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Observations on the Holothurians of New Zealand; with Descriptions of four New Species, and an Appendix on the Development of the Wheels in *Chirodota*.

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[Read 5th November, 1896.]

(PLATES 3–7.)

1. INTRODUCTORY REMARKS.

MY attention was first directed to the subject of this communication shortly after my arrival in New Zealand, by the receipt of a remarkable specimen collected on the New Brighton (Christchurch) beach by Mr. R. M. Laing, M.A. I shortly afterwards received a second specimen of the same species from Mr. J. P. Grossmann, M.A., of which I made a detailed anatomical examination. The species proved to be a new *Colochirus*, covered with overlapping scales, and is described in the context as *Colochirus ocnoides*.

Early in the course of this investigation, I was greatly struck with the inadequacy of our knowledge of the New Zealand Holothurians, and especially with the remarks to that effect made by Théel in his 'Challenger' Report.

I therefore determined to attempt a revision of the group, and proceeded to Wellington with a view to examining the type specimens in the Colonial Museum. Thanks to the kindness of Sir James Hector, I was enabled to do this, so far as the present condition of the specimens allowed. I found there specimens, apparently the original types, of "*Synapta uncinata*," "*Synapta inæqualis*," "*Molpadia coriacea*," "*Chirodota? alba*," "*Thyone brevidentis*," and "*Thyone longidentis*," described by Hutton in 1872 in his 'Catalogue of the Echinodermata of New Zealand.'

I unfortunately found these specimens in a very bad state of preservation, owing to the short-handedness of the Museum staff, but they were still of the greatest service in determining questions of synonymy.

Captain Hutton himself very kindly placed at my disposal type-slides of the spicules of his "*Molpadia coriacea*," "*Chirodota alba*," "*Thyone caudata*," and "*Holothuria mollis*," all marked "Wellington."

I also applied to Professor T. J. Parker for material from the

Dunedin Museum, and am greatly indebted to him for named specimens of "*Thyone caudata*," "*Echinocucumis alba*," and especially his own "*Chirodota dunedinensis*," as well as for a new species of *Psolus* collected at the Macquarie Islands.

Unfortunately the type specimens of Hutton's "*Cucumaria Thomsoni*," "*Labidodesmus turbinatus*," and "*Holothuria Robsoni*" had been sent from Dunedin to the Colonial and Indian Exhibition in London, and thence presumably to the British Museum; so that I am unable to add anything to our knowledge of these species, and can only hope that they will be re-examined by the Museum authorities.

I am also indebted both to Captain Hutton and Professor Parker for several additional specimens of that remarkable Holothurian *Caudina* (*Molpadia*) *coriacea*, and to Captain Hutton again for the loan of specimens of *Colochirus ocnoides*, n. sp., and *Cucumaria Huttoni*, n. sp., from the Canterbury Museum.

Mr. H. Farquhar, of Wellington, very kindly gave me another specimen of "*Echinocucumis alba*," dredged in Wellington Harbour, and allowed me to make use of a manuscript Catalogue of New Zealand Echinodermata compiled by himself.

While I was staying at Wellington, my friend Mr. H. B. Kirk took me to some of his favourite collecting-grounds in Cook Straits, where we secured living specimens of *Stichopus mollis*, Hutton sp., and *Colochirus calcarea*, n. sp. Mr. Kirk also sent me a further supply of these species to Christchurch.

To all these gentlemen I wish to express my very sincere thanks.

The only other Holothurians known from New Zealand are those collected by the 'Challenger' Expedition and described by Théel. I have of course been unable to examine the types of these, but the full descriptions and figures given in the 'Challenger' Report render this unnecessary. Indeed I ought also to express my indebtedness to the admirable monographic account of the group given in the 'Challenger' Report, as but for it I could not have completed this investigation, for I need hardly point out that in the absence of zoological libraries such a piece of work becomes almost impossible.

2. Summary of Results.

The majority of the already known species of New Zealand Holothurians have been re-examined, especially with regard to

the hitherto almost entirely unknown internal anatomy and spiculation, and the results are given in the body of this paper, illustrated by figures of the characteristic spicules and other parts.

Four new species are described and illustrated, viz., *Cucumaria Huttoni*, *Colochirus ocnoides*, *Colochirus calcarea*, and *Psolus macquariensis*.

The 'Challenger' specimens of *Chirodota australiana* are shown to be probably identical with *C. dunedinensis*, the sigmoid spicules of the latter having been hitherto unrecorded; so that it is very doubtful if the Australian species has been found in New Zealand waters at all, unless indeed the two be identical.

Echinocucumis alba, Hutton, is shown to be a *Colochirus*.

Thyone brevidentis, Hutton, is shown to be almost certainly a *Colochirus* also.

Thyone caudata, Hutton, and *Thyonidium rugosum*, Théel, are shown to be identical with *Thyone* (*Pentadactyla*) *longidentis*, Hutton.

Stichopus sordidus, Théel, is shown to be identical with *Holothuria mollis*, Hutton, which is really a *Stichopus*.

Allowing for these determinations in synonymy, the number of known species of New Zealand Holothurians now becomes seventeen, but four of these, viz., *Synapta inæqualis*, *Cucumaria* (?) *Thomsoni*, *Cucumaria* (?) *turbinata*, and *Holothuria Robsoni*, are still very imperfectly known and may prove to be synonymous; while two of them, viz., *Ankyroderma Marenzelleri* and *Holothuria lactea*, were obtained by the 'Challenger' in deep water, and perhaps ought scarcely to be included in the New Zealand fauna.

It is remarkable that no fewer than three of our New Zealand species, viz., *Cucumaria Huttoni*, *Colochirus alba*, and *Colochirus ocnoides*, are provided with overlapping dermal plates, a condition which elsewhere does not appear to be at all common in the group.

Théel has already pointed out that the genus *Colochirus* is especially characteristic of the Indian and Pacific Oceans, so that it is not surprising to find that no fewer than four of our species are referable thereto.

I have not thought it necessary to give figures of the general anatomy because no strikingly new anatomical facts have been discovered, and descriptions of the internal organs appear generally to be sufficient for systematic purposes.

Perhaps the most interesting anatomical result is that *Chirodota*

dunedinensis is shown to be unisexual, as opposed to the hermaphrodite condition supposed to be characteristic of the genus.

A little-known type of spicule is described in a species of *Stichopus* (figs. 83–87); and some apparently new facts concerning the structure and development of the wheels of *Chirodota* are given in the Appendix.

The arrangement of the genera is that followed in the 'Challenger' Report.

3. The New Zealand Species.

Synapta uncinata, *Hutton*.

1872. Synapta uncinata, *Hutton, Cat. Echinoderm. N. Z.* p. 16.

1886. Synapta uncinata, *Théel, 'Challenger' Holothurioidea*, p. 27.

The original description runs:—"Body curved, ? tapering behind, broadest at the mouth; tentacula thirteen, very short, merely tubercles, with two incurved hooks at the end of each.

"Pale reddish-brown.

"Length ·6; breadth at anterior end ·2.

"Dermal plates anchor-shaped; the flukes equal."

A small jar in the Wellington Museum, labelled "31. *Synapta uncinata*," contained what is evidently the type and only known specimen of this species. The specimen is merely the anterior end of the animal, about half-an-inch in length, bearing the crown of thirteen tentacles. The individual to which it belonged may have been of considerable size, probably at least four or five inches in length. The thirteen tentacles are of equal size and arranged in single series. In their present contracted state they are short and stumpy, and each bears four incurved digits at its extremity, the two inner ones being larger than the two outer. They are evidently the two larger digits to which Hutton refers under the name of "incurved hooks." Each tentacle also bears along each margin, and facing inwards, a double row of small projections which are indistinguishable from sucker-bearing tube-feet.

On cutting the specimen open, I found the madreporic ring and its appendages still in a fair state of preservation. There were nine long, straight, slender Polian vesicles and three madreporic canals. Of the latter, two were branched and slightly convoluted; the other much convoluted, but apparently not branched. The madreporic canals were situate dorsally, on the same side as the mesentery. The longitudinal muscles were very strongly developed, and there were no retractors.

Although I examined preparations of the integument, both simply cleared with absolute alcohol and oil of cloves and after boiling with caustic potash (2 per cent. solution), I could find no spicules, nor could I find any pharyngeal skeleton.

Possibly the spirit in which the specimen has lain for more than twenty years may have contained some acid which has effectually removed all calcareous deposits.

SYNAPTA INÆQUALIS, *Hutton*.

1872. Synapta inæqualis, *Hutton, Cat. Echinoderm. N. Z.* p. 17.

1886. Synapta inæqualis, *Théel, 'Challenger' Holothurioidea*, p. 32.

The original description runs:—"Conical; inflated anteriorly and tapering behind; soft, minutely papillose; tentacles none?

"Brownish grey.

"Length 1·0; breadth at the anterior end ·33.

"Dermal plates anchor-shaped, with one fluke much longer than the other."

The type specimen in the Wellington Museum is in a perfectly useless condition. It was nearly dry when I first saw it and has apparently at some time been completely desiccated, so that it now resembles a small fragment of brown, shrivelled leather. As in the type of *S. uncinata*, the spicules have apparently all been dissolved out.

CHIRODOTA DUNEDINENSIS, *Parker*. (Pl. 3. figs. 1–8.)

1881. Chirodota dunedinensis, *Parker, Trans. N. Z. Inst.* vol. xiii. p. 418.

1886. Chirodota australiana, *Théel, 'Challenger' Holothurioidea*, p. 16.

1886. Chirodota dunedinensis, *Théel, 'Challenger' Holothurioidea*, p. 34.

The original description of the species runs:—"Tentacles ten, each with about ten processes, which increase in size progressively from the proximal to the distal end. Integument quite smooth, there being no tentacles or papillæ. Colour yellowish (owing to the bright yellow viscera shining through the translucent skin) with small crimson spots which disappear in spirit; tentacles whitish, with dark spots on the inner side at the base; these spots are unaffected by spirit. Length, in the extended condition, about 4 cm. Otago harbour: littoral."

This is supplemented by the following generic diagnosis:—"Worm-like; calcareous spicules in the form of wheels imbedded

in the skin; tentacles shield-shaped, produced at the edges into finger-like processes (Tentacula peltato-digitata)."

Professor Parker has very kindly sent me six specimens of this beautiful little Holothurian, three preserved after treatment with osmic acid and three after treatment with picric. Although it is ten or twelve years since they were bottled, the specimens are in an excellent state of preservation, especially those treated with picric acid. I am thus able to add the following particulars to the above description.

The spicules (which have not been perceptibly injured by the method of preservation) are of two kinds:—(1) Wheels (figs. 1–6), about 0·16 mm. in diameter, and each with six spokes (*vide* Appendix). (2) Contorted sigmoid spicules (fig. 7), resembling the siliceous spicules known as "contort sigmata" in sponges; measuring about 0·11 mm. from bend to bend. Both kinds of spicule are abundant and both are loosely and irregularly scattered through the interambulacral integument, not aggregated in papillæ; but whereas the sigmata occur abundantly in all the interambulacra, the wheels appear to be entirely absent from the two interambulacra of the ventral surface.

There is a pharyngeal skeleton in the form of a slender calcareous ring of ten simple pieces, of which the ends touch (fig. 8).

The integument is thin and translucent, but the five longitudinal bands of muscle are well developed. There are, of course, no retractor muscles.

The alimentary canal is not thrown into loops but runs straight from mouth to anus, and is slightly convoluted by the contraction of the body.

There is a single elongated, slender Polian vesicle, placed ventrally; and what appears to be the madreporic canal is very small and situate dorsally.

The sexes are distinct, and the females may be readily distinguished by the relatively large eggs in the ovary, which give that organ a coarsely granular appearance very different from that of the smooth-looking testis. The reproductive organs have the same form and relations in both sexes, consisting of a few long slender tubes hanging down from the end of the short genital duct, which lies dorsally at the anterior end of the body. The longer tubes extend back nearly to the hinder end of the body.

The condition of the reproductive organs is especially inter-

esting, because the genus *Chirodota* is usually considered to be characteristically hermaphrodite; and this is, I believe, the first species known to depart from the typical condition in this respect.

The species is evidently very closely related to *C. australiana*, Stimpson*. Théel, however, being unaware of the existence of sigmoid spicules in *C. dunedinensis*, placed it in a different section of the genus. As a matter of fact the Australian species seems to be distinguished by little if anything more than the aggregation of the spicules into two kinds of papillæ. A comparison of the two may even show them to be identical, but I do not think this very likely.

Théel observes that in the 'Challenger' specimens identified by him with *C. australiana*, "the wheels and sigmoid bodies seem to be present all over the body," and that the aggregation of the spicules into papillæ was not distinct. These specimens at any rate are probably identical with the Dunedin species. The record of locality in the 'Challenger' Report seems to be somewhat doubtful, viz. "*Habitat.* Port William (New Zealand, Falkland Islands?); depth 5–10 fathoms; two specimens."

ANKYRODERMA MARENZELLERI, *Théel.*

Ankyroderma Marenzelleri, *Théel, 'Challenger' Holothurioidea*, p. 41, pl. iii. fig. 1.

This appears to be a deep-water species, and only a single incomplete specimen was obtained by the 'Challenger,' from a depth of 700 fathoms (Station 169). It has not since been met with.

CAUDINA CORIACEA, *Hutton.* (Pl. 3. figs. 9–18.)

1872. Molpadia coriacea, *Hutton, Cat. N. Z. Echinoderm.* p. 17.

1879. Caudina (?), Echinosoma (?), *Hutton, Trans. N. Z. Inst.* vol. xi. p. 307.

1883. Caudina meridionalis, *Bell, Proc. Zool. Soc. Lond.* p. 58, pl. xv. fig. 1.

1886. Caudina coriacea, *Théel, 'Challenger' Holothurioidea*, pp. 47, 54, pl. iii. fig. 4.

The original description runs as follows:—"Body cylindrical, tapering rather suddenly into an attenuated and tapering tail, which is half the length of the body; skin rough, coriaceous; body transversely wrinkled; anterior end smooth; mouth with from ten to twenty short, simple papillæ; teeth five, long, bifid; longitudinal muscles with a deep central groove."

* *Vide* Théel, *loc. cit.* p. 16 &c.

"Pale brown.

"Length 4·0; breadth ·65."

This description is preceded by the following diagnosis of the genus *Molpadia* :—"Body attenuated posteriorly; tentacula simple, short, cylindrical."

I found in the Wellington Museum a single specimen in a jar labelled "34. Molpadia coriacea," which is doubtless one of the specimens examined by Hutton, though as it had not been cut open it can hardly be the one from which the above description was taken. The specimen was in a very bad state of preservation, having evidently been desiccated; in fact it was nearly dry when I first saw it. The spicules, however, were still present.

I have also received from Captain Hutton a type-slide of the spicules of this species, from Wellington.

I have also had for examination a fine specimen from Akaroa, belonging to the Canterbury Museum; three *fresh* specimens cast up on the shore at Oamaru, from Captain Hutton; and three spirit-preserved specimens from the same locality from Professor Parker. I have also seen a specimen cast up on the New Brighton beach; so that the species would appear to be not uncommon on the East coast of New Zealand.

The original description was apparently based on a shrivelled specimen, and will be seen to require considerable modification. The 'Challenger' specimens were fragmentary, and the specimens described by Bell also seem to have been in a very unsatisfactory state. Théel states that he saw two specimens presented by Hutton to the State Museum of Stockholm, but he was evidently unable to make a complete examination of them. Under these circumstances the following particulars as to this very remarkable-looking Holothurian may be of interest.

The animal consists of an inflated, subcylindrical or ovoid body, broadly rounded in front and contracting suddenly behind to form the stout cylindrical "tail," which tapers gradually to the terminal anus. None of the specimens examined by me show any definite anal papillæ or teeth, as described by Théel for the 'Challenger' specimens. In the largest example which I have seen, the body and tail are each somewhat over 3 inches in length, the body about 1¼ inches in diameter in the middle, and the tail about ¼ inch in diameter in the middle.

The tentacles are fifteen in number, short and stumpy, each with four conical digits, two large and two small. They are

evidently the contracted tentacles which Hutton describes as "papillæ" in the neighbourhood of the mouth. In fresh specimens the body is of a dull purple colour, and the tail greyish yellow. The tentacles are orange, sometimes streaked longitudinally with pink. The body-cavity is filled with a large quantity of thin, reddish-brown liquid, resembling blood, to the presence of which the dull purple colour of the animal is largely due. The integument in fresh specimens is smooth and subglabrous all over, transversely wrinkled only at the root of the tail. It is thin and soft in the region of the body, though tough. It appears firmer in the tail because of the absence of any large, fluid-containing body-cavity therein.

The alimentary canal appears to be quite typical. It consists in the swollen "body" of three limbs, descending, ascending and, descending, forming the usual S-shaped loop, the last limb ending in the long, slender rectum, which occupies the whole of the tail and is attached to the body-wall by radial muscle-fibres. The two respiratory trees, attached to the commencement of the rectum, are large and very copiously branched.

The longitudinal muscles are powerfully developed, each consisting of two distinct bands with a deep groove between them. There are no properly developed retractor muscles, but these are probably represented by certain small slips of muscle which arise one from each half of each longitudinal muscle near its anterior end, and unite together in pairs to become attached to the radial plates of the calcareous ring.

The ambulacral ring has a single, sausage-shaped Polian vesicle, placed ventrally, and a single small madreporic canal, placed dorsally close to the genital duct. There are fifteen elongated tentacular ampullæ.

The sexes are distinct. The reproductive organs are bulky and consist of a great number of copiously branched, slender, moniliform tubes, attached near the anterior end of the body to the single short dorsal genital canal.

The pharyngeal skeleton (Pl. 3. fig. 18) consists of a complete calcareous ring of ten pieces. The five radials are rather large, and each ends posteriorly in a bifid prolongation. The interradials are small and simple, wedged in between the anterior ends of the radials. The anterior margin of the ring is provided with fifteen small sharp teeth, two belonging to each radial and one to each interradial.

The typical spicules (figs. 9–11) are described by Théel as "wheel- or cup-shaped deposits," and his figures leave no doubt as to their identity with those examined by me. I should prefer to describe them, however, as rings, which enclose a cross on the one side and a square on the other. The margin is undulating, curving in at eight points, where the cross and square are attached. The diameter of the ring is about 0·055 mm. These spicules are very abundantly scattered through the integument, forming an almost continuous crust.

As Théel has already pointed out, the spicules around the anus differ from those elsewhere, being irregularly branched or reticulate (Pl. 3. figs. 12–14). The tentacles contain only a few small reticulate plates lying near their bases.

This Holothurian is very remarkable for the brownish-red cœlomic fluid, which bears many points of resemblance to human blood. Under the microscope it is seen to consist of a colourless liquid in which numerous corpuscles float. The most conspicuous of these are spherical bodies (Pl. 3. fig. 15) of a brownish-yellow colour, and about a quarter as large again as human red blood-corpuscles. These are extremely numerous, and sometimes appear polygonal from mutual pressure (Pl. 3. fig. 15 *a*). They are mostly of about the same size, though some are a good deal smaller than the majority. Each contains, as a rule, one or a few highly refractive particles. A 5 per cent. solution of common salt causes the cell-contour to become wrinkled, but they never appear flattened like human red corpuscles.

Colourless corpuscles also occur in the cœlomic fluid; these appear to be of two kinds, some being only slightly smaller than the brown corpuscles and coarsely granular, while others are only of about half the diameter of the brown corpuscles, and finely granular. The cœlomic fluid does not coagulate on exposure to the air, but does so in alcohol.

The above observations were made on fresh specimens which had been out of the water for some little time.

The only kindred observations known to me are those of Howell, who describes* hæmoglobin-bearing corpuscles in the water-vascular and perivisceral fluids of *Thyonella gemmata*. Howell has also referred to the existence in this species of two kinds of colourless corpuscles; and the structural differences which

* Howell, W. H. Studies from the Biol. Lab. of Johns Hopkins Univ., Baltimore, vol. iii. p. 284.

I have observed in these in *Caudina* are suggestive of those discovered and more fully investigated by Hardy * in the Crustacea.

CUCUMARIA HUTTONI, n. sp. (Pl. 3. figs. 19, 20.)

Body cucumiform, bluntly rounded in front, more tapering behind; posterior extremity slightly turned up dorsalwards. Integument smooth, but hard and thick, with minutely but distinctly scaly appearance, owing to the presence of overlapping calcareous plates, which are distinctly visible to the naked eye. No distinct teeth or papillæ around mouth or anus. Length of body a little more than 3 inches, diameter in the middle about two-thirds of an inch.

Tentacles copiously branched, dendriform, ten in number. The mid-ventral tentacle is longer, and that on each side of it shorter, than any of the others; the mid-dorsal is also perhaps rather shorter than the lateral tentacles, but all are well-developed.

The body when fresh is of a pale greyish-yellow colour. The tentacles are abundantly speckled with brown.

The ambulacral appendages are very feebly developed. Three irregular, multiple, but rather scanty rows of small pedicels (? any fully developed tube-feet) are visible on the ventral ambulacra, in the middle part of the body. None are visible on the dorsal surface. Dissection failed to reveal the presence of any ampullæ.

The five longitudinal muscles are undivided and powerfully developed. The retractors of the pharynx are remarkably strong, and spring from the corresponding longitudinal muscles at about one-third of the distance from the anterior to the posterior extremity of the contracted animal.

The pharynx (Pl. 3. fig. 19) is very large and consists of two distinct parts. The anterior part is about half an inch in length, eversible, muscular and soft-walled. The posterior part is about an inch in length and is supported by the very strongly developed calcareous ring, to the radial pieces of which are attached the retractor muscles. The tentacles are attached at the junction of the anterior and posterior portions of the pharynx, a little in front of the retractor muscles. In the retracted state they point straight backwards, and are thus lodged in the posterior part of the pharynx, which they completely fill.

The calcareous ring (Pl. 3. fig. 19) is very complex, and consists of ten compound pieces. The radial pieces are rather narrow, but

* HARDY, W. B. Journ. of Physiol. vol. xiii. p. 165.

they are prolonged backwards each into a pair of long slender many-jointed processes, the hinder extremities of which curl inwards at the bottom of the pharynx. These bifurcate prolongations are about an inch in length. The interradials are of about the same width as the radials in front, and are continued backwards between the bifurcate processes of the latter, for about three quarters of an inch, each in the form of a long flat rod made up of many joints. Owing to their much greater width, the backward prolongations of the interradials are much more conspicuous than those of the radials.

The entire ring closely resembles that of *Cucumaria conjungens*, as figured by Semper*; but in our species the interradials are prolonged much farther backwards, and the radials and interradials are separated by considerable intervals, instead of touching one another as in Semper's figure. This last feature is, however, probably dependent upon whether or not the pharynx is distended by the enclosed tentacles, as it is in our specimen.

There is a single dorsal madreporic canal running forwards for a short distance along the pharynx by the side of the genital duct. There are two Polian vesicles, situate ventrally, and remarkable for their great length and slenderness (fig. 19). Each is rather more than two inches long, so that when pulled out they reach backwards from their attachment at the hinder end of the pharynx to beyond the hinder end of the body.

Following immediately on the pharynx, the alimentary canal is for a short distance thick-walled and tubular. The thin-walled narrow intestine is very long indeed, and very greatly convoluted, the posterior portion, for some distance before the rectum, being twisted into a close spiral. The rectum is about an inch long, and attached to the body-wall by numerous radial muscles. The respiratory trees are strongly developed, copiously branched, with four main branches, one branch lying in each interambulacrum except the mid-dorsal.

The single specimen is a female; and the ovaries consist of two remarkably small bunches of short, slender tubes, attached right and left to the dorsal mesentery a little in front of the middle of the body. The single oviduct runs up along the dorsal mesentery as usual.

The spicules are flat reticulate scales or plates (Pl. 3. fig. 20), of

* 'Reisen im Archipel der Philippinen—Holothurien,' pl. xiv. fig. 4.

more or less oval shape, very abundant, large and small, measuring up to about 0·92 mm. by 0·77 mm. in the two diameters.

The specimen was found at Oamaru, and is the property of the Canterbury Museum.

CUCUMARIA (?) THOMSONI, *Hutton*.

1879. Cucumaria Thomsoni, *Hutton, Trans. N. Z. Inst.* vol. xi. p. 307.
1886. Cucumaria Thomsoni, *Théel, 'Challenger' Holothurioidea*, p. 116.

The original description runs as follows:—"Body fusiform, scarcely subpentagonal. Skin rough, wrinkled. Ambulacra with the tubercles densely crowded in about 5 or 6 rows. No feet on the interambulacral areas. Tentacles — ?

"Rich brown, the white tips to the feet giving the ambulacral areas a spotted appearance. Length 1¾ inches.

"Stewart Island.—Presented to the Museum by G. M. Thomson, Esq., after whom I name it. A single specimen in spirit."

This is all the information we have concerning the species, Théel simply mentioning it.

Professor Parker, who is now in charge of the Dunedin Museum, informs me that the type specimen was sent to the Colonial and Indian Exhibition in London, and thence to the British Museum, where it should now be, so that we must look in that direction for more light on the subject.

CUCUMARIA (?) TURBINATA, *Hutton*.

1879. Labidodesmus turbinatus, *Hutton, Trans. N. Z. Inst.* vol. xi. p. 307.
1886. ? Cucumaria turbinata, *Théel, 'Challenger' Holothurioidea*, p. 117.

The original description runs as follows:—"Body rounded, suddenly contracted posteriorly into a short-pointed tail, and anteriorly into a rather long, cylindrical neck; skin smooth, slightly transversely wrinkled; the two dorsal ambulacra with two rows each of rather distant feet; the three ventral ambulacra either like the dorsal or with more crowded feet in several rows. Tentacles — ?

"Body white, covered with a brown epidermis, which easily peels off, except round the ambulacral feet. Length 2½ or 3 inches.

"Stewart Island.—Presented to the Museum by G. M. Thomson, Esq. Two specimens in spirits."

In this case again, Professor Parker informs me that the type

or types were sent to the Colonial and Indian Exhibition, and thence to the British Museum.

COLOCHIRUS ALBA, *Hutton*, sp. (Pl. 4. figs. 21–32.)

1872. Chirodota (?) alba, *Hutton, Cat. Echinoderm. N. Z.* p. 17.

1879. Echinocucumis alba, *Hutton, Trans. N. Z. Inst.* vol. xi. p. 307.

1886. ? Echinocucumis alba, *Théel, 'Challenger' Holothurioidea*, p. 119.

The original description runs as follows :—"Cylindrical, tapering behind; skin reticulated, and with longish papillæ on the back and sides; tentacula ten, large, branched and plumose.

"White; skin translucent; tentacles brownish white, spotted with violet on the inside near the base.

"Length 1 inch.

"Wellington Harbour (*H. Travers*)."

To this was added in 1879 the following:—"The receipt of another specimen of the *Chirodota* (?) *alba* of my Catalogue has enabled me to dissect it, and I find that it has five well-marked ambulacra, and should be placed in the genus *Echinocucumis*."

Théel observes that the species certainly does not belong to the genus *Echinocucumis*, and I find that it is really a *Colochirus*.

My own observations have been based upon :—(*a*) Two specimens from the Wellington Museum, in the same bottle, labelled "33. *Chirodota* ? *alba*. Wellington Harbour." (One of these is probably Hutton's type.) (*b*) One specimen from the Dunedin Museum, labelled "*Echinocucumis alba*," and probably the specimen dissected by Hutton. (*c*) One specimen dredged in Wellington Harbour (12 fathoms, mud), and given to me by Mr. H. Farquhar, who had already identified it with Hutton's species.

The external appearance is very characteristic. The body, which is only about an inch in length, is bluntly rounded in front and tapers rather suddenly behind to a slender tail, which occupies about $\frac{1}{4}$ to $\frac{1}{3}$ of the total length of the animal. In three of the specimens the posterior half or more of the body is strongly bent dorsalwards, the middle of the body being somewhat swollen or bellied. I counted the tentacles in the larger of the Wellington Museum specimens, in which they were well extended, and found them to be dendriform, ten in number, with the two ventral very much smaller than the remainder.

Five ambulacral bands of rather conspicuous tube-feet (or

papillæ) extend from end to end of the body, being in approximately single series in the anterior and posterior portions, but more numerous in the middle, especially on the ventral surface, where there are also a few scattered on the interambulacra. Dissection revealed ampullæ only on the ventral side, in the middle part of the body.

The entire body is covered with overlapping calcareous scales, which give rise to the reticulate appearance of the skin observed by Hutton.

The anus is surrounded by a slight fringe of slender spicules.

The internal anatomy agrees very closely with that of *Colochirus ocnoides*, described below. There are two genital bundles, right and left, attached to the dorsal mesentery a little in front of the middle of the body. The Polian vesicle is single, dorsal, much inflated, lying to the left of the single dorsal madreporic canal. The respiratory trees are, as usual, attached to the anterior end of a long rectum, and the alimentary canal resembles that of *C. ocnoides*.

The calcareous ring is composed of ten Y-shaped pieces, with their forks directed backwards (Pl. 4. fig. 32). The radial pieces are much longer and project much further backwards than the interradials, so that the ends of the limbs of the interradials articulate with about the middle of the stems of the radials, which widen out somewhat at this point. The notch between the two limbs of the radials is also much smaller than in the interradials.

The most abundant spicules are the large and small reticulate plates or scales (Pl. 4. figs. 21–24), measuring up to about 1 mm. in diameter. In addition to these there are small, deep reticulate cups (Pl. 4. figs. 27–31), the margins of which are beset with a variable number of very conspicuous, rather slender, short projections. These cups, with their crown-like margins, are highly characteristic; they measure about 0·02 mm. across the margin, and about the same in depth. Perforated rods (figs. 25, 26) also occur in boiled-out preparations. They doubtless belong to the tube-feet.

COLOCHIRUS OCNOIDES, n. sp. (Pl. 4. figs. 33–43.)

Body cucumiform, cylindrical, with the posterior third or thereabouts strongly turned up dorsalwards and tapering to the anus. Anterior end much more bluntly rounded (when the

tentacles are retracted) than the posterior. Tentacles ten, *tufted* with short branches; the two ventral much smaller than the eight others.

Integument hard, covered with a close armour of imbricating scales. In the anterior and posterior portions of the body the scales overlap very regularly, the free edges pointing towards the extremity in each case. In the middle third the arrangement is less regular. The colour of the living animal is pink, and the colouring-matter appears to be located in the central portion of each scale. The oral and anal openings are guarded by a few irregular nodules.

The fully developed tube-feet appear to be confined to the middle third of the ventral surface of the body. They are very numerous and arranged in three crowded ambulacral bands. They have sucking-disks and ampullæ. Small papillæ are irregularly scattered over the dorsal surface, but chiefly on the ambulacral areas. Both tube-feet and papillæ die away towards the extremities, leaving the terminal portions of the body smooth but scaly. Both are far more numerous in the larger specimens.

The internal anatomy is typical. The five retractor muscles are well developed. The alimentary canal is very long and much convoluted in the middle part of its length, but still showing the usual arrangement in descending and ascending loops. The rectum is long, its actual dimensions varying with the state of contraction of the animal. The two respiratory trees are well developed and copiously branched, and extend forwards to the anterior end of the body. The genital organs consist of two voluminous tufts of slender cæca, situated in the middle third of the body, from which the genital duct runs forward dorsally along the mesentery to open close to the crown of tentacles (if not actually between two of them). There is a single Polian vesicle, attached to the ambulacral ring a little to the left of the mid-dorsal line, and a single madreporic canal attached dorsally (Pl. 4. fig. 33). The calcareous ring (Pl. 4. fig. 34) consists of ten Y-shaped pieces with their forks directed posteriorly. (In the radial pieces, to which the retractor muscles are attached, the single arm of the Y appears to be jointed on to the fork, but this is probably due to accidental fracture, caused by the excessive contraction of the muscles.) The radials and interradials are more nearly equal and similar than in *C. alba*.

The principal spicules are large and small, flat, reticulate

plates or scales (Pl. 4. figs. 35, 36), measuring up to about 1 mm. in diameter, and varying from oval to roundedly triangular in outline. In addition to these, there are small reticulate cups (Pl. 4. figs. 41–43), of the same fundamental form as in *C. alba*, but much larger and with the marginal projections represented merely by blunt warts. These cups measure about 0·054 mm. in diameter. Perforated rods (Pl. 4. figs. 37–40) occur.

The type specimen, from which the anatomical details were taken, measured about 53 mm. in length (exclusive of tentacles). Another specimen from the same locality (New Brighton) was of about the same size, but the tail portion was longer and narrower, apparently less contracted. Two more specimens, belonging to the Christchurch Museum, and of unknown locality, were respectively rather more and rather less than twice as long as the type, and thick in proportion.

One of the two larger specimens was also dissected and exhibited a peculiar abnormality in the tentacles, two dorsal being the smallest instead of the two ventral, which latter were well developed. The left dorsal retractor muscle was also found to be disconnected from the calcareous ring, so that its anterior end projected freely into the body-cavity. It looked as though it had been ruptured and the ruptured end had healed up. Possibly the degeneration of the dorsal tentacles is to be connected with the injury to this muscle. All the tentacles, however, were completely retracted.

It is not easy to convey in writing an adequate idea of the distinction between this species and the preceding. Both species are remarkable for their scaly armature. It is very interesting to find in two closely allied species from such near localities a slight difference in external characters accompanied by a slight but well-marked difference in spiculation.

COLOCHIRUS CALCAREA, n. sp. (Pl. 5. figs. 44–53.)

Animal minute. Body short, sausage-shaped, bluntly rounded at both ends and without dorsal flexure. Colour chalky white in life and in spirit. Tentacles dendriform, ten in number, the two ventral much smaller than the eight others; pale yellow in colour. Tube-feet in almost or quite simple series on the three ventral ambulacra. Papillæ on the dorsal surface, chiefly in two rows, sparse, moveable and retractile, each sometimes

with a pink tip. Anus surrounded by five teeth, each overhung (in life) by a slender cylindrical process *.

The largest specimen which I have seen measured, after preservation in spirit, about half an inch long by rather less than $\frac{3}{16}$ inch in greatest diameter.

In spirit specimens the tube-feet and papillæ appear to be very irregularly arranged, and no distinct teeth are visible around the mouth or anus.

The integument is thick, friable and chalky white, owing to the very numerous minute spicules which it contains.

The pharynx is provided with a slender calcareous ring of ten simple triradiate pieces, each with the odd ray pointing forwards (fig. 53). The radial pieces are rather larger than the interradials, and differ from them in being deeply notched posteriorly between the paired arms and in having the apex of the odd arm slightly bifid.

Following on the pharynx the short slender œsophagus passes directly into the wide intestine, the first part of which seems to have thicker walls than the remainder, but does not appear to be muscular. The intestine is rather wide throughout, looped in descending, ascending, and descending portions as usual, but not convoluted. The rectum is very short, the respiratory trees springing from close to the anus. The respiratory trees are short, digitate, with very short wide branches, very short even in proportion to the size of the body.

The reproductive organs consist of two small bunches of short cæca, placed one on each side of the dorsal mesentery rather far forward, just behind the œsophagus.

Retractor muscles as usual, but rather long and slender, springing from about the middle of the body.

Madreporic canal single and dorsal. Polian vesicle single, rather short, inflated, situated on the left side.

The most abundant spicules are small, oval, reticulate plates or buttons, each with four perforations, and studded on both surfaces with rounded, pearl-like knots, which give them a highly characteristic appearance (Pl. 5. figs. 44–47). These spicules measure about 0·062 mm. in longer diameter. There are typically fourteen knobs on each side, arranged as shown in fig. 47, but often

* I could not make certain whether or not similar processes occur also between the teeth. The processes look like ambulacral appendages.

one or two more or less, as in figs. 44, 45. There are also much smaller spicules (Pl. 5. figs. 48, 49) of similar general form, but concave on one side and with the knobs very small and irregularly scattered. These doubtless represent the cups of the other species of *Colochirus*; they measure about 0·029 mm. in longer diameter. Curved perforated rods (Pl. 5. figs. 50–52) are also abundant, especially at the bases of the tentacles and in the tube-feet. The tube-feet and papillæ are also provided with beautiful reticulate end-plates.

This interesting little Holothurian occurs not uncommonly on seaweed in Cook Straits, near Wellington, where it may be collected at low tide.

COLOCHIRUS BREVIDENTIS, *Hutton*, sp. (Pl. 5. figs. 54–61.)

1872. Thyone brevidentis, *Hutton, Cat. Echinoderm. N. Z.* p. 16.

1886. Thyone brevidentis, *Théel, 'Challenger' Holothurioidea*, p. 141.

The original description runs as follows:—"Cylindrical, rather flatter below, and rounded at both ends; papillate all over with suckers, those on the back larger and farther apart; tentacula ten, very short, of unequal length, triangular, frondose; teeth very short; longitudinal muscles narrow, attached to the dental apparatus.

"Brown; tentacles pink, with yellowish tips.

"Rather more than an inch in length."

Théel merely mentions the species; and the only specimen which I have seen is one belonging to the Wellington Museum, doubtless Hutton's type. Unfortunately it is in a very bad state of preservation. The tentacles and the whole of the viscera had been removed, leaving nothing but the integument, in the form of a dry and empty shell, shaped like a short, thick sausage.

The integument is thick and hard, owing to the very abundant spicules, and it is not corrugated. The smaller "suckers" observed by Hutton are doubtless tube-feet; they occur thickly and irregularly scattered over the ventral surface, except at the anterior and posterior ends. The larger papillæ, perhaps twice the size of the retracted tube-feet, are abundantly and pretty uniformly scattered over the remainder of the body; they appear to have retractile apices, and both tube-feet and papillæ are provided with well-developed reticulate end-plates.

The spicules are very numerous, forming a dense crust in the integument. The most abundant and characteristic are the

knobbed reticulate plates or buttons (Pl. 5. figs. 54–57), distinguished from those of *C. calcarea* by their somewhat larger size and less regular shape, measuring about 0·09 mm. in longer diameter. The characteristic reticulate cups of the genus are represented by small perforated plates beset with minute knobs. Some of these are closely similar to the cups of *C. calcarea*; some are almost, if not quite, flat and of irregular shape (Pl. 5. figs. 58–60); they are very numerous and vary a good deal in size. In the integument of the dorsal surface large reticulate nodules are also abundant; these are of rounded or oval form, and up to 0·5 mm. in longer diameter. Curved perforated rods (Pl. 5. fig. 61) and reticulate end-plates also occur.

Thus the spiculation makes a near approach to that of my *Colochirus calcarea*, but differs especially in the presence of the large nodules.

The arrangement of the ambulacral appendages and the spiculation leave no doubt in my mind that the species is really a *Colochirus*. The shortness of the "teeth," referred to by Hutton, and the unequal length of the tentacles also favour this view. It seems to be nearly related to *C. calcarea*, but differs from that species in its much larger size, in the much more numerous and more prominent papillæ, and in the spiculation as already pointed out.

Psolus macquariensis, n. sp. (Pl. 7. figs. 70–72.)

Body in spirit slug-like, somewhat flattened ventrally to form a creeping sole, which extends from end to end and is not sharply defined. Broadly rounded in front and behind, about $\frac{1}{8}$ inch long and $\frac{1}{4}$ inch broad in the middle. Integument soft and smooth, but corrugated, chiefly transversely. Mouth anterior; anus at posterior end but slightly dorsal. There are three sharply defined ventral ambulacra, each with two or three rows of irregularly alternating tube-feet, possibly forming a single series when the body is extended. The remainder of the integument is quite devoid of ambulacral appendages. Tentacles ten, bushily branched and of about equal size.

Pharynx subglobular, thin-walled, swollen out with the indrawn tentacles. No complete calcareous ring, the pharyngeal skeleton being reduced to a few white patches composed of aggregations of granules. The retractor muscles, however, are well developed. Œsophagus short, marked off by a sharp

constriction from the globular, thick-walled stomach, which is followed by a long and rather wide thin-walled intestine. Rectum very short, attached to the body-wall by radiating muscle-fibres. The two respiratory trees are well developed and copiously branched as usual.

There are four long, narrow Polian vesicles, and a single dorsal madreporic canal running in the mesentery close to the genital duct as usual. The Polian vesicles and madreporic canal are arranged at approximately equal intervals round the ambulacral ring. The ampullæ of the tube-feet are few and small.

The reproductive organs consist of two bunches of short cæca attached one on each side to the dorsal mesentery far forward, alongside the œsophagus.

The spicules are small, oval, reticulate plates (Pl. 7. figs. 70–72), very sparingly scattered through the integument. Diameter about 0·1 mm. Some of them have small warts on the surface.

The type specimen from which this description was taken was collected at Macquarie Island, and given to me by Professor Parker, and I have since received through Mr. H. Suter four smaller specimens collected at the same place by Mr. A. Hamilton, and evidently belonging to the same species. Two of these still show in spirit a distinct purple tint on the dorsal surface, which appears to be normally quite smooth.

THYONIDIUM LONGIDENTIS, *Hutton*, sp. (Pl. 6. figs. 62–69.)

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, 'Challenger' Holothurioidea*, p. 95, pl. v. fig. 5.

1886. Thyone longidentis, *Théel, 'Challenger' Holothurioidea*, p. 141.

1886. Thyonidium caudatum, *Théel, 'Challenger' Holothurioidea*, p. 147.

1891. Phyllophorus caudatus, *Ludwig, Bronn's Klassen und Ordnungen, Echinodermen*, p. 347.

1891. Phyllophorus rugosus, *Ludwig, Bronn's Klassen und Ordnungen, Echinodermen*, p. 347.

It is only after much trouble that I have arrived at the conclusions expressed in the above synonymy, from which it will be seen that I regard three "species" hitherto kept separate as identical. My chief reasons for this conclusion are—the identity in structure of the extremely complex calcareous ring in all three, the identity

in spiculation, and the identity in locality; the condition of the type specimen of *T. longidentis* being such as to preclude detailed comparison in other respects.

I regret to have to differ from the opinion of so great an authority as Théel, who, while redescribing *T. caudatum* from specimens furnished by Captain Hutton, also describes his own *T. rugosum* as distinct; but I cannot help thinking that there has been some oversight here, and that an impartial observer would admit that Théel's own descriptions are almost sufficient to establish the identity of the two.

In order to justify my conclusions I must now discuss the evidence in some detail.

The original description of Hutton's *Thyone longidentis* runs as follows:—

"Cylindrical; body rugose, with numerous small suckers; head smooth, transversely striated; tentacula five, short, thick, clavate, pedunculated, frondose; dental apparatus very long, nearly half the length of the body, tubular for half its length, the rest cut into five teeth.

"Brown, tenacula pale brown.

"About an inch in length.

"The dental apparatus is composed of five plates, each bifid for half its length, joined to one another, and the lateral process of the two adjacent plates together form a tooth."

In 1879 Captain Hutton changed the name to "*Pentadactyla longidentis*," erecting the new genus *Pentadactyla* especially for the reception of this species, with the generic diagnosis—"Feet evenly spread over the greater part of the body. Tentacles five, pedunculated, frondose; dental apparatus very large." He also observes of the species, "It is, however, evident that it is not a *Thyone*, but belongs to the family *Aspidochirotæ*." Why this conclusion should have been arrived at is difficult to see, for the author describes the tentacles as "frondose," and I find from examination of the type specimen that well-developed retractor muscles are present. Théel, no doubt correctly, supposes the species to be a Dendrochirote, though possibly not a *Thyone*.

Unfortunately, the type specimen (from the Wellington Museum) was represented merely by the empty skin, from which all the viscera have been removed, and by the separated pharynx (in the same bottle) with the calcareous ring intact (Pl. 6. fig. 62)

and two retractor muscles still attached. The tentacles had apparently been removed.

The calcareous ring (Pl. 6. fig. 62) is very complex, made up of many small pieces, and agreeing minutely in structure with that of Théel's *Thyonidium rugosum*, as figured in the 'Challenger' Report.

The spicules (Pl. 6. figs. 63–65), abundantly scattered through the integument, are perforated plates, or, as Théel calls them, "tables," each with a conical central spine or "spire" on one side. The spire is made up of two rods united apically. These spicules differ from those figured by Théel for his *Thyonidium rugosum* only in that a great many of them are irregularly quadriradiate in outline. They measure about 0·38 mm. in maximum diameter. The spires appear foreshortened in the figures; they may attain a length of at least 0·18 mm.

If Captain Hutton's observations on the number of tentacles were correct, it would seem inevitable that this specimen should form the type of a distinct genus, as he proposed. On the other hand, the detailed agreement of the very complicated calcareous ring with that of Théel's *Thyonidium rugosum*, which was obtained by the 'Challenger' from near Wellington, together with the close agreement in spiculation and in external characters, including the pedials, which in both cases are wart-like with retractile ends only, convince me that the two are really identical. The tentacles may easily have been wrongly counted in the first instance, for it is by no means easy to make sure of the number when they are bunched together in spirit specimens. Only the apparent slight difference in spiculation then remains to be accounted for, and this is probably more apparent than real and does not amount to a specific distinction.

Turning now to Hutton's *Thyone caudata*, we find the original description as follows:—

"Cylindrical, tapering rather suddenly to the tail; body rough, covered with papillæ, except the posterior end, which is transversely ridged; tentacula ten, moderate, peduncled and frondose; dental system large, with five bifid teeth.

"Reddish brown, paler at the extremities.

"Length 2·5; breadth ·5."

This species was redescribed by Théel from specimens furnished by Captain Hutton, and in the same work the author

describes his *Thyonidium rugosum*, also from New Zealand. Of both species he remarks that they are nearly allied to *Thyonidium japonicum*, and yet he does not seem to have been struck with their resemblance to one another. His descriptions alone, as already pointed out, are almost sufficient to establish the identity of the two, there being only two apparent points of difference worthy of notice, the first concerning the number and arrangement of the tentacles, and the second the structure of the calcareous ring.

Before proceeding to discuss these points, I should say that I have examined a specimen labelled *Thyone caudata*, received from the Dunedin Museum, and a type-slide of spicules given to me by Captain Hutton and bearing the same name.

Now as regards the number and arrangement of the tentacles, I find that in the Dunedin specimen there are actually only nineteen tentacles, five pairs of small alternating with four and a half pairs of very much larger ones, and the smaller ones lying slightly inside the larger. Thus one of the larger tentacles has apparently been removed, accidentally or otherwise; and I have no doubt the arrangement was originally typical, there being twenty tentacles arranged in an outer circle of five pairs of larger ones and an inner circle of five alternating pairs of smaller ones. I venture to think that in Théel's specimen the arrangement of the tentacles was really the same, but that *two* of them have been lost. His description strongly confirms this view of the case. He says:—"The tentacles are retracted, their true position being difficult to determine. In conformity with the general condition in the genus *Thyonidium*, the tentacles are unequal and arranged in pairs, five pairs being several times smaller than the eight remaining tentacles, which are distributed as three pairs and two odd tentacles. Thus, these species deviate from the typical forms with twenty tentacles by the circumstance that two of the tentacles are unpaired."

As regards the calcareous ring, we find that in the case of "*Thyonidium rugosum*" Théel figures but does not really describe it, while in the case of "*T. caudatum*" he describes but does not figure it. It is evident, however, that the ring is practically identical in the two. In "*T. caudatum*" it is described as ending posteriorly in "five slender bifurcate prolongations." Hutton also speaks of "five bifid teeth." I must confess that these descriptions alone do not convey a very clear idea to my mind.

On referring to the Dunedin specimen of "*T. caudatum*," however, I found the calcareous ring (fig. 66) to be practically identical in structure with that figured by Théel for "*T. rugosum*," and also with that of the type specimen of *T. longidentis* (compare figs. 62 and 66). Now neither the actual specimens nor the figure referred to show what I should term "five slender bifurcate prolongations" or "bifid teeth;" and I am inclined to think that there has been a good deal of confusion in the terminology and description of the parts of this very complex structure. Again, in describing *T. longidentis*, Hutton says—"The dental aparatus is composed of five plates, each bifid for half its length, joined to one another, and the lateral process of the two adjacent plates together form a tooth." As a matter of fact each interradial plate bifurcates posteriorly and the divisions unite in pairs to form the five slender radial prolongations or teeth, exactly as shown in Théel's figure for "*T. rugosum*."

I found in the Dunedin specimen a single madreporic canal and a single much elongated Polian vesicle placed nearly opposite to it. The spicules (Pl. 6. figs. 67–69) are like those figured by Théel for "*T. rugosum*;" but both in the Dunedin specimen and in Hutton's type-slide of "*T. caudata*" there are plenty of irregularly quadriradiate ones like those of the type of *T. longidentis*.

Comparison of Théel's figures of the spicules and calcareous ring of "*T. rugosum*" and my figs. 62–69, representing the corresponding parts in "*T. caudata*" and *T. longidentis*, will, I think, leave little doubt in the mind of the reader that the three are specifically identical.

STICHOPUS MOLLIS, *Hutton*, sp. (Pl. 7. figs. 73–82.)

1872. Holothuria mollis, *Hutton, Cat. Echinoderm. N. Z.* p. 15.
1879. Holothuria mollis, *Hutton, Trans. N. Z. Inst.* vol. xi. p. 308.
1886. Holothuria mollis, *Théel, 'Challenger' Holothurioidea*, p. 239.
1886. Stichopus sordidus, *Théel, 'Challenger' Holothurioidea*, p. 167, pl. viii. fig. 3.

The original description runs as follows:—"Body soft, tapering slightly posteriorly; a row of large tubercles like suckers on each side, and another row of fewer suckers on each side of the back; lower surface with many small suckers irregularly placed; tentacles twenty, shortly peduncled, on hollow cylinders, and ending in frondose appendages, which are

longer on the outside; dental apparatus short; respiratory organs moderately branched; longitudinal muscles very broad.

"Yellowish, largely mottled with brown above, and in a lesser degree below; tentacles yellowish brown.

"About 6 inches in length, and 1½ in breadth.

"The suckers are arranged in five rows, but the two upper ones are nearly obsolete; the three other rows are near together, and often run one into the other; from two to four abreast in a row; these five rows can be well seen near the posterior end, when the intestine and muscular tissue has been removed."

In 1879 (*loc. cit.*) Hutton observes, "This species in many respects approaches *Stichopus*. I have had no specimens for dissection, and cannot therefore say whether the reproductive organs are in one or two bunches. A knowledge of this will settle to which genus it should be referred."

My own dissections show that the reproductive organs are arranged in two bunches, and the species must therefore be referred to the genus *Stichopus*.

Théel quotes Hutton's species in a list of imperfectly known forms, but I think there can be no doubt that his *Stichopus sordidus*, which the 'Challenger' obtained plentifully in Cook Straits, is identical therewith.

Thanks to the kindness of Mr. H. B. Kirk, I was able myself to collect specimens in Cook Straits, in the neighbourhood of Wellington, where the species is abundant in rock-pools, and also to make observations on the living animal. Hutton's type specimen appears to be no longer in existence, but I have examined carefully a type-slide of spicules prepared by him, and I do not think there can be any doubt of the identification.

Probably the living animal varies considerably in colour. Hutton described it as yellowish, mottled with brown, but the usual colour appears to be nearly black, and it is possible, as we shall see presently, that some of the light-coloured specimens may belong to a distinct species. One specimen, however, which undoubtedly belongs to Hutton's species, was during life "an even white, not striped, on the ventral surface," as I am informed by Mr. Kirk.

The dorsal processes in life are very conspicuous, large and sharply conical, some of them forming a crown around the ventrally situated mouth, as described by Théel. The tube-feet are numerous, and in life appear to be irregularly scattered over

the ventral surface, but in spirit specimens an arrangement in three broad, ill-defined bands is recognizable. The living animal attains a considerable size, but varies much according to its state of contraction. In spirit it becomes very much contracted and deeply corrugated, the conical projections being withdrawn. It is very difficult to prevent the animal from discharging its viscera when one attempts to preserve it.

The internal anatomy is typical. There is a bunch of long, slender genital tubes on each side of the dorsal mesentery, situated very near the anterior end. There is a pair of well-developed respiratory trees. The calcareous ring (Pl. 7. fig. 82) consists of ten short and simple pieces, the radials being larger than the interradials, and both notched posteriorly. The tentacular ampullæ are finger-shaped and well developed. There is a single large, inflated Polian vesicle placed ventrally, and a single unbranched madreporic canal running forwards in the dorsal mesentery.

The most abundant spicules are the usual "tables" characteristic of the genus (Pl. 7. figs. 73–77), with basal plates about 0·06 mm. in diameter. In addition to these occur thin, reticulate, bilateral plates (Pl. 7. figs. 78, 79), as mentioned by Théel, and curved rods (Pl. 7. figs. 80, 81).

One specimen, also found near Wellington, contains in addition large numbers of another and very peculiar type of spicule in the integument. These spicules are represented in figs. 83–87. They might be described as *dichotomously foliaceous*, and are apparently in fundamental constitution akin to those described by Bell for *Cucumaria inconspicua* * from Port Phillip Heads. They measure about 0·03 mm. in greatest diameter. The specimen in which they occur is of a much lighter colour than usual, in spirit being of a mottled yellowish brown. I can, however, detect no other points of distinction. External characters, the number of tentacles (20), the calcareous ring, the single Polian vesicle and madreporic canal, the tentacular ampullæ, all appear to agree with the corresponding structures in *S. mollis*. Under these circumstances I prefer to await further information before erecting a new species.

HOLOTHURIA ROBSONI, *Hutton*.

1879. Holothuria Robsoni, *Hutton, Trans. N. Z. Inst.* vol. vi. p. 308.
1886. Holothuria Robsoni, *Théel, 'Challenger' Holothurioidea*, p. 239.

* BELL, F. J. Proc. Zool. Soc. Lond. 1887, p. 532.

The original description runs as follows :—"Elongated, rather slender. Skin, smooth. Feet, scattered sporadically over the ventral surface, apparently none on the back. Tentacles, 20. Anus, round. Back, pale purplish brown. Ventral surface, dirty white, with scattered brown spots. Length, 4½ inches.

"Cape Campbell. Presented to the Museum by Mr. C. H. Robson, to whom I have much pleasure in dedicating it."

I am informed by Professor Parker that the type specimen was sent to the Colonial and Indian Exhibition and thence to the British Museum. Nothing further is known of the species.

HOLOTHURIA LACTEA, *Théel*.

Holothuria lactea, *Théel*, '*Challenger*' *Holothurioidea*, p. 183, pl. x. figs. 9, 15.

This is a deep-water species, obtained by the 'Challenger' at Station 169, East of New Zealand, at a depth of 700 fathoms, and also at Station 78, in the North Atlantic, at a depth of 1000 fathoms.

APPENDIX.

On the Structure and Growth Changes of the Wheels in Chirodota dunedinensis.

The fully-developed wheel lies in the integument with its two faces parallel to the surface of the body. The two faces differ very markedly in structure, and, as the position appears to be constant, we may conveniently distinguish them as the inner and outer faces respectively.

The outer face is shown in Pl. 3. fig. 1; from which it will be seen that there is a small round hole in the centre, from which the six flattened spokes radiate to the margin of the wheel. At the margin the ends of the spokes are connected together by the rim, which is strongly incurved on this face and provided with a finely serrated edge.

The inner face of the wheel is shown in fig. 2. Here we see in the middle a six-rayed cross, covering over a central depression or cavity in which lies the small round hole already seen on the outer face. The rays of the cross are much narrower than the corresponding spokes, into which they merge at their outer ends.

Fig. 2*a* represents an optical vertical section of the wheel; passing through two spokes, through the centre of the cross and through the hole in the outer face, which is here placed lower-

most. The strong curvature of the spokes is well seen, and also the central cavity, with the cross on one side and the small round hole on the other.

We may now pass on to describe the growth changes of the wheel. It has long been known that it first appears as a six-rayed cross, and I find that this cross persists as the cross on the inner face of the fully-formed spicule.

In the earliest stage which I have met with (Pl. 3. fig. 3) there is already a thickening at the end of each ray of the primary cross and on its outer face. These thickenings increase in size and extend both outwards (towards the outer surface of the integument), and centripetally (towards the centre of the cross), till they meet together (figs. 3 *a*, 4), leaving a hexagonal aperture in the middle. The lines of junction between the adjacent thickenings are at first clearly visible (figs. 4, 5), but they presently disappear, and at the same time the margin of the aperture becomes rounded off. Thus is formed the small round hole seen in the middle of the outer face of the fully-formed spicule.

Meanwhile the thickening of each primary ray has also been extending centrifugally to form one of the six spokes of the wheel, each of which is for some time irregularly bifid at its extremity (figs. 4, 5). When the spokes have attained their full length their ends thicken laterally and on the outer aspect, and these thickenings, meeting and fusing, form the rim of the wheel, in the manner well known for other species.*

It is the formation of the first, centripetal thickenings and the consequent development of the small round hole on the outer face of the spicule which have not, so far as I am able to ascertain, been hitherto described.

EXPLANATION OF THE PLATES.

Plate 3.

Figs. 1–8. *Chirodota dunedinensis.*

Figs. 1–2. Wheels, viewed from the two surfaces and represented as opaque objects. (Zeiss D, Oc. 2, Camera.)

Fig. 2 *a*. Optical vertical section of wheel.

3. Early stage in the development of the wheel, the ends of the primary rays just commencing to thicken. (Zeiss D, Oc. 2, Camera.)

* *Cf.* Ludwig in Bronn's Klass. u. Ordnung. d. Thier-Reichs, Bd. ii. Abth. 3 (Echinod.), p. 55, and also Kishinouye, Zool. Anz. Bd. xvii. p. 146.

Fig. 3*a*. Optical vertical section of slightly later stage, with the thickening greatly increased.

Figs. 4–5. Later stages; the thickenings have met together so as to enclose a hexagonal aperture. (Zeiss D, Oc. 2, Camera.)

(In figs. 3, 4, 5 the primary six-rayed cross is shaded and the spicule is represented as transparent.)

Fig. 6. Later stage, represented as an opaque object and showing the commencement of the rim of the wheel. (Zeiss D, Oc. 2, Camera.)

7. Sigma-shaped spicules. (Zeiss D, Oc. 2, Camera.)

8. Part of calcareous ring, × 12.

Figs. 9–18. *Caudina coriacea.*

Figs. 9–11. Characteristic spicules of the integument. (Zeiss D, Oc. 2, Camera.)

12–14. Irregular spicules from tip of tail. (Zeiss D, Oc. 2, Camera.)

Fig. 15. Coloured corpuscles of the cœlomic fluid. (Zeiss D, Oc. 3.)

15*a*. Group of similar corpuscles, polygonal from mutual pressure. (Zeiss D, Oc. 3.)

16. Large, coarsely granular, colourless corpuscle from the cœlomic fluid. (Zeiss D, Oc. 3.)

17. Small, finely granular, colourless corpuscles from the cœlomic fluid. (Zeiss D, Oc. 3.)

18. Part of calcareous ring, × 3. (A few transverse cracks, apparently accidental, have been omitted.)

Figs. 19, 20. *Cucumaria Huttoni.*

Fig. 19. Pharynx, showing calcareous ring, &c., × 2. *i.*, interradial plate; *r.*, radial plate; *r.m.*, retractor muscles; *m.c.*, madreporic canal; *p.v.*, Polian vesicles; *a.c.*, alimentary canal.

20. Small reticulate plate from integument. (Zeiss D, Oc. 2, Camera.)

PLATE 4.

Figs. 21–32. *Colochirus alba.* (Specimen from the Wellington Museum.)

Figs. 21–24. Small reticulate plates from integument. (Zeiss D, Oc. 2, Camera.)

25–26. Perforated rods. (Zeiss D, Oc. 2, Camera.)

27–31. Reticulate cups from different points of view. (Zeiss D, Oc. 2, Camera.)

Fig. 32. Part of calcareous ring, × 13.

Figs. 33–43. *Colochirus ocnoides.* (Specimen from New Brighton.)

Fig. 33. Dissection, showing pharynx, crown of tentacles, &c., × 3. *i.*, interradial plate; *r.m.*, retractor muscles; *m.c.*, madreporic canal; *p.v.*, Polian vesicle; *a.c.*, alimentary canal; *g.d.*, upper end of genital duct; *int.*, integument around crown of tentacles.

34. Part of calcareous ring, × 15. (The crack across the radial plate is probably accidental.)

35. Part of large reticulate plate from integument. (Zeiss D, Oc. 2, Camera.)

36. Small reticulate plate from integument. (Zeiss D, Oc. 2, Camera.)

Figs. 37–39. Perforated rods. (Zeiss D, Oc. 2, Camera.)
Fig. 40. Side view of rod. (Zeiss D, Oc. 2, Camera.)
Figs. 41–43. Reticulate cups from different points of view. (Zeiss D, Oc. 2, Camera.)

PLATE 5.

Figs. 44–53. *Colochirus calcarea.*

Figs. 44–47. Knobbed reticulate plates from integument. (Zeiss D, Oc. 2, Camera. 46 in profile.)
48–49. Knobbed reticulate cups. (Zeiss D, Oc. 2, Camera.)
50–52. Perforated rods. (Zeiss D, Oc. 2, Camera.)
Fig. 53. Part of calcareous ring, drawn from microscopical preparation and slightly restored. × 30.

Figs. 54–61. *Colochirus brevidentis.* (Specimen from Wellington Museum.)
Figs. 54–57. Knobbed reticulate plates from integument. (Zeiss D, Oc. 2, Camera.)
58–60. Small knobbed reticulate plates. (Zeiss D, Oc. 2, Camera.)
Fig. 61. Perforated rod. (Zeiss D, Oc. 2, Camera.)

PLATE 6.

Figs. 62–65. *Thyonidium longidentis.* (Type specimen from Wellington Museum.)

Fig. 62. Calcareous ring, in a much contracted condition, × 8.
Figs. 63–65. Reticulate plates from integument. (Zeiss C, Oc. 2, Camera.)

Figs. 66–69. *Thyonidium longidentis.* (Specimen from Dunedin Museum, labelled *Thyone caudata.*)

Fig. 66. Sketch of portion of calcareous ring, × 5½.
(The outlines between the polygonal plates are in parts very difficult to make out, and the drawing does not pretend to absolute accuracy in this respect.)
Figs. 67–69. Reticulate plates from integument. (Zeiss C, Oc. 2, Camera.)

PLATE 7.

Figs. 70–72. *Psolus macquariensis.*

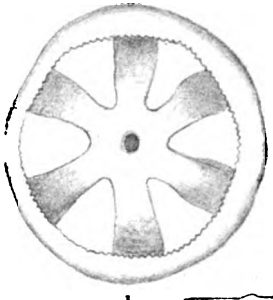
Reticulate plates from integument. (Zeiss D, Oc. 2, Camera.)

Figs. 73–82. *Stichopus mollis.*

Figs. 73–77. Characteristic spicules ("Tables") from various points of view.
78–79. Thin reticulate bilateral plates.
80–81. Curved rods.
(Figs. 73–81 drawn from Capt. Hutton's type slide; Zeiss D, Oc. 2, Camera.)
Fig. 82. Part of calcareous ring, × 2½.

Figs. 83–87. *Stichopus mollis* ?

Additional spicules from a yellow specimen collected near Wellington (Zeiss D, Oc. 2, Camera.)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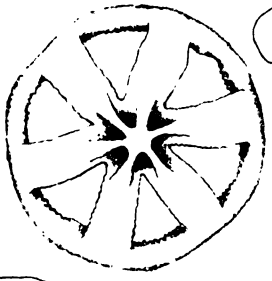
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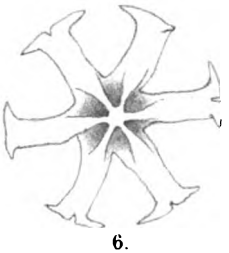
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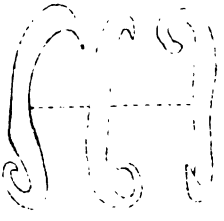
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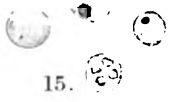
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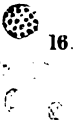
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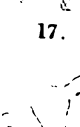
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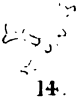
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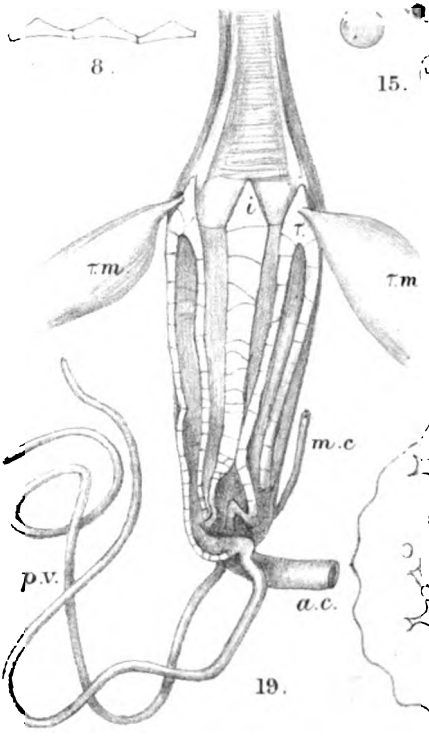

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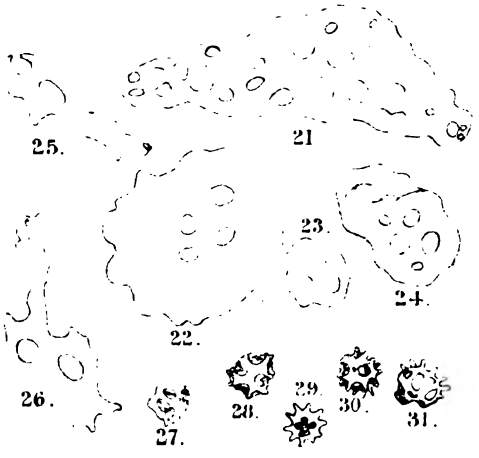

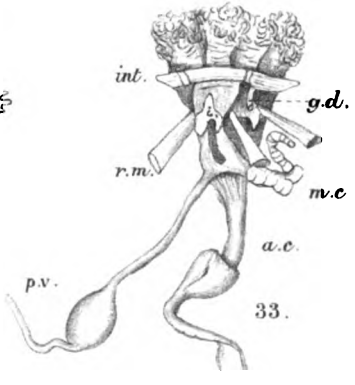

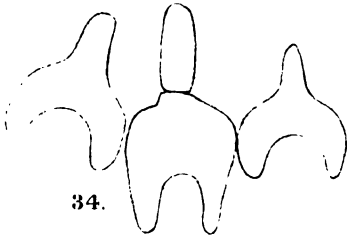

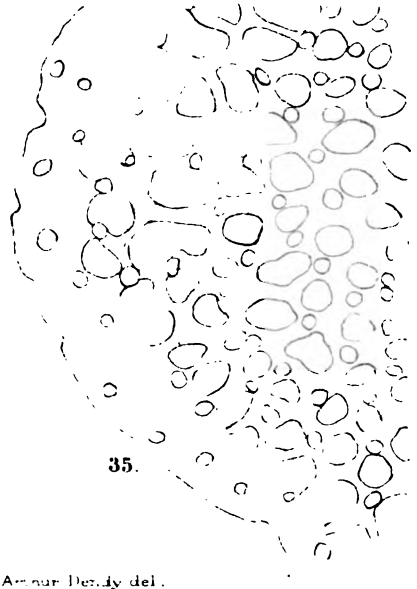

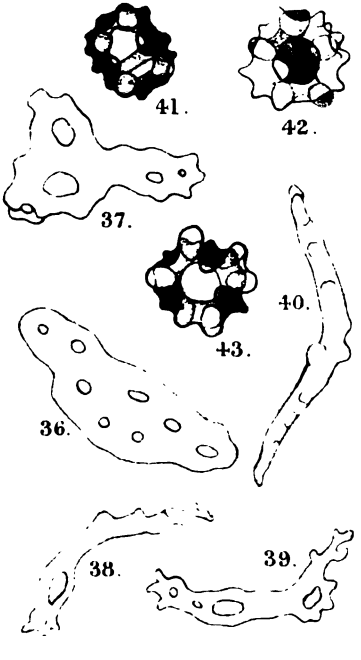

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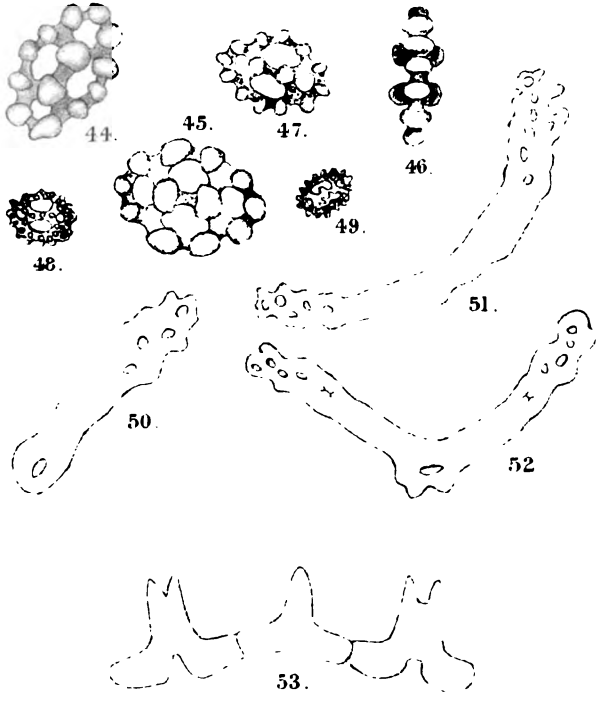

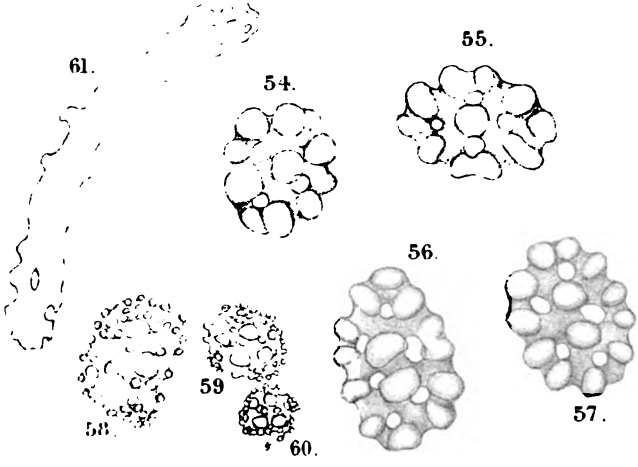

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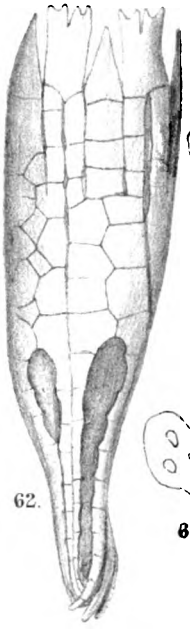

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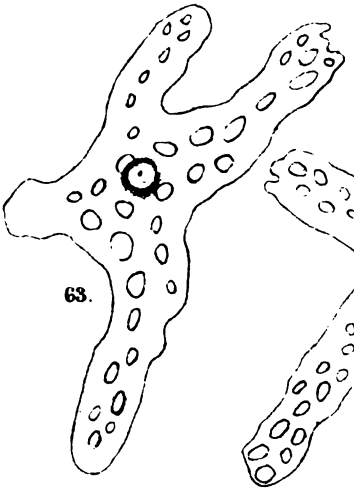

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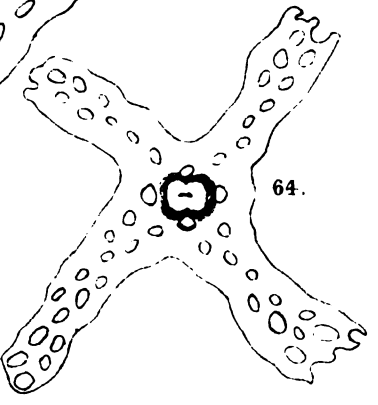

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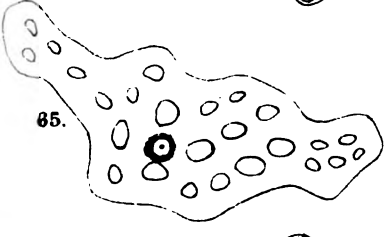

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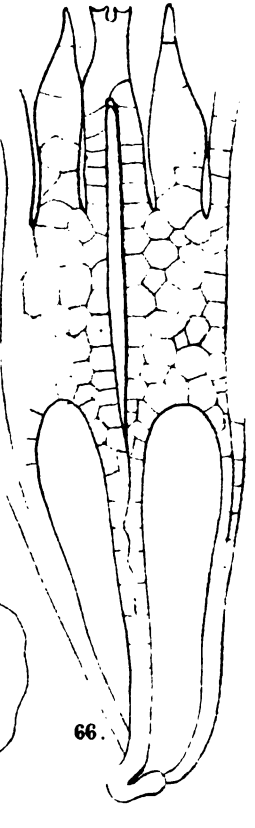

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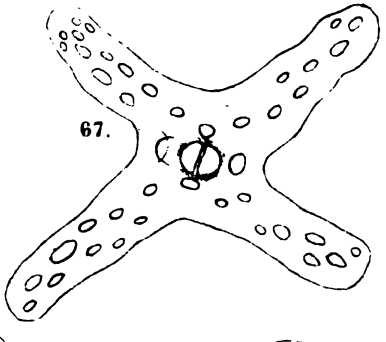

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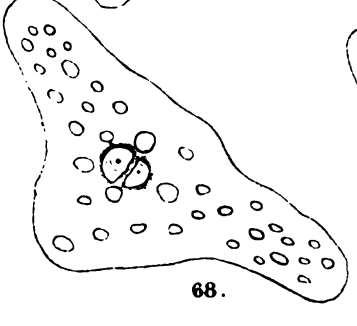

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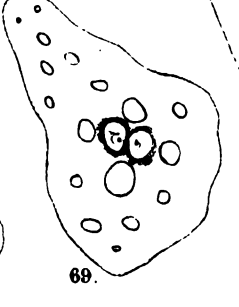

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F.H Michael lith.

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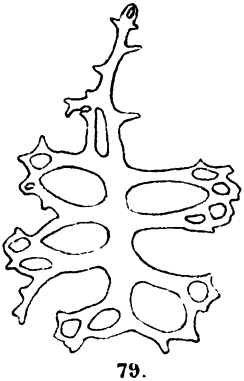
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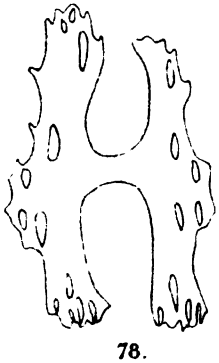
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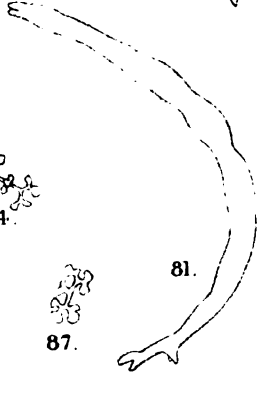
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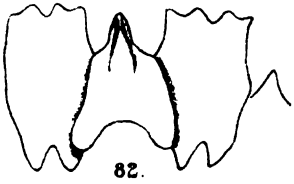
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