are fairly regularly arranged. The inter-radial plates are somewhat shorter and a little wider than the radials. Each is concave behind and anteriorly produced into a pointed tongue-like process. Each inter-radial plate is composed of a number of small polygonal pieces.

The pharynx leads into a very thick-walled narrow œsophagus (fig. 15, *œ.*) a little more than 1 cm. long. After a slight constriction this widens out into a thin-walled intestine (*i.*) which exhibits the usual **S**-like curvature. The first descending limb is much convoluted, the ascending limb rather less so, and the last descending limb is straight. The first two limbs are kept in position by the dorsal mesentery and the last part by the right mesentery.

The terminal part of the alimentary canal is dilated into a cloaca in the dorsal wall of which open the two large respiratory trees. The cloaca is kept in position by a large number of muscle-fibres, radially arranged, running from its outer surface to the body-wall.

The respiratory trees (fig. 15, *r.t.*) are richly branched and extend almost to the anterior extremity of the body-cavity, the left tree being slightly larger than the right. They unite immediately before opening into the cloaca.

The five longitudinal muscle-bands are well developed. Although single whilst on the body-wall, at the anterior end each becomes double as soon as it passes on to the introvert, and runs along the latter as two very thin strips of muscle. Each strip is attached to the corresponding half of the bifurcate process of one of the radial plates.

The five retractor muscles of the pharynx are very stout bands attached to the radials at one end and to the corresponding longitudinal muscle-bands at the other. Their points of attachment to the radials are remarkably small, considering the thickness of the muscle, and in the specimen before us have all become detached from the corresponding plates.

Arising from the ambulacral ring, by a wide base, is a long thin Polian vesicle extending, in the retracted specimen, almost to the posterior end of the body-cavity (fig. 15, *p.*). The madreporic canal (fig. 15, *m.*) is a slender sinuous tube which ends in a small madreporite, situated on the dorsal mesentery.

Running along the intestine are the usual dorsal and ventral vessels.

The gonads (fig. 15, *g.*) consist of two bundles of slender radiating cæca placed right and left of the dorsal mesentery at about one-third the length of the animal from the anterior end (in the retracted state). As they appear to contain nothing but ova, this species is probably diœcious. A very slender

genital duct (*g.d.*) runs forward along the dorsal mesentery and then on the introvert to open by a small aperture situated between the two large tentacles of the mid-dorsal inter-radius.

This species somewhat resembles *Phyllophorus Drummondii* (Thompson), in which also spicules are typically absent from the body-wall. They differ from one another chiefly in the size of the calcareous ring, which is little more than one-tenth the length of the body in *P. Drummondii*, whereas it is one-third the length of the body (in its retracted state) in *P. dearmatus*. In our species again there is only one Polian vesicle, whereas in *P. Drummondii* there are two or three. Finally, the geographical distribution is quite different, *P. Drummondii* having been recorded only from the Northern Hemisphere. Without hesitation, therefore, we consider our specimens to represent a distinct species, and propose the name *dearmatus* in view of the fact that it has lost the spicules of the body-wall.

PSEUDOCUCUMIS BICOLUMNATUS, sp. n. (Plate **11.** figs. 6, 6 *a*; Plate **12.** figs. 13, 14.)

A single example of this species was obtained by Mr. A. Hamilton off Dunedin.

The animal is cucumiform, tapering slightly at both ends, and possesses a short and inconspicuous conical tail (Pl. **11.** fig. 6). The length of the body is 3·5 cms. and the greatest transverse diameter is 1·25 cms. The tentacles are completely retracted within the pharynx.

The tube-feet are entirely restricted to the five radii, thereby giving the animal a very well-marked external radial symmetry. For the greater part of its length they form two double rows along each radius, but towards the anterior and posterior ends they are arranged in two single rows. The tube-feet are more numerous on the ventral than on the dorsal surface, and about the middle of the body may even form six irregular rows on each ventral radius.

The inter-ambulacra are quite naked.

There are apparently nineteen tentacles, arranged in two circles round the mouth, at the anterior extremity of the body. The outer circle is formed by five pairs of large and richly branched arboriform tentacles, each about 0·7 cm. long. The inner circle is apparently formed by nine smaller tentacles, four pairs and an odd one alternating with the five pairs of large tentacles external to them. Probably there are normally five pairs of smaller tentacles in this species, as, in our specimen, there appears to be the remnant of another by the side of the odd tentacle, and it seems likely that the tentacle has been lost by accident; so that the total number would probably be twenty. The small tentacles are short and thickly branched, and about 1 mm. in length. Surrounding the circle of tentacles is a complete ring of small digitiform papillæ, each about 1 mm. long, forming a very definite circle.

The anus is situated in a small depression at the apex of the conical tail. It is a small circular aperture surrounded by fifteen small papillæ, three in each radius. These papillæ appear to be modified tube-feet.

The body-wall itself is rather thin, but the circular muscles attached to it are remarkably thick and form very conspicuous transverse bands between the radial longitudinal muscles. Whilst on the body-wall the latter are single, but as they run down the introvert each divides into two strips of muscle, and each strip ends on the corresponding process of the bifurcate radial.

The body-wall contains a large number of spicules which are almost entirely in the form of small tables (fig. 13 *a*). These tables have an approximately oval base perforated by eight holes, arranged radially, four large alternating with four small ones. The presence of these eight holes is very constant, for in examining several hundred of the tables the only exception found was the one represented in fig. 13 *b*, which is evidently abnormal. The spire is formed of only two pillars supporting a cross-bar at their distal extremities, and this bar usually bears about six spines. The dimensions of an average-sized table are :—length of oval plate, 0·058 mm. ; breadth, 0·041 mm. ; height of spire, 0·017 mm. The size of these tables is, however, very variable, the plate sometimes reaching 0·07 mm. × 0·049 mm. In a few of them the spire is not developed, with the result that biscuit-shaped forms are produced (fig. 13 *c*). These also have the usual eight perforations.

In addition to these spicules of the body-wall, two more kinds occur in the tube-feet. Each tube-foot is supported at its extremity by a circular convex perforated plate, usually about 0·28 mm. in diameter, and resembling those of *Phyllophorus dearmatus* in form. Round the edge of this end-plate is a complete circle of irregular perforated plates (fig. 13 *d*) which support the rim of the sucker.

The mouth leads into a wide thin-walled pharynx supported at its anterior end only by the calcareous ring (fig. 14), composed of ten simple plates, five radial and five inter-radial (fig. 6 *a*). The radials are oblong plates about three times as long as they are wide and bifurcate at both ends. Each anterior limb is abruptly truncated and exhibits a very slight further bifurcation. Each posterior limb tapers to a pointed extremity attached to the end of the corresponding inter-radial. These latter are Λ-shaped pieces, whose posterior extremities turn outwards and thicken slightly at their ends, where they are attached to the radials, as shown in the figure.

The retractor muscles are attached partly to the anterior limbs of the radials and partly to the pharynx-wall itself. Each runs from its pharyngeal attachment to the corresponding longitudinal muscle, and is inserted somewhat in front of the middle of the body (in its retracted state).

The posterior part of the pharynx narrows rapidly into an intestine (fig. 14, *i.*) which does not vary much in structure throughout its whole length, there

being no differentiated œsophagus. It exhibits the usual S-shaped curvature. The first limb, extending to the posterior end of the body-cavity, is slightly convoluted; the middle part is almost straight; and the last limb is quite straight, and is supported by the right ventral mesentery. There is no well-marked dilatation of the terminal part of the intestine to form the cloaca, and there are no radially arranged muscle-fibres in that region; a fact which may doubtless be correlated with the feeble development of the respiratory trees.

The latter extend almost to the anterior extremity of the body, but are very little branched and differ markedly from the respiratory trees of *P. dearmatus*. They unite immediately before opening through the dorsal wall into the posterior end of the intestine.

The water-vascular ring (fig. 14, *a.c.*) surrounds the pharynx immediately before the latter narrows into the intestine. The Polian vesicle (*p.*) is a long thin tube ending in a pear-shaped dilatation, and arises from the ventral side of the ambulacral ring. It is 1·7 cms. in length; the diameter of the narrow portion is 0·5 mm. and of the dilatation 3·5 mm. The madreporic canal (*m.*) is a very slender sinuous tube arising from the dorsal part of the ambulacral ring, and running posteriorly to end in a somewhat large madreporite, attached to the dorsal mesentery.

The gonads (*g.*) consist of two bunches of very long filaments situated right and left of the dorsal mesentery a little behind the middle of the (retracted) body. The left bunch is larger than the right and its branches extend to both ends of the animal and are very numerous *. The genital duct (*g.d.*) runs forward in the dorsal mesentery from the junction of the two bunches of cæca to open to the exterior on the dorsal surface.

The spiculation and the structure of the calcareous ring distinguish this species from all other members of its genus.

The tables differ markedly from those of *P. intercedens*, Lampert, and this is the only other known species of *Pseudocucumis* with only two rods to the spire of the table. *P. bicolumnatus* is also distinguished from this species by the number of the tentacles and the presence of only one Polian vesicle.

CAUDINA CORIACEA, *Hutton*, sp.

1872. *Molpadia coriacea*, Hutton, Cat. Echinoderm. N.Z. p. 17.
1879. *Caudina*? (*Echinosoma*?) *coriacea*, Hutton, Trans. N.Z. Inst. vol. xi. p. 337.
1883. *Caudina meridionalis*, Bell, Proc. Zool. Soc. Lond. pp. 58–59, pl. 15. fig. 1.
1885. *Molpadia coriacea*, Lampert, Die Seewalzen, pp. 208–209.
1886. *Caudina meridionalis*, Lampert, Die Seewalzen, pp. 210–211.
1886. *Caudina coriacea*, Théel, Chall. Reports, vol. xiv. pp. 47, 54–55, pl. 3. fig. 4.
1897. *Caudina coriacea*, Dendy, Proc. Linn. Soc., Zool. vol. xxvi. pp. 28–32, pl. 3. figs. 9–18.

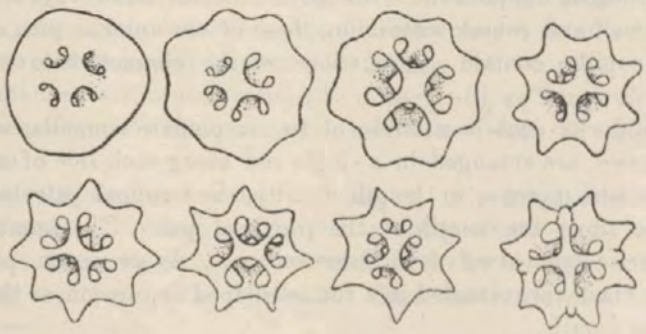
* Only a few of these branches are shown in fig. 14.

1898. *Caudina coriacea*, Dendy, Journ. Linn. Soc., Zool. vol. xxvi. pp. 456–464, pl. 29. figs. 1–13.
1898. *Caudina coriacea*, Ludwig, Hamb. Magalh. Sammelreise, Holothurien, pp. 63–64.
1905. *Caudina pulchella*, Rémy Perrier, Ann. Sc. Nat., Zool. 9e sér. i. 1905, pp. 117–120, pl. 5. figs. 14–17.
1905. *Caudina coriacea*, var. *brevicauda*, Rémy Perrier, Ann. Sc. Nat., Zool. 9e sér. i. 1905, pp. 121–123.

In July 1896, immense numbers of young specimens of this animal were thrown up on the beach at New Brighton, near Christchurch. Thirteen months later it was again cast up in the same locality in large numbers, together with countless millions of other marine animals, such as *Cucumaria ocnoides*, as already described by one of us. "The remarkable Holothurian *Caudina coriacea* was found in enormous numbers, and the specimens were nearly all adult, while on a previous occasion, as already mentioned, large numbers of young specimens were thrown up, and no adults. The American *Caudina arenata* is known to bury itself in the sand with only the tip of the tail projecting, and doubtless the same is true of our species, so that only a considerable disturbance of the sea-bed would cause it to be thrown on shore in such quantities."*

The characters which Perrier considers distinctive of his *Caudina pulchella* and of his variety *brevicauda* appear to us to be too slight for purposes of specific or even varietal distinction. The diameter of the caudal appendage would vary according to its state of contraction, and would always be a very unsafe character to depend upon. For a similar reason the thickness of the integument would also vary. As for the supposed difference in spiculation

Fig. B.



Spicules of *Caudina coriacea* (× 345).—All the spicules in this figure were from the integument of one specimen. (Camera drawing.)

we doubt its existence, for the integument of each example of *C. coriacea* that we have examined contained every variety of spicule shown in the

* Dendy, "Notes on a remarkable Collection of Marine Animals lately found on the New Brighton Beach, near Christchurch," Trans. N.Z. Inst. vol. xxi. p. 323.

accompanying drawing (fig. B) and also gradations between them. It will be seen from this figure that the range of variation is such as to include both varieties which Perrier figures for his *Caudina pulchella*.

On the other hand, the exact agreement of the calcareous ring, spiculation, general form of the body, number of tentacles, and, finally, the fact that Perrier's two specimens also come from New Zealand, convince us that *Caudina pulchella*, Rémy Perrier, is not distinct from *Caudina coriacea*, Hutton.

CHIRODOTA GIGAS, sp. n. (Plate **12.** figs. 9–11.)

The following description is taken from a single individual, collected at the Chatham Islands by Prof. H. B. Kirk. Unfortunately, it had broken into three pieces, and, in addition, ejected most of its gut, before it came into our possession.

The fragments when put together measure as much as 11·3 cms. in length, with a maximum transverse diameter of 1·2 cms. The body tapers posteriorly to a transverse diameter of 0·7 cm. at the extremity. As these measurements were made on a spirit-specimen, the living animal must have been very large for a *Chirodota*.

The body is elongated and cylindrical, attaining the greatest diameter immediately behind the anterior extremity. This region of the body is thickly covered by small round papillæ. The number of these papillæ gradually diminishes posteriorly, while they unite to form somewhat vermiform prominences which are most abundant in the middle of the body and disappear towards the posterior extremity. In this latter region the papillæ are again small and round, resembling those of the anterior part of the body. All these papillæ contain aggregations of the characteristic wheel-shaped spicules.

At the anterior end is a circle of twelve pinnate tentacles, whose digitiform processes are arranged in a single row along each side of a wide stem. These processes increase in length distally, the terminal pair being usually about three times the length of the proximal pair. The number on each tentacle varies from twelve to fourteen (*i. e.*, six or seven pairs). The retracted tentacles are situated in a funnel-shaped depression, at the bottom of which is the mouth.

The body-wall is thickest at the anterior end, and here the aggregations of wheels are very numerous. Posteriorly it becomes thin and semitransparent, and the wheel-bearing prominences are very conspicuous.

There are four kinds of spicules :—

(i.) Small six-rayed wheels (figs. 11 *c*–11 *g*.), which are commonly 0·1 mm. in diameter, but vary from 0·08 mm. up to 0·13 mm. In structure these

wheels appear to differ both from those of *C. dunedinensis*, as described by Dendy *, and also from those of *C. pisanii*, as described by Ludwig †.

In *C. pisanii* a plug is developed from the original six-rayed cross, which grows up and fills the round hole left between the spokes on the outer face of the wheel. In *C. dunedinensis* this plug is not developed, and the round hole on the outer face is left open.

In *C. gigas*, on the other hand, the six spokes on the outer face themselves unite completely in the middle, and form a round papilla without any perforation. A plug is not developed and the papilla in the centre of the outer face of the wheel is thus formed quite differently from that of *C. pisanii*. The development of these spicules (figs. 11 *e*, 11 *f*) appears to take place as in *C. dunedinensis*, and the young forms have a round hole in the middle of the outer face, as in that species.

A single four-rayed wheel (fig. 11 *g*) was found ; this is a point of some interest, as the presence of six rays is regarded as a generic character.

The arrangement of the wheels is also of interest. At the anterior end of the body they are confined to the round papillæ, each of which contains on an average about thirty wheels. Towards the middle of the body, where the papillæ seem to run together, the wheels are accordingly collected mainly in larger aggregations of somewhat vermiform shape, and in addition a few wheels occur isolated in the body-wall, thus giving a condition intermediate between *Chirodota* and Ludwig's genus *Trochodota*. Towards the posterior extremity the papillæ (now round again) become more definite and are arranged concentrically around the anus.

(ii.) Short and thick curved rods (fig. 11 *b*) slightly expanded at both ends, which are covered with short spines. The average length of these rods is 0·1 mm., and thickness 0·016 mm., but they vary both in size and shape. Their ends are occasionally bifurcate.

These spicules are concentrated along the radii as five wide bands, one outside each longitudinal muscle, but also occur scattered about the interradial areas.

(iii.) Smooth slender curved rods (fig. 11 *h*), frequently with slightly branching ends. The average length is about 0·065 mm., and thickness 0·005 mm. ; but they are very variable both in size and shape. These spicules are confined to the tentacles, where they form two rows in each branch of each tentacle.

(iv.) Short thick rods, with smooth and rounded ends (fig. 11 *a*), sometimes known as miliary granules. A fairly large example of these is 0·035 mm. in length and 0·01 mm. in thickness, but they vary enormously in size. These spicules are restricted to the radii, where they form two bands (each two or

* Dendy, Journ. Linn. Soc., Zool. vol. xxvi. 1897, pp. 49–50, figs. 1–6.

† Ludwig, Zeitschr. f. wiss. Zool. pp. 350–353, pl. 16. figs. 1–9.

three spicules wide), one on either side of each mid-radial line, and thus in the middle of the broad band of larger curved rods.

The two ventral muscle-bands are much closer together than the other three bands.

The calcareous ring (fig. 9) is composed of twelve short nodular pieces, five being radial and seven inter-radial in position (as in *Chirodota fernandensis*). The two extra inter-radial pieces are situated one in each lateral dorsal inter-radius. The inter-radial nodules possess two short posterior processes where they join the radials. The latter are simple ovoid pieces. The figure shows the junction of two inter-radials as well as that of the radials with the inter-radials.

The water-vascular system consists of an ambulacral ring, from which are given off twelve large tentacular canals running up to the tentacles. A large number of Polian vesicles arise from the ventral half of the ring (fig. 10). In our specimen there are nineteen well-defined vesicles (*p.*), and in addition two or three papillæ which may be small ones, but the number is probably indefinite. A tightly-coiled madreporic canal (*m.*) runs forward in the dorsal mesentery and ends in an oval madreporite.

The gonads consist of two bunches of long cæca, extending to the middle of the body, which are arranged right and left of the dorsal mesentery. From their point of union, at about the level of the calcareous ring, the genital duct runs forward in the dorsal mesentery.

The characters detailed above, especially the size and the spiculation, distinctly mark off this animal from all hitherto described species of *Chirodota*. It is distinguished from *C. dunedinensis*, the only other known New Zealand species with wheels, by

(1) The much larger size of the animal.
(2) The presence of twelve instead of ten tentacles.
(3) The structure of the calcareous ring.
(4) The presence of numerous Polian vesicles.
(5) The absence of sigmoid spicules.
(6) The presence of definitely arranged rods and granules.
(7) The much smaller size of the wheels and the closure of the round holes on their outer faces.

The species presents a condition intermediate between that of *Chirodota*, in which the wheels are all aggregated into papillæ, and that of *Trochodota*, in which they are scattered. We therefore consider it undesirable to recognize any generic distinction between these two forms.

CHIRODOTA GEMINIFERA, sp. n. (Plate **14.** fig. 30.)

We propose this name for a single specimen of a remarkable *Chirodota* which was obtained from the New Brighton Beach, near Christchurch, by

Mr. Henry Suter in 1896, at the same time as the original specimen of *Rhabdomolgus novæ-zealandiæ*. The specimen was slightly damaged, about 2·5 cms. in length and about 0·15 cm. in transverse diameter in the middle. When it first came into our hands it was of a very pale pinkish colour, nearly white, and opaque, the opacity being probably due to the alcohol in which it was preserved.

The tentacles are ten in number, pinnately branched, each with about five branches on each side increasing in length towards the distal end of the tentacle. The calcareous ring is feebly developed and composed of numerous small pieces, the arrangement of which could not be satisfactorily made out. The internal anatomy, so far as determinable, is typical.

The integument bears numerous scattered sense-papillæ as in *Rhabdomolgus novæ-zealandiæ*. It contains no wheels but fairly numerous scattered, slender, contort, sigmoid spicules, about 0·05 mm. in length, which as a general rule have sharply and gradually pointed ends (fig. 30 *a*). The spicules appear to be confined to the anterior portion of the body, where they are uniformly scattered over the inter-radii, leaving a narrow band opposite the middle of each longitudinal muscle quite free from them. The most remarkable feature about them is their apparently constant arrangement in pairs (figs. 30 *b*, 30 *c*), the two individuals of each pair lying parallel with one another and so close together as frequently to appear as a single spicule. In each pair the curvature of the two sigmata appears to be identical, and in the case of the larger ones the two components of the pair actually appear to have fused together by concrescence throughout the greater part of their length, remaining separate only at the two extremities (fig. 30 *c*). We believe that this curious arrangement of the sigmata in pairs is unique; but in *Chirodota japonica*, which is perhaps the most closely related species, they are arranged in radiate groups of from three to nine *.

Like *Chirodota japonica*, our species would fall under Studer's proposed genus *Sigmodota*, characterized by the presence of sigmoid spicules without wheels; this genus has, however, been abandoned by recent authors. The reduction of the spiculation in "*Sigmodota*," and especially the absence of spicules from the hinder part of the body of our species, seem to indicate the probability that the species of *Rhabdomolgus* are simply *Chirodotas* which have progressed still further in this direction and completely lost their spicules.

RHABDOMOLGUS NOVÆ-ZEALANDIÆ, sp. n. (Plate **11.** figs. 1–4; Plate **13.** figs. 16–17; Plate **14.** figs. 22–29.)

The history of this species has already been briefly referred to in our introductory remarks. It first became known through the discovery of a

* *Vide* Théel, 'Challenger' Reports, vol. xiv. Holothurioidea, p. 17.

single specimen on the New Brighton Beach (near Christchurch, New Zealand), by Mr. Henry Suter in 1896. This was described by one of us at the time, but as it was preserved in formalin, which frequently has a solvent action on calcareous spicules, it was considered inadvisable to publish. Subsequently however, in December 1898, the species was again found by one of us at Kaikoura, on the east coast of the South Island of New Zealand, where it occurs in large numbers under stones between tide-marks. Again in 1901 a considerable number of specimens were found by one of us living under rocks or in pools on the shore at Ouenga, in the Chatham Islands. It is therefore evidently a common species in the localities where it occurs, but its distribution would appear to be very sporadic.

External characters.—The living animal is of a pale pinkish-brown colour, very transparent. The surface is beset with numerous minute papillæ (sense-papillæ), which give it a finely granulated appearance. These papillæ are especially abundant at the anterior end.

A specimen from Kaikoura in life measured about 5 cms. in length, but after preservation in alcohol only 2·9 cms. The largest specimen in the collection measures (in spirit) 4·75 cms. in length, 0·55 cm. in transverse diameter at the anterior and 0·40 cm. at the posterior end ; so that the living animal may probably attain a length of at least 8 cms.*

In spirit-specimens the body is elongated, cylindrical and vermiform, with a slight spiral twist ; it is slightly expanded at the anterior and tapers towards the posterior end. The surface is slightly wrinkled transversely throughout most of its length, but at the anterior end this wrinkling is very inconspicuous (fig. 1). The integument is very thin and transparent, especially at the anterior end, showing the longitudinal and circular bands of muscle, the latter being very feebly developed in the more thin-walled anterior portion. Tube-feet are entirely absent. The mouth is a circular aperture at the anterior extremity, and is surrounded by a circle of ten outwardly-curving tentacles, of equal size, about 2·3 mm. in length (fig. 17). Each tentacle gives off twelve pinnately arranged branches, which increase gradually in length from 0·3 mm. at the base, up to 1·4 mm. at the apex of the tentacle. Each branch in the present retracted condition is strongly curved towards the posterior end of the body and its concave surface is deeply wrinkled, even slightly lobate, transversely, as shown in fig. 17. The anus is usually conspicuous as a wide pentagonal opening, surrounded by a raised lip, at the posterior extremity. The genital pore is situated between the bases of the two dorsal tentacles and internal to them.

A very noticeable feature of this animal is its tendency to break up into

* Ludwig gives the dimensions of spirit-specimens of *Rhabdomolgus ruber* as only 5 mm. long and 0·6 mm. thick. Keferstein's original specimen was 10 mm. long, presumably in life.

three parts when irritated. Of the spirit-specimens in our possession about half the number exhibit two very well marked constrictions, one about the middle of the body, and the other about midway between this and the posterior end. The constriction in the middle of the body is of very constant occurrence, for out of about thirty specimens only one (fig. 1) was entirely free from it. There does not appear, however, to be any special structural modification in relation to this tendency.

Integument.—The body-wall, as in all known Holothurians, exhibits four layers:—(i.) an epithelial layer (epidermis); (ii.) a connective-tissue layer with a nervous layer internally; (iii.) a muscular layer; and (iv.) a peritoneal layer.

(i.) *Epidermis.*—A thin structureless cuticle (fig. 4, *cu.*) covers the outside of the epidermis and appears to be continuous over the whole surface of the animal. The epithelial cells (figs. 3, 4, 22, *c.e.*) are elongately columnar and arranged in a single layer; the average size of each is about 15 μ by 3 μ. Each cell possesses a conspicuous deeply-staining nucleus, which is usually situated about the middle of the cell. All the cells taper internally and become more granular.

In addition to the ordinary columnar epithelial cells, gland-cells (fig. 22, *gl.*) occur, especially on the tentacles and on the papillæ of the integument. They are elongated ovoid cells, each possessing very granular protoplasm and a large nucleus. Sense-cells of the usual type also occur in the papillæ; they will be described later under the head of sense-organs.

(ii.) *Connective-tissue layer* (figs. 3, 4, 22, *c.l.*).—This usually consists of a very loose layer of connective-tissue fibres containing a few nucleated connective-tissue cells scattered about amongst them. It varies considerably in thickness (from 5 μ–50 μ), being especially thick in the sense-papillæ. On the inner face of the connective-tissue layer is a layer of nerve-fibres and nerve-cells (*n.l.*) In the sense-papillæ there is also a thin layer of nerve-fibres (fig. 22, *s.n.*) just beneath the epidermis, which is connected with the deeper nervous layer by a special nerve (*n.p.*) in each papilla. This layer does not seem to occur in other parts of the body.

(iii.) *Muscular layer.*—There is a layer of circular muscles (figs. 3, 4, 22, *c.m.*) immediately beneath the nerve-layer. Its average thickness is about 10 μ. This layer is continuous, not being interrupted by the longitudinal muscle-bands. At short intervals throughout the length of the body it becomes thickened and forms a series of transverse ridges projecting into the body-cavity.

The longitudinal muscles form five stout radially situated bands arising from the calcareous ring and running back to the posterior end (figs. 16, 22, *l.m.*).

(iv.) *Peritoneal layer* (fig. 22, *per.*).—This is a single layer of cubical cells

showing indications of cilia in places, each cell with a conspicuous nucleus. As usual, it forms a continuous lining to the body-cavity.

General Structure of Alimentary Canal (fig. 16).—The mouth leads into a wide pharynx supported by the calcareous ring. The pharynx narrows down to a short œsophagus, which gradually increases in size and passes insensibly into the intestine, which is sacculated and slightly convoluted ; but this latter feature may, to some extent, be due to the contraction of the body. It is kept in position by two mesenteries, the anterior one being mid-dorsal in position (*d.m.*), and the posterior one on the right side. As in all Holothurians, the anterior mesentery extends to about the middle of the body of the animal, and is attached to the dorsal side of the alimentary canal and to the body-wall in the mid-dorsal line (*d.m.*). The right mesentery commences immediately behind the dorsal one, and extends between the right side of the alimentary canal and the right longitudinal muscle, to the posterior extremity. Along the intestine run the usual dorsal and ventral vessels.

Histology of Alimentary Canal.—The epidermis of the buccal region within the bases of the tentacles does not differ from that of other parts of the body except in the absence of sense-papillæ and in the presence of large numbers of ciliated depressions, presumably taste-pits, which will be described later on. The buccal region passes gradually into the pharynx, but around the actual mouth is a thicker layer of circular muscle-fibres which probably serves as a sphincter.

The pharynx is thick-walled and exhibits the following layers from without inwards :—(i.) A layer of peritoneal epithelial cells. (ii.) A very thin outer layer of connective tissue. (iii.) A layer of circularly arranged muscle-fibres, which is fairly well developed. (iv.) A layer of longitudinal muscle-fibres. (v.) An inner very thick layer of connective tissue in which the fibres are further apart than in the corresponding layer of the integument. It contains a large number of stellate and bipolar connective-tissue cells and a few apparent amœbocytes. Some of the latter are large with deeply-staining granular protoplasm. In addition to these large amœboid cells, other brown bodies are present which may be either large single cells or aggregates of cells. There is no nervous layer within this layer. (vi.) An inner epithelium lines the pharynx and is composed of elongated columnar cells, tapering peripherally, and covered at their free ends by a hyaline cuticle. Gland-cells occur very commonly between the ordinary columnar cells ; they are much longer than the latter and are rounded off peripherally. They are often arranged around depressions in the epithelium to form simple glands. In the pharynx also occur ciliated depressions (taste-pits) similar to those which are so common in the buccal region. "Sphæruliferous corpuscles" and wandering-cells are found embedded amongst the epithelial cells.

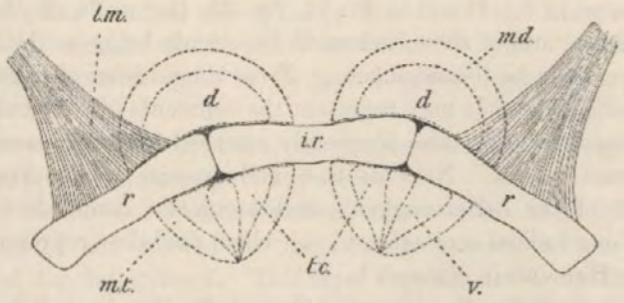
The intestine appears to be uniform in structure throughout its whole length and differs from the pharynx only in the following details:—

(i.) The epithelium is much more glandular and its surface is much more irregular than in the pharynx.

(ii.) There appear to be many more wandering-cells both in the epithelium and in the inner connective-tissue layer.

Calcareous Ring.—The calcareous ring is composed of ten simple, somewhat dumbbell-shaped pieces, five radial and five inter-radial. These pieces are all very similar to one another, and the difference between radials and inter-radials can only be recognized by their position with regard to other structures, especially by the attachment of the longitudinal muscles to the radials. The natural clefts between the pieces are overlapped and almost concealed by the diverticula of the tentacular canals (fig. 17), and at first sight the junctions appear to be in the constricted portions of the ring between the tentacular canals. This appearance, however, is deceptive, and the true relation of the constituent parts of the ring to the radial muscles and tentacular canals is shown diagrammatically in the accompanying text-figure (fig. C).

Fig. C.



Diagrammatic transverse section through the calcareous ring of *Rhabdomolgus novæ-zealandiæ*.—*d* = diverticula of tentacular canals; *i.r.* = inter-radial; *l.m.* = longitudinal muscle-band; *m.d.* = muscular wall of diverticulum; *m.t.* = muscular wall of tentacular canal; *r* = radial; *t.c.* = tentacular canals; *v.* = valve.

Water-vascular System.—The circular canal is a thin-walled tube which encircles the pharynx just behind the calcareous ring (fig. 17, *a.c.*). Its wall is only 12 μ thick, but yet the following layers can be distinguished:—(i.) An outer layer of peritoneal cells; (ii.) a connective-tissue layer; (iii.) a clear zone which does not appear to contain either cells or nuclei; (iv.) a thin layer of circular muscle-fibres; (v.) a lining endothelium composed of cells, probably ciliated, resembling peritoneal cells.

The circular canal gives off a single madreporic canal (*m.*) dorsally, a single Polian vesicle (*p.*) ventrally, and in addition ten adradially situated tentacular canals (*t.c.*) to the tentacles.

The madreporic canal is nearly straight and ends in an inconspicuous madreporite. Its length is about 1·3 mm. and transverse diameter 0·18 mm. Its wall consists of three layers:—(i.) An inner layer of columnar cells which are much longer on the side remote from the dorsal mesentery than on the side to which it is attached (fig. 24); (ii.) a connective-tissue layer, from which calcareous deposits are absent; (iii.) a layer of peritoneal cells.

The Polian vesicle is a comparatively large thin-walled sac of an elongated ellipsoid shape, opening into the circular canal on its ventral side. It is usually about 2·5 mm. long and 0·5 mm. in thickness at its widest part. The wall appears to contain the same layers as the circular canal, but they are thicker owing to the greater development of the muscular and connective-tissue layers.

The ten tentacular canals arise from the anterior side of the circular canal. They run forward on the pharynx internal to the calcareous ring. Opposite the anterior part of the ring they widen considerably, and each canal gives off a blind diverticulum which runs backwards over the outer side of the calcareous ring and is very closely applied to it (fig. 17, *d*, and fig. C, *d*). The calcareous ring therefore appears to be partially enclosed in the tentacular canals, as shown in fig. C and in Pl. **14.** fig. 23, the walls of the tentacular canals themselves and of their backward diverticula being so thin where they touch the ring as to be inconspicuous. From the position of these diverticula it seems possible that they may represent the remnants of tentacular ampullæ, for when present these are also frequently attached to the calcareous ring, for a short distance at least. Near its base, and opposite to the diverticulum on the other side of the calcareous ring, each tentacular canal shows in section a couple of longitudinal septa (fig. C, *c*.) which doubtless represent the valves described by Hamann in *Synapta* *.

The tentacles exhibit five layers in their walls (fig. 4):—(i.) An external columnar epithelium, the cells of which are very long, tapering internally, and are covered at their outer ends by a thin layer of cuticle. These cells do not differ from those described under the heading of integument, except in being longer (50–60 μ) on the outer side of the tentacle. (ii.) A connective-tissue layer which varies considerably in thickness, but is usually thickest on the outer side of the tentacle. It has the structure of the connective tissue of the integument, containing connective-tissue cells, stellate cells, and scattered fibres, with an internal nervous layer; in addition it contains a great number of peculiar, large and frequently multi-nucleate cells of doubtful nature. (iii.) A very thin layer of circular muscle-fibres. (iv.) A layer of longitudinal muscles supported internally by a basement membrane. This layer is thickest in the stem of the tentacle, gradually diminishing in

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 33.

thickness and finally disappearing at the end of the pinnules. (v.) A layer of peritoneal cells.

Nervous System.—The central nervous system consists of a ring of nervous tissue surrounding the pharynx between the latter and the calcareous ring. The nerve-cells are arranged in definite bands and are thus very conspicuous, as they stain deeply. From the nerve-ring arise five radial nerves (figs. 17, 23, *n.*) which run forwards between the tentacular canals, bend outwards beneath the five longitudinal muscles and then run backwards beneath the latter for a very short distance. They disappear before reaching the level of the calcareous ring, leaving only a cavity, containing some structureless substance which looks as if it were a coagulum (fig. 22, *cav.*). This cavity probably represents both epineural and hyponeural canals from which the nerve has disappeared. It persists to the posterior end of the body, where it ends blindly.

The structure of the radial nerve before it disappears is quite typical (fig. 21). Each is divided into two bands, an inner and an outer, by a very thin septum, which passes across the nerve nearer to the hyponeural than the epineural canal. The nerve-cells are arranged chiefly in two aggregations on the sides of the outer band, as shown in the figure. There is also a tract of nerve-cells on the inner side of the inner nerve-band adjacent to the hyponeural canal. The epineural canal is large and well-defined, the hyponeural less so.

Each radial nerve gives off a pair of nerves shortly after its origin ; each of these nerves supplies the corresponding otocyst.

In addition to the nervous system described above, there is the continuous layer of nerve-fibres and nerve-cells immediately exterior to the circular muscular layer of the integument. This layer supplies nerves to the sense-papillæ and to the "taste-pits," described below.

Sense-Organs.

(i.) *Sensory papillæ* (fig. 22, *p.*).—These are distributed over the whole surface of the body, but are most numerous in the anterior part. Each consists of a core of connective tissue covered by the epidermis, and contains a special ganglionic mass (*g.*), supplied by a nerve (*n.p.*) which comes from the nerve-layer. The ordinary columnar cells of the epidermis in these papillæ are much longer than those of the general surface of the body. The ectoderm also contains gland-cells and sensory-cells similar to those described by Hamann in the sense-papillæ of *Synapta* *. The lower ends of these sensory-cells are connected with the ganglion by means of nerve-fibrils, which form a thin layer beneath the ectoderm-cells, and appear

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 18.

to radiate from the ganglion, which also lies immediately beneath the epidermis.

(ii.) "*Taste-pits*" (fig. 3).—These are common in the epithelium of the buccal region. Each consists of an ectodermal pit which is lined by very regular, concentrically-arranged, columnar cells. As the nuclei of these cells are situated at their bases, the whole organ appears as a conspicuous subspheroid body in the ectoderm, with a diameter of 0·031 mm. In the centre of this body is a core of sensory cells (*c.*) bearing short cilia which project into the lumen of the pit. A nerve (*n.*), arising from the nerve-layer of the integument, supplies these sensory cells. From the structure of these cells it is probable that they are gustatory in function, and their restriction to the buccal region also supports this view. The ordinary columnar cells of the pit appear to serve merely as a support for the sensory cells of the core.

These organs resemble the ciliated pits described in *Synapta* by Hamann *.

(iii.) *Otocysts* (fig. 2, fig. 23, *ot*).—There are five pairs of otocysts, each pair being situated on the pharynx right and left of the corresponding radial nerve shortly after its commencement. Each is supplied by a branch from its corresponding nerve. The structure of the otocyst appears to differ somewhat from that of *Synapta*, as figured by Semon †. In transverse sections the sac appears triangular with somewhat convex sides and rounded angles. The length of the otocyst is 0·084 mm. and breadth 0·056 mm. Its wall is formed by a single layer of cells which on the side nearer to the radial nerve are of approximately equal size and cubical in shape. The middle of the wall remote from the radial nerve appears as a thin membrane (fig. 2, *d.*) and is composed of flattened cells. The nerve enters at one corner of the triangle, and here the lining cells of the otocyst are more elongated than in any other part. The nerve appears to separate into fibres which form a layer round the outside of the otocyst. The sac contains numerous rounded otoliths (*ot.*) of varying size.

Reproductive Organs.—The sexes are distinct. In both male and female the gonads (fig. 16, *g.*) consist of two bunches of sparingly-branched cæca, arranged right and left of the dorsal mesentery in the anterior third of the body-cavity. The left bunch is larger than the right. About the level of the ring-canal they unite in a slender genital duct (fig. 17, *g.d.*) running forwards in the dorsal mesentery to open mid-dorsally between, and internal to, the two dorsal tentacles.

"*Ciliated Funnels*" (figs. 25–29).—Peculiar funnel-shaped organs occur commonly on the mesentery and the longitudinal muscle-bands; in the former position they are almost invariably clustered together, in little groups of

* Hamann, Beiträge zur Histologie der Echinodermen. Die Holothurien, p. 22.

† Semon, Beiträge zur Naturgeschichte der Synaptiden des Mittelmeeres. 2. Mittheilung. Mittheilungen aus der Zoologischen Station zu Neapel, vol. vii. pl. 15. fig. 8.

about twenty individuals, whereas in the latter position they are usually isolated. The size of the open ciliated funnels from the mesentery is usually about 0·147 mm. in length, and 0·054 mm. in transverse diameter across the widest part.

The form of a ciliated funnel from the mesentery is shown in fig. 25. The entire organ may be regarded as a flat plate with the two sides curved inwards until they meet at the base, but left gaping for the greater part of their length. These ciliated funnels from the mesentery are always situated on the end of a long stalk and all of them appear to be widely open. The centre of the funnel is always filled with a large number of cells which may possibly be cœlomic cells carried into it by the action of the cilia occurring on the inside of the funnel (fig. 27).

The wall of the funnel appears to consist of a single layer of regularly arranged columnar cells bearing cilia on their inner ends. Semon describes the ciliated funnel of *Synapta* as possessing two layers of cells, an outer layer of peritoneal epithelium and an inner layer of columnar cells. We have not yet had an opportunity of examining these organs in *Synapta*, but in our *Rhabdomolgus* we have not been able to detect the external peritoneal covering.

The "funnels" which occur on the longitudinal muscle-bands appear to differ from those occurring on the mesentery. They are apparently not ciliated and present various stages from a mere closed sac-shaped body, at the end of a stalk, to the funnel-shaped body shown in fig. 26. In the earlier stages of their development these organs appear to be quite solid, and ovoid in form, consisting of a central mass of protoplasm containing a few scattered nuclei, surrounded by a more or less definite outer layer of cells as shown in fig. 28. The central mass of protoplasm later on appears to break up into large cells with conspicuous nuclei, which may be seen in figs. 26 & 29. At the same time the whole structure increases in size, becomes funnel-shaped, and finally opens at the distal extremity, apparently to allow the large granular cells of the interior (? ova) to escape (fig. 26).

From a consideration of the above facts, it seems possible that these remarkable funnel-like structures may be parasites. All those occurring on the longitudinal muscles appear to be of the same kind and possibly represent one stage in the life-history of the individual. The cells which escape from these funnels are certainly very different from any other cells occurring in the Holothurian both in size and structure. They may possibly give rise to the "ciliated funnels" of the mesentery or to others of their own kind.

The open ciliated funnels of the mesentery may thus represent another stage in the life-history, or may even be males, while those on the longitudinal muscles are females. A strong argument in favour of the view that these structures are parasites is the fact that they are much less numerous in some

individuals than in others and also that they have no definite arrangement, but are scattered haphazard over the peritoneal epithelium. In *Rhabdomolgus ruber* these organs appear to be absent *, a fact which also supports our suggestion as to their nature.

A variety of functions have been assigned to these organs, but none of them seem very probable. Some authors have regarded them as excretory organs; others suppose that they serve to maintain the circulation of cœlomic fluid; whilst one regards them as accessory respiratory organs. Semon † described those of *Synapta* in detail, and came to the conclusion that they are "lymph-stomata." Ludwig discusses the question and also gives references to the literature in his work on the "*Holothuroidea*" in Bronn's 'Klassen und Ordnungen des Thier-reichs.' Although differing considerably in structure, the ciliated urns of the Sipunculidæ may perhaps be cited as a parallel case of structures previously regarded as integral parts of the animal in which they occur and subsequently as parasites.

The genus *Rhabdomolgus* was founded by Keferstein in 1863 for an apparently pelagic Holothurian observed only once, at St. Vaast, and to which he gave the specific name *ruber* ‡. Ludwig has recently re-described the species after an interval of forty-two years (*loc. cit.*).

That the New Zealand species is distinct from that found at St. Vaast can, we think, scarcely be doubted. In the latter the tentacles are "undivided, slightly lobate on the sides," whereas in our species the pinnæ of the tentacles are well developed. An even more striking difference is the enormous size of the New Zealand species as compared with the European one.

The probable relationship of *Rhabdomolgus* to *Chirodota* is discussed under the heading of *Chirodota geminifera*, sp. n.

EXPLANATION OF THE PLATES.

Plate 11.

Figs. 1–4. *Rhabdomolgus novæ-zealandiæ*, sp. n.

Fig. 1. Sketch of the entire animal. (× 2.)

Fig. 2. Transverse section of an otocyst. (× 550.)

c.e. = cubic epithelium; *d.* = thin part of wall; *n.* = nerve supplying otocyst; *ot.* = otoliths.

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* Ludwig, "Ein wiedergefundenes Tier: *Rhabdomolgus ruber*, Keferstein," Zoologischer Anzeiger, Bd. xxviii. (1905) pp. 458–459.

† Semon, Beiträge zur Naturgeschichte der Synaptiden des Mittelmeeres. 2. Mittheilung. Mittheilungen aus der Zoologischen Station zu Neapel, Bd. vii. p. 415, Taf. 15. figs. 9–15.

‡ Keferstein, "Untersuchungen über niedere Seethiere," Zeitschrift für wissenschaftliche Zoologie, Band xii. pp. 34-35, Taf. 11. fig. 30.

Fig. 3. Vertical section of a ciliated depression ("taste-pit") from the buccal region, with the surrounding integument. (× 900.)
c. = central core of sensory cells bearing short cilia; *c.m.* = circular muscle-layer; *c.s.* = supporting columnar cells; *c.e.* = columnar epithelium of body-wall *cu.* = cuticle; *n.* = nerve supplying the taste-pit; *n.l.* = nerve-layer; *c.l.* = connective-tissue layer; *s.l.* = granular wandering-cell.

Fig. 4. Transverse section of a branch of a tentacle. (× 500.)
c.e. = columnar epithelium; *c.l.* = connective-tissue layer; *c.m.* = circular muscle-layer; *cu.* = cuticle; *m.* = thin basement membrane supporting the longitudinal muscles; *l.m.* = longitudinal muscle-layer; *p.* = peritoneal layer.

Figs. 5 *a*–5 *b*. *Stichopus simulans*, sp. n.

Fig. 5 *a*. Table.

Fig. 5 *b*. Dichotomously foliaceous spicules.

Figs. 6–6 *a*. *Pseudocucumis bicolumnatus*, sp. n.

Fig. 6. View of entire animal. (× 1½.)

Fig. 6 *a*. Part of the calcareous ring. (× 9.)
i.r. = inter-radial; *r.* = radial.

Figs. 7–8. *Phyllophorus dearmatus*, sp. n.

Fig. 7. View of entire animal. (× 1½.)

Fig. 8. Part of calcareous ring. (× 3.)
i.r. = inter-radial; *r.* = radial.

Plate 12.

Figs. 9–11 *h*. *Chirodota gigas*, sp. n.

Fig. 9. Sketch of a part of the calcareous ring. (× 10.)
i.r. = inter-radial; *r.* = radial.

Fig. 10. Diagram of the water-vascular ring and its appendages. (× .)
m. = madreporic canal; *p.* = Polian vesicles; *r.* = ring nal.

Fig. 11 *a*. Miliary granules from the radii. (× 250.)

Fig. 11 *b*. Curved rods. (× 250.)

Fig. 11 *c*. Fully developed wheel. (× 250.)

Fig. 11 *d*. Optical vertical section of a wheel. (× 250.)

Figs. 11 *e*, 11 *f*. Developmental stage of the wheel. (× 490.)
11 *e* = inner face of wheel; 11 *f* = outer face.

Fig. 11 *g*. A four-rayed wheel (abnormal). (× 490.)

Fig. 11 *h*. Curved rods from the tentacles. (× 280.)

Fig. 12. *Stichopus mollis*.
Irregular perforated plate from a tube-foot. (× 250.)

Figs. 13–14. *Pseudocucumis bicolumnatus*, sp. n.
Figs. 13 *a*–13 *d*. Spicules of the integument. (× 350.)

Fig. 13 *a*. Three views of characteristic tables.

Fig. 13 *b*. A single table with one column (abnormal).

Fig. 13 *c*. An oval perforated plate.

Fig. 13 *d*. An irregular perforated plate.

Fig. 14. Internal anatomy of the animal seen when opened up along the right ventral inter-radius. (× 2.)

a.c. = ambulacral ring-canal; *c.* = cloaca; *g.* = gonad; *g.d.* = genital duct; *i.* = intestine; *i.r.* = inter-radial; *l.m.* = longitudinal muscle; *m.* = madreporic canal; *p.* = Polian vesicle; *ph.* = pharynx; *r.* = radial; *r.mes.* = right mesentery; *ret.m.* = retractor muscle of the pharynx; *r.t.* = respiratory tree.

Fig. 15. *Phyllophorus dearmatus*, sp. n.

Internal anatomy of the animal seen when opened up along the right lateral inter-radius. (× 1½.)

œ. = œsophagus. (Other lettering as in the preceding figure.)

Plate 13.

Figs. 16–17. *Rhabdomolgus novæ-zealandiæ*, sp. n.

Fig. 16. Sketch of the internal anatomy of the animal seen when opened up along the left dorso-lateral inter-radius. (× 2.)

a.c. = ambulacral ring-canal; *c.r.* = calcareous ring; *d.m.* = dorsal mesentery*; *d.v.* = dorsal vessel; *g.* = gonad; *g.d.* = genital duct; *i.* = intestine; *l.m.* = longitudinal muscle-band; *m.* = madreporic canal; *p.* = Polian vesicle; *t.* = tentacles; *t.c.* = tentacular canals; *t.m.* = transverse ridges formed by the circular muscle-layer; *v.v.* = ventral vessel.

Fig. 17. Semidiagrammatic sketch of the anterior part of the alimentary canal, together with the tentacles &c., viewed laterally. (× 12.)

a.c. = ambulacral ring-canal; *c.r.* = calcareous ring; *d.* = diverticula of tentacular canals; *g.* = gonad; *g.d.* = genital duct; *m.* = madreporic canal; *n.* = radial nerve; *p.* = Polian vesicle; *ph.* = pharynx; *pinn.* = pinnules of a tentacle; *t.* = tentacles; *t.c.* = tentacular canal.

Figs. 18 *a*–18 *d*. *Phyllophorus longidentis.*

Spicules, showing various stages of development. (× 150.)

Fig. 18 *a*. An early stage at which no perforations are complete and the two rods which form the spine are still distinct.

Fig. 18 *b*. A stage at which four perforations have been completed; the two rods of the spine are still distinct.

Fig. 18 *c*. A more advanced stage at which the two rods have fused to form a single spine.

Fig. 18 *d*. Side view of a spinous plate.

Figs. 19 *a*–19 *c*. *Holothuria difficilis.*

Fig. 19 *a*. A bilateral perforated plate. (× 200.)

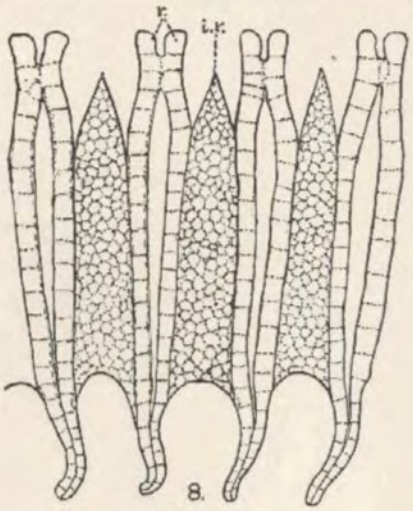
Fig. 19 *b*. Various biscuit-shaped spicules. (× 250.)

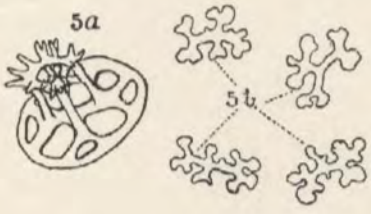
Fig. 19 *c*. Two views of a table. (× 200.)

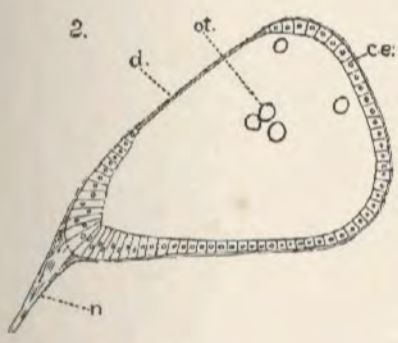
Fig. 20. *Phyllophorus dearmatus*, sp. n.

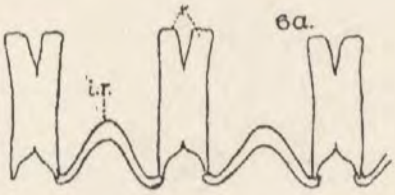
Perforated end-plate from a tube-foot. (× 150.)

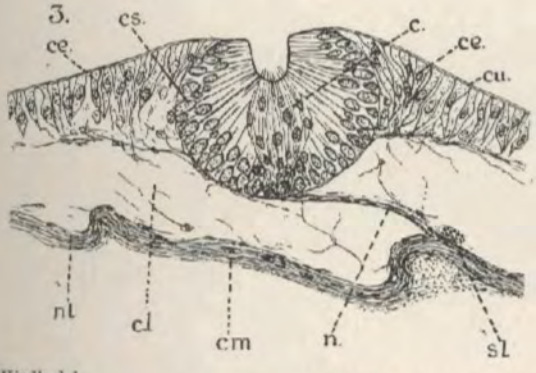
* The dotted line should be continued in a little further.

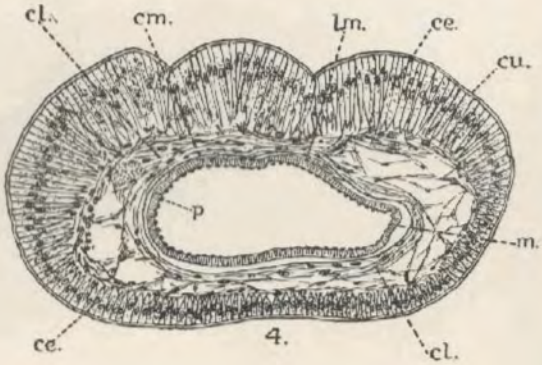












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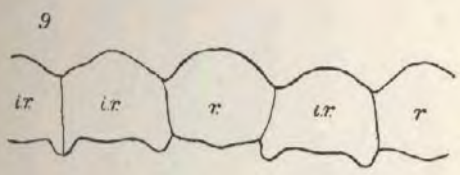

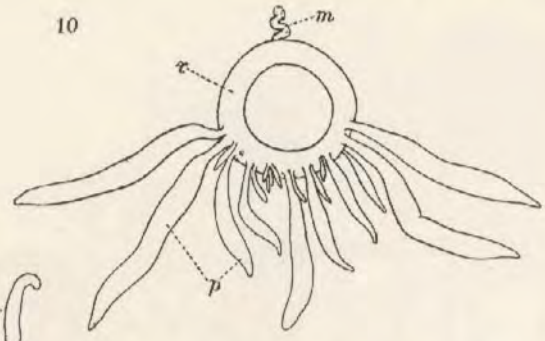

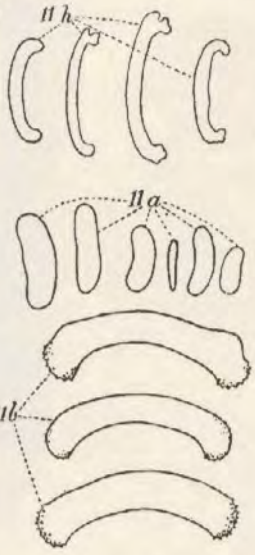

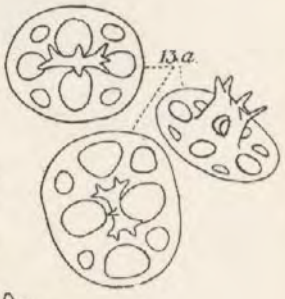

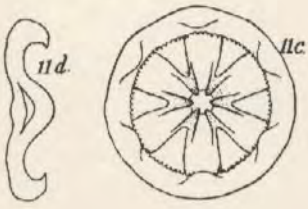

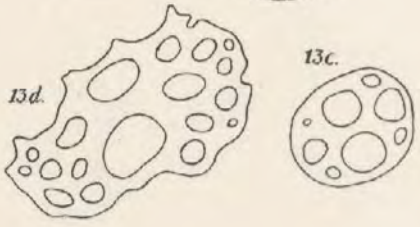

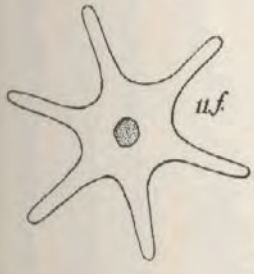

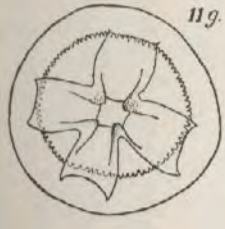

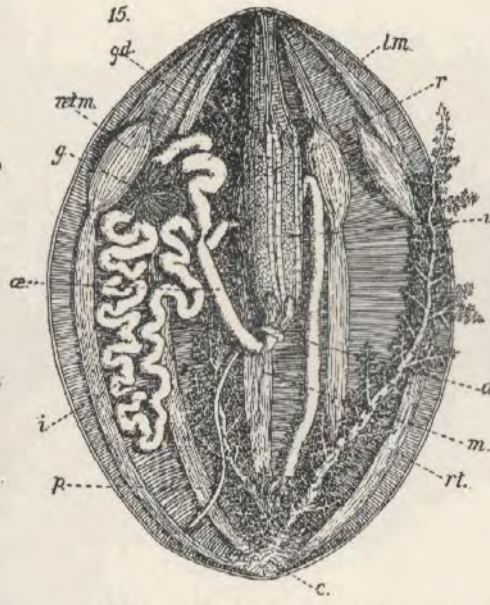

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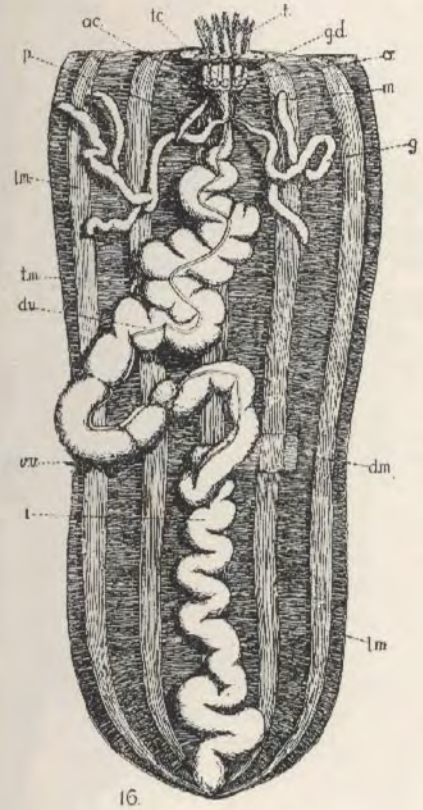

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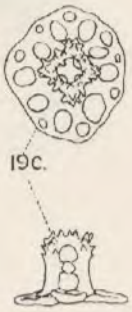

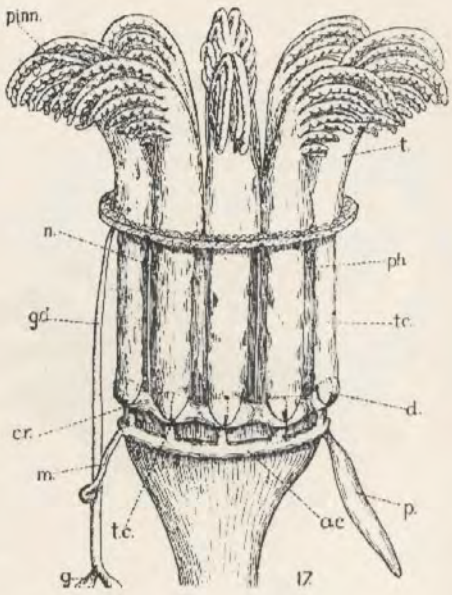

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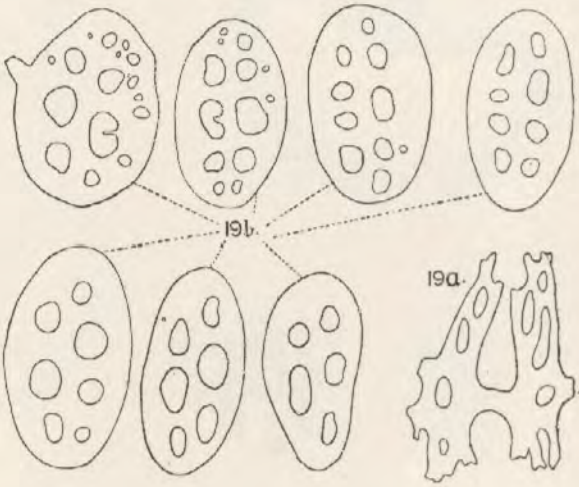
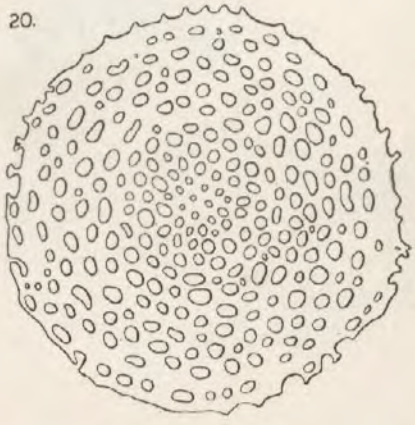
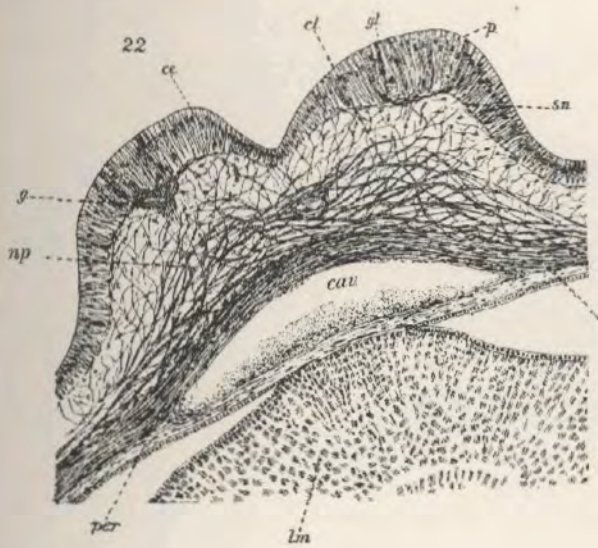
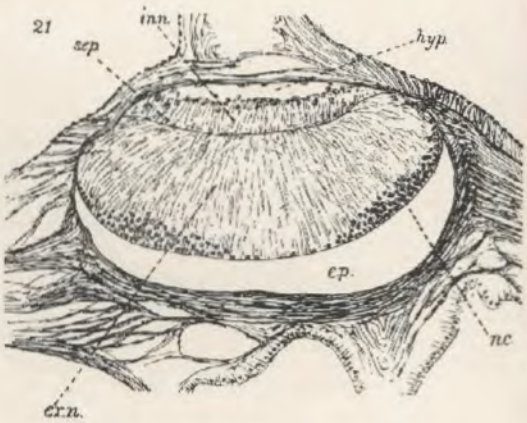


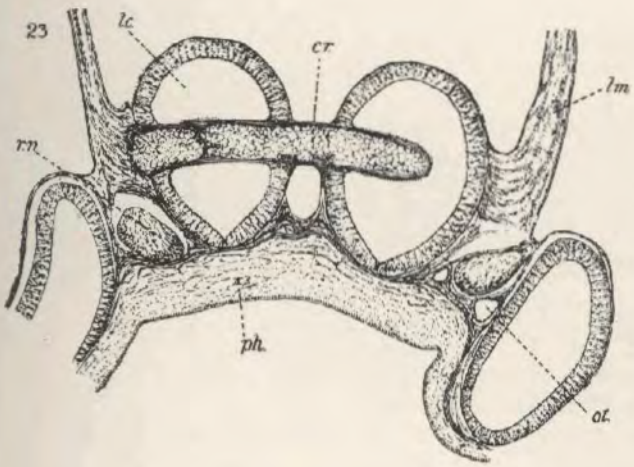


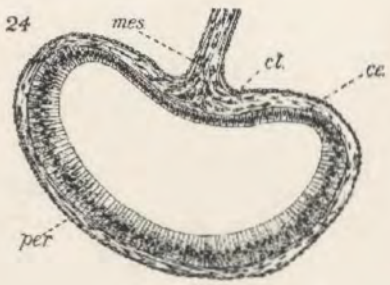
E. H indle del.

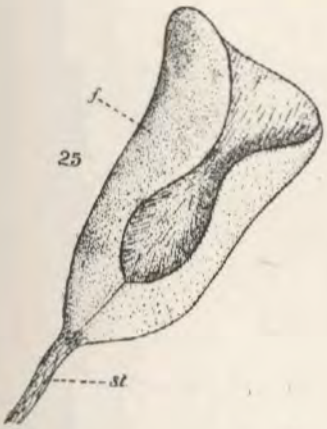
NEW ZEALAND HOLOTHURIANS.











E. Hindle del.

NEW ZEALAND HOLOTHURIANS.

Plate 14.

Figs. 21–29. *Rhabdomolgus novæ-zealandiæ.*

Fig. 21. Transverse section of the radial nerve whilst on the pharynx. (× 225.)
ep. = radial epineural space; *ex.n.* = external band of the radial nerve; *hyp.* = radial hyponeural space; *in.n.* = internal band of radial nerve; *n.c.* = nerve-cells; *sep.* = septum of connective tissue between the inner and outer bands of the radial nerve.

Fig. 22. Transverse section of radial region of the body-wall after the disappearance of the radial nerve. (× 225.)
cav. = radial cavity; *c.e.* = columnar epithelium; *c.l.* = connective-tissue layer; *c.m.* = circular muscle-layer; *g.* = ganglion, from which radiate the nerves of the sense-papilla; *gl.* = gland-cell; *l.m.* = longitudinal muscle-band; *n.l.* = nerve-layer*; *n.p.* = nerve supplying the ganglion *g.*; *p.* = sense-papilla; *per.* = peritoneal layer; *s.n.* = superficial layer of nerve-fibres beneath the epithelium.

Fig. 23. Transverse section (somewhat oblique) through the calcareous ring, &c. (× 55.)
c.r. = calcareous ring; *l.m.* = longitudinal muscle-band; *ot.* = otocyst; *ph.* = pharyngeal wall; *r.n.* = radial nerve; *t.c.* = diverticulum of tentacular canal.

Fig. 24. Transverse section of the madreporic canal. (× 250.)
c.e. = endothelium of columnar cells (probably ciliated); *c.t.* = connective-tissue layer; *mes.* = mesentery; *per.* = peritoneal layer.

Fig. 25. Ciliated funnel from the dorsal mesentery. (× 300.)
f. = funnel; *st.* = stalk.

Fig. 26. Funnel from a longitudinal muscle-band showing two large cells (? ova) escaping from the mouth. (× 250.)
c. = large nucleated cells, filling the funnel; *ov.* = large cells escaping from the funnel; *st.* = stalk.

Fig. 27. Transverse section of an open ciliated funnel from the dorsal mesentery. (× 300.)
c.c. = ciliated columnar cells; *p.c.* = cellular contents.

Fig. 28. Transverse section of a closed funnel from a longitudinal muscle-band. (× 300.)

Fig. 29. Transverse section of another funnel from a longitudinal muscle-band. (× 300.)

Figs. 30 *a*–30 *c*. *Chirodota geminifera*, n. sp.

Fig. 30 *a*. Sigmoid spicules showing some variations of shape. (× 280.)

Fig. 30 *b*. A young pair of sigmoid spicules. (× 280.)

Fig. 30 *c*. An older pair of sigmoid spicules, partially fused. (× 280.)

* The dotted line has been accidentally omitted; the nerve-layer lies just outside the layer of circular muscles, but is not distinctly shown.