Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

XXIX.

Echinoderms of New Zealand and the Auckland-Campbell Islands.

III—V. Asteroidea, Holothurioidea and Crinoidea.

By
Dr. **Th. Mortensen.**

(With Pls. XII—XIV).

III. Asteroidea.

The first seastar to be recorded from New Zealand was *Astrogonium miliare*, described by Gray in 1847 [1]. The second was *Stephanaster elegans*, described by Ayres in 1851 [2], which proved, however, to be identical with *Pentagonaster pulchellus* Gray. This species was described already in 1840 [3], Gray giving, however, — doubtlessly on account of an incorrect label — China as the locality. These two species were the only ones known from New Zealand until Verrill in 1867 [4] published the description of four new species of seastars from there, viz. *Coelasterias australis, Coscinasterias muricata, Asterina (Asteriscus) regularis* and *Astropecten Edwardsi.*

In his "Catalogue of the Echinodermata of New Zealand" 1872 Hutton describes the following four new species: *Asterias mollis, Margaraster (?) scaber, Astrogonium rugosum* and *Pteraster inflatus;* also a new variety of *Pentagonaster pulchellus* is described. Three

[1]) J. E. Gray. Descriptions of some new genera and species of starfishes. Ann. Mag. Nat. Hist. XX. 1847, p. 200.

[2]) W. O. Ayres. Stephanaster elegans. Proc. Boston Soc. Nat. Hist. IV. 1851. (1854); p. 118.

[3]) J. E. Gray. Synopsis of the genera and species of the class Hypostoma (Asterias Linn.). Ann. Mag. Nat. Hist. VI. 1840; p. 280.

[4]) A. E. Verrill. Notes on the Radiata in the Museum of Yale College. No. 1. Descriptions of new Starfishes from New Zealand. Trans. Connect. Acad. Sci. I. 1867; p. 247.

more species are recorded as new to the New Zealand fauna: *Astropecten armatus* Gray (?), *Henricia occulata* Penn. and *Othilia luzonica* Gray. The latter species is included in the New Zealand fauna on the apparent authority of Gray, who in his "Synopsis of the species of Starfish in the British Museum" 1866, p. 12, quotes from Müller & Troschel's "System der Asteriden" *Echinaster eradanella* (sic!) with the locality New Zealand. This is, however, simply a lapsus calami on the part of Gray, as Müller & Troschel have only the locality "Neu Irland" for the said species. (The species *eridanella* and *luzonicus* appear to be synonyms only of *Ech. purpureus*).

In 1875 E. Perrier[1]) describes two new species of seastars from New Zealand, viz. *Pentagonaster dilatatus* and *Asterina novæzelandiæ*, while *Asterina Gunnii* Gray is recorded from New Zealand; it is also stated under *Pentagonaster australis* (Gray) (Op. cit. p. 200) that there are three specimens of this species in the collection Michelin "designés avec doute comme provenant de la Nouvelle-Zélande". As this species has not since been recorded from New Zealand, the label doubtlessly was incorrect. Perrier further states that Verrill's *Coelasterias australis* belongs to the genus *Stichaster* M. & Tr., that his *Coscinasterias muricata* is the same as *Asterias calamaria* Lamk., and that Hutton's *Pteraster inflatus* belongs to the genus *Palmipes* Linck.

Hutton in 1878[2]) adds four species to the New Zealand fauna of seastars, viz. *Asteracanthion graniferus* Lamk., *Asterias rupicola* Verr., *Echinaster (?)* sp. and *Chætaster maculatus* Gray; in the same paper he states the *Henricia occulata* of his Catalogue to be *Echinaster fallax* M. & Tr., which is again the same as *Othilia luzonica* Gray. Further in 1879[3]) he describes a seastar from the Auckland Isl. under the name of *Asterias rupicola* Verr., var. *lævigata*.

[1]) E. Perrier. Révision de la collection de Stellérides du Muséum d'histoire naturelle de Paris. 1875. (Arch. de Zool. expér. & génér. IV—V. 1875—76). — In the quotations of this paper in the following the page numbers refer to the separate copy.

[2]) F. W. Hutton. Notes on some New Zealand Echinodermata, with descriptions of New Species. Trans. N. Z. Inst. XI. p. 305;

[3]) F. W. Hutton. Notes on a collection from the Auckland Islands and Campbell Island. Ibidem. p. 343.

In his report on the zoological collections made at Campbell Island during the Transit of Venus-Expedition in 1874 H. Filhol[1]) mentions only two species of seastars from there, viz. *Cribrella ornata* Perrier and *Ophidiaster Campbelli*. The latter is only a nomen nudum. Dr. L. Germain kindly informs me that there is no specimen thus labelled in the Muséum d'histoire naturelle, Paris, whereas there is a specimen labelled *Cribrella campbellensis*. This specimen having been sent me, I find it to be a typical specimen of *Henricia lukinsii* (Farquhar), thus, indeed, the same as the *Cribrella ornata* mentioned by Filhol. Howsoever Filhol came to the name *Ophidiaster Campbelli*, it is — like *Cribrella campbellensis* — a nomen nudum, to be left out of consideration.

Sladen, in his "Challenger" Asteroidea records *Choriaster granulatus* Ltk. and *Metrodira subulata* Gray from New Zealand; although also W. K. Fisher in his "Starfishes of the Philippine Seas" (1919) gives New Zealand under the localities of these two species, it may be regarded as fairly certain that they do not occur in New Zealand seas, these statements resting, evidently, on old unreliable Museum-labels[2]).

Not counting some deep-water species taken off New Zealand by the "Challenger" and the "Gazelle", the next addition to the Asteroid fauna of New Zealand is due to de Loriol, who in 1894[3]) describes a new species, *Stichaster Suteri*, which had been collected and sent him by Suter.

From the following year until 1909 the increase of our knowledge of the New Zealand Asteroid fauna is due exclusively to H. Farquhar, who in a series of important papers has described several new species, corrected mistakes in older identifications and, upon the whole, done a highly meritorious work in extending

[1]) H. Filhol. Recueil de Mémoires, Rapports et Documents ..... Passage de Vénus sur le Soleil. III. Mission île Campbell. Chapitre X. Échinodermes p. 572.

[2]) In the Index Faunæ Novæ Zealandiæ *Ophidiaster cylindricus* (Lmk.) is enumerated among the New Zealand Asteroidea on the authority of Sladen, Challenger-Asteroidea. However, Sladen gives as the only locality of this species Kandavu, Fiji Islands. It is thus by mistake that *Oph. cylindricus* is included in the list of New Zealand sea-stars.

[3]) P. de Loriol. Notes pour servir à l'Étude des Échinodermes. IV. Rev. Suisse de Zoologie. II. 1894. p. 477.

our knowledge of the New Zealand Echinoderm fauna. In 1895 [1]) he describes the new species *Stichaster insignis*, *Stichaster littoralis* and *Tarsaster neozelanicus*; the latter he recognizes in his next paper, 1897 [2]) as identical with *Stichaster polyplax* Müll. & Trosch., *Stichaster littoralis* is stated to be the same as de Loriol's *Stichaster Suteri*, the description of the latter, published almost contemporaneously with Farquhar's paper being naturally unknown to Farquhar by that time; finally Hutton's *Astrogonium pulchellum*, Var. B. is referred to *Astrogonium abnormale* Gray. In the same year, 1897, Farquhar describes [3]) the new species *Cribrella lukinsii*, while Hutton's *Henricia occulata* is identified with *Cribr. compacta* Sladen. He also mentions a specimen of *Cribrella ornata* Perr. from the Snares Isl., different from the *Cr. ornata* of Filhol *(= H. lukinsii)*.

In the following publication, 1898 [4]), Farquhar gives only a compilation of all the species of seastars (a. o. Echinoderms) known — or recorded — from New Zealand up to that time. In 1907 [5]) he shows Hutton's *Astrogonium rugosum* to be the same as Gray's *Astrog. miliare*, in 1909 [6]) he describes a new variety, *reischeki*, of *Ast. calamaria*, and finally in 1913 [7]) be publishes the description of one of the finest starfishes in existence: *Eurygonias hylacanthus*, known till now only in one single specimen, found off Wellington.

In his report on the Echinoderma collected by the New Zealand Governm. Trawling Expedition in 1907 [8]) Benham increases our knowledge of the New Zealand Asteroid fauna very considerably; he describes two new species, *Mediaster Sladeni* and *Echinaster Far-*

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[1]) H. Farquhar. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII. 1894 (1895).

[2]) H. Farquhar. A contribution to the History of New Zealand Echinoderms. Journ. Linn. Soc. Zoology. XXVI. 1897.

[3]) H. Farquhar. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. 1897.

[4]) H. Farquhar. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. 1898.

[5]) H. Farquhar. Notes on New Zealand Echinoderms; with description of a new species. Trans. N. Z. Inst. XXXIX.

[6]) H. Farquhar. Further Notes on New Zealand Starfishes. Ibidem. XLI.

[7]) — On two new Echinoderms. Ibidem. XLV.

[8]) Records of the Canterbury Museum. I.2. 1909.

quhari and records as new to the New Zealand fauna *Psilaster acuminatus* Sl. (hitherto known only from deeper water), an unidentified *Luidia* sp. and *Odontaster Grayi* Bell. Hutton's *Uniophora (Asteracanthion) granifera* Lamk. is stated to be a misidentification. In the same year he records *Asterina fimbriata* Perrier from the Auckland Islands[1]), likewise a new addition to the New Zealand fauna; on the other hand he restricts the number of species of New Zealand Asteroids, declaring *Cribrella lukinsii* Farquhar to be the same as *Henricia ornata* (Perrier).

The last author to contribute to the New Zealand fauna of seastars is Koehler, who in 1911[2]) describes a new species, *Goniodon angustus*, and further, in his report on the Asteroidea of the Australasian Antarctic Expedition, 1920, declares the *Asterina* from the Auckland Islands, which Benham identified as *Asterina fimbriata* Perr., to be a new species, *Asterina aucklandensis*.

In the present paper 6 new species are described, viz. *Astropecten dubiosus, A. primigenius, Luidia varia, L. neozelanica* (— the *Luidia* sp. of Benham), *Peridontaster Benhami* (— the *Odontaster Grayi* of Benham), *Nectria pedicelligera*, and a new variety of *Henricia compacta*, var. *aucklandiæ*; besides, two varieties, a and b, of *Asterina regularis* are described. One species, *Ophidiaster kermadecensis* Benham is recorded as new to the New Zealand fauna; on the other hand three are eliminated as synomyms only, viz. *Astropecten Edwardsi* Verr. (Syn. of *Astrop. polyacanthus), Pentagonaster abnormalis* Gray (Syn. of *P. pulchellus)* and *Goniodon angustus* Koehler (Syn. of *Goniodon dilatatus)*.

The corrected list of New Zealand Asteroids, not including those known only from the Kermadec Islands or from the Deep-Sea off New Zealand, then looks as follows, in modern nomenclature.

1. **Astropecten polyacanthus** Müll. & Troschel (= *Astropecten Edwardsi* Verrill)
2. „ **dubiosus** n. sp.
3. „ **primigenius** n. sp.

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[1]) Subantarctic Islands of New Zealand. 1909. Art. XIII. Echinoderms, other than Holothurians.

[2]) R. Koehler. Description de quelques Astéries nouvelles. Rev. Suisse de Zool. 19. 1911.

4. **Psilaster acuminatus** Sladen.
5. **Luidia varia** n. sp.
6. „ **neozelanica** n. sp,
7. **Pentagonaster pulchellus** Gray (= *Pentagonaster abnormalis* Gray; *Stephanaster elegans* Ayres).
8. **Diplodontias dilatatus** (E. Perrier) (= *Goniodon angustus* Koehler)
9. **Asterodon miliaris** (Gray) (= *Astrogonium rugosum* Hutton)
10. **Mediaster Sladeni** Benham
11. **Peridontaster Benhami** n sp. (non *Odontaster Grayi* Bell)
12. **Eurygonias hylacanthus** Farquhar
13. **Nectria pedicelligera** n. sp.
14. **Ophidiaster kermadecensis** Benham.
    (Ophidiaster cylindricus (Lmk.) — not New Zealand)
    (Metrodira subulata Gray — not New Zealand)
    (Chætaster maculatus Müll. & Trosch. = *Nepanthia maculata* Gray — not New Zealand)
    (Choriaster granulatus Ltk. — not New Zealand)
15. **Asterina (Patiriella) regularis** Verrill
? „ „ *Gunnii* Gray
? „ *(Patiria) novæ-zelandiæ* Perrier
16. „ **(Asterinopsis) aucklandensis** Koehler (non = *Asterina fimbriata* Perrier)
17. **Stegnaster inflatus** (Hutton)
18. **Echinaster Farquhari** Benham
? *Echinaster purpureus* Gray
19. **Henricia lukinsii** (Farquhar)
20. „ **compacta** (Sladen)
21. „ „ var. **aucklandiæ** n. var. (non = *Henricia ornata* Perrier)
22. **Calvasterias Suteri** (de Loriol) (= *Stichaster littoralis* Farquhar; *Asterias rupicola* Hutton, non Verrill)
23. „ **lævigata** (Hutton)
24. **Stichaster australis** (Verrill)
25. **Allostichaster polyplax** (Müll. & Trosch.) (= *Tarsaster neozelanica* Farquhar)
26. „ **insignis** (Farquhar)
27. **Sclerasterias mollis** (Hutton)

28. **Astrostole scabra** (Hutton)
(*Uniophora granifera* Lmk. — not New Zealand)
29. **Coscinasterias calamaria** (Gray) (= *Coscinasterias muricata* Verrill; *Asterias calamaria,* var. *reischeki* Farquhar)

The Index Faunæ Novæ Zelandiæ (1904) records 31 species of seastars as belonging to the New Zealand fauna, against which the number of species recorded here, 29, apparently does not stand out very favourably. An analysis of the list in the Index, however, alters the result considerably in favour of the present list. Among the species enumerated in the Index four *(Solaster torulatus, Cribrella sufflata, Freyella polycnema* and *Asterias fragilis)* are Deep-Sea forms, and two *(Asteropsis imperialis* and *Asterias rodolphi)* are known only from the Kermadec Islands; these do not concern us here. Four species *(Ophidiaster cylindricus, Asterina novæ-zelandiæ, Echinaster purpureus* and *Uniophora granifera)* do not belong to the New Zealand fauna or are, at least, not known with certainty from there, and three *(Astropecten Edwardsi, Astrogonium abnormale* and *Gnathaster rugosus)* are synonyms only. Thus reduced the list of the Index really contains only 18 species of sea-stars actually known from New Zealand. The present list of 29 species known with certainty from the New Zealand seas thus represents quite a considerable addition to our knowledge of the New Zealand fauna. That the list will ultimately be not inconsiderably increased I do not doubt. Especially the sea to the North of New Zealand may well be expected to yield a rich harvest, and also in the Cook Strait we may expect to meet with species not yet recorded from New Zealand. Even the littoral fauna may yield surprises, as exemplified by the find of the single specimen of *Nectria pedicelligera.* A species of *Echinaster* is stated by Farquhar (Tr. N. Z. Inst. XVII, p. 202) to be found sometimes at low water on the rocks of Lyall Bay and Island Bay in December and January, which would appear to be an undescribed species. Questionable is still the occurrence on New Zealand Coasts of the two Asterinas, *A. Gunnii* and *novæ-zelandiæ,* and the two varieties of *A. regularis* described in the present report may turn out to be separate species.

The number of seastars known from the Auckland-Campbell Islands has not been materially angumented; in fact no new form

was discovered there by the author; the different conception alone of the species found there accounts for the difference between the list given by Benham *(Asterina fimbriata* Perr., *Henricia ornata* Perr., and *Stichaster Suteri,* var. *lævigatus* Hutton) and that given here *(Asterina aucklandensis* Koehler, *Henricia lukinsii* (Farquhar), *H. compacta,* var. *auklandiæ* n. var. and *Calvasterias lævigata* Hutton).

From a morphological point of view only one of the new species described here is af special interest, namely *Astropecten primigenius*, which on account of its great number of oral intermediate plates appears to represent the most primitive type of all true Astropectens. The discovery that *Calvasterias lævigata* is one of the brood-protecting forms is likewise of considerable interest.

1. *Astropecten polyacanthus* Müll. & Troschel.

Astropecten polyacanthus. 1842. Müller & Troschel. System der Asteriden; p. 69. Taf. V. Fig. 3
— *armatus.* 1842. Müller & Troschel. Ibidem, p. 71.
— *Edwardsi.* 1867. A. E. Verrill. Descriptions of new Starfishes from New Zealand. Trans. Conn. Acad. I. p. 250.
— *armatus* Gray? 1872. Hutton. Catalogue Echinod. New Zealand, p. 6.
— *polyacanthus.* 1889. Sladen. "Challenger" Asteroidea; p. 201.
— — 1898. Farquhar. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 309.
— — 1906. W. K. Fisher. Starfishes of the Hawaiian Islands. Bull. U. S. Fish Comm. for 1903; p. 1004, Pl. I. 1, Pl. II. 1. a.—b.
— — 1917. F. Jeffr. Bell. British Antarctic ("Terra Nova") Expedition IV. 1. Echinoderma; p. 6.
— — 1917. L. Döderlein. Die Gattung Astropecten u. ihre Stammesgeschichte. Siboga Exped. XLVI. a; p. 134. Taf. 4. 4—5, Taf. 12. 4—5.
— — 1919. W. K. Fisher. Starfishes of the Philippine Seas and adjacent waters. Bull. U. S. Nat. Mus. 100.s. p. 63.
— — 1923. H. L. Clark. The Echinoderm Fauna of South Africa. Annals of the S. African Museum. XIII, p. 249.

Colville Channel, 35 fms. Sandy mud. 21/XII. 1914. Several, mostly young specimens.
Little Barrier Isl., 30 fms. Shells. 29/XII. 1914. 3 large specimens.
Moko Hinau, Hauraki Gulf; 5 fms. Coarse sand, gravel. 30/XII. 1914. 2 specimens.
Off Albatross Point, 25 fms. Sand. 11/I. 1915. 1 large specimen.
Further one specimen received from Professor Benham, from off Cape Campbell, 30 fms.

This characteristic species appears to occur all round the North Island of New Zealand, while there is as yet no records of its occurrence off the South Island, the locality off Cape Campbell being the southernmost one on record till now.

I do not see how to distinguish the New Zealand specimens from those of other Pacific localities (Port Jackson, Misaki etc.). The *Astropecten Edwardsi* of Verrill, accepted by Döderlein as a separate New Zealand variety of *A. polyacanthus*, I must, therefore, regard simply as a synonym of the latter. To make *A. Edwardsi* a separate species, besides *A. polyacanthus*, as is done in the "Index faunæ Novæ-Zelandiæ" is wholly out of question; the description given by Verrill shows beyond doubt that his specimen was of the *polyacanthus*-type, and as the available, fairly rich material of *polyacanthus* from New Zealand seas does not support the view that these specimens make a special, recognizable variety of the species, the conclusion is inevitable that *A. Edvardsi* is simply a synonym of *A. polyacanthus*.

The larger specimens generally have a characteristic coloration; the disk is dark, the arms brownish, this latter lighter colour continuing in a narrow stripe inwards over the disk, sometimes to the centre. There is thus formed a conspicuous, dark starshaped figure on the disk, strongly contrasting against the lighter colour of the arms. There may also be a, more or less distinct, dark band across the arms.

2. *Astropecten dubiosus* n. sp.

Pl. XII. Figs. 3—4.

Off North Cape, 40 fms. 2 specimens. (Capt. Bollons).
R—28 mm; r—6 mm; R=4,7 r; breadth of ray at base 7 mm. Number of superomarginals 22—23.
R—18 mm; r—5 mm; R=3,6 r; — — — 5 mm. — of superomarginals 17.

Arms long and slender, regularly tapering to a point; paxillar area rather narrow. The paxillæ (Fig. 1.d) with ca. 10—12 peripheral and 3—5 central spinelets, all alike, slender and thorny. No enlarged central spinelet. The paxillæ of the disk are slightly larger than those of the arms, diminishing in size only very close to the small central cone. They do not form regular transverse series on the arms. The number of spinelets in the paxillæ gradually diminishes a little on the arms. No pedicellariæ.

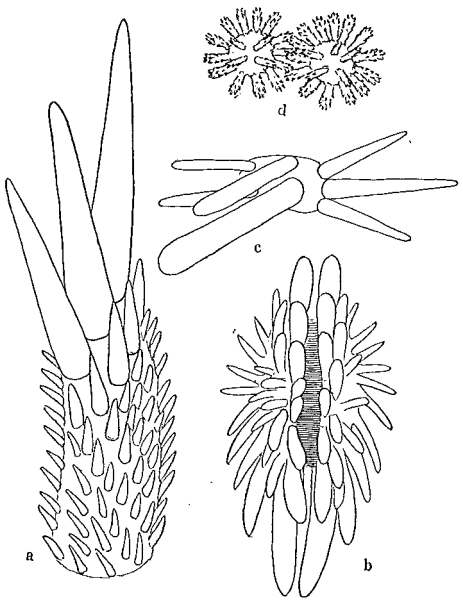


Fig. 1. *Astropecten dubiosus*. a. inferomarginal; b. mouthplates; c. adambulacral plate; d. paxillæ. a—c. $^{14}/_{1}$; d. $^{21}/_{1}$.

Superomarginals covered with a close coat of very fine, short spinelets; the proximal 3—4 ones with an erect, not very prominent or strong spine. In places there is an indication of a spine on a few of the following plates, unto the eighth, from which fact it may be concluded that in adult specimens the superomarginal spine will be developed at least to about the middle of the arms. In the smaller specimen these spines are still very small, even on the innermost plates. The inferomarginals (Fig. 1.a), which project only very little beyond the superomarginals, carry an oblique series of 3—4 pointed, not flattened spines; on the proximal 2—3 plates the uppermost spine is the longest, from about the fourth generally a smaller spine appears above the larger upper one. The lower part of the plate is covered with small spines, somewhat coarser in the middle of the plate.

Terminal plate very finely granular, nearly smooth. In the larger specimen there are no spines on the terminal plate, but in the smaller specimen one of the plates has traces of two fairly robust spines below the point. Probably these spines have then been

lost in the larger specimen, and it may be supposed that the terminal plates are normally provided with such spines.

Adambulacral plates (Fig. 1.c) with 3 furrow spines, the middle one somewhat longer than the lateral ones. Outside these are generally two spines, the distal one conspicuously the larger, and at the abradial edge of the plate 2—3 slender spines. — The mouth plates (Fig. 1.b) are covered with small spines, arranged in three indistinct rows; the distal and proximal spines are enlarged. The inner edge carries two strong, conical spines, which cover the mouth-opening. The marginal series somewhat longer than the superficial spines. — 3 small intermediate plates in each interbrachial space; in the smaller specimen in places only 2. Each carries a grouph of slender spinelets.

Madreporic plate small, very close to the superomarginal edge. It carries at its inner edge a bundle of spinelets, which partly conceals it.

Colour brownish, with an indication of a darker transverse band on the middle af the arms.

The two specimens, which were presented me by Captain Bollons, are dried and not in the very best condition. No doubt they are far from adult. Still it seems necessary to describe them as a new species of the group of the "pluriseriate" Astropectens. Evidently, this species belongs to the "*pectinatus*"-group, and among the species of that group its relations appear to be the nearest with *imbellis* Sladen, from which it differs in the much narrower arms, the shape of the paxillæ, the oral and adambulacral armature. The differences are, however, small and not very important, and were it not that *imbellis* is known only from the Philippine seas, I would be inclined to think the New Zealand specimens to belong to that species.

One of the specimens was sent to Dr. H. L. Clark during his recent visit to the British Museum and he kindly undertook to compare it with the type of *Astropecten imbellis* Sladen. He informs me that he finds it so very much alike *A. imbellis* that he would rather be inclined to regard the differences as merely individual. Still, as both the type, and only specimen known, of *A. imbellis* and the New Zealand specimens are young, immature, it is very

well possible that the adult specimens of the two forms may be recognizably distinct.

In my opinion, it is the safest course for the present, to keep the New Zealand form as a separate species, duly pointing out its close relationship and possible identity with *A. imbellis*. To the Australian species *A. pectinatus* it appears to be not so nearly related.

3. *Astropecten primigenius* n. sp.

Pl. XII. Figs. 1—2.

N. of Cuvier Isl., 30 fms. 2 specimens. (Captain Bollons).

R—28 mm; r. 9 mm; R=3 r; breadth of ray at base 10 mm; number of superomarginals 17.

R—16 mm; r. 6 mm; R=2.7 r; breadth of ray at base 7 mm; number of superomarginals 13.

Paxillar area rather narrow, occupying only half the width of the arm; the paxillæ are arranged in distinct transverse rows on the arms, two rows corresponding to one marginal plate; they are very low, hardly with any pedicel at all, on the disk very crowded and scarcely decreasing in size towards the middle of the disk, where no elevated cone is found. There are about 6—8 central spinelets and an outer circle of about 12, all in the shape of short, smooth grains (Fig. 3).

Superomarginals very broad and low, making a very broad margin to the ray, which is upon the whole low and flattened. No spines on the superomarginals, only a uniform, close covering of low, rounded grains. Inferomarginals (Fig. 2.a) with an oblique series of 6 pointed, closeset, appressed spines. The middle ones are the longest, about so long as the width of the plate only. These spines, accordingly, are very little prominent and hardly to be seen from above. Sometimes there is a small spine adorally to the upper one, the series then consisting of in all seven spines. Further there is another parallel series of 3—4 similar, slightly smaller spines on the upper, aboral edge of the plate, covered by the spines of the primary series and distinctly seen only on the removal of these latter. A series of 4—3 lateral spines is found along the aboral edge of the plate, somewhat smaller than those of the oblique series, likewise closely appressed. Otherwise the inferomarginal

plates are covered with very small, slender spinelets, those close to the primary series of spines being sligthly enlarged, flattened and pointed. — The terminal plate is seen in the small specimen to be covered with the same sort of grains as those of the supero-

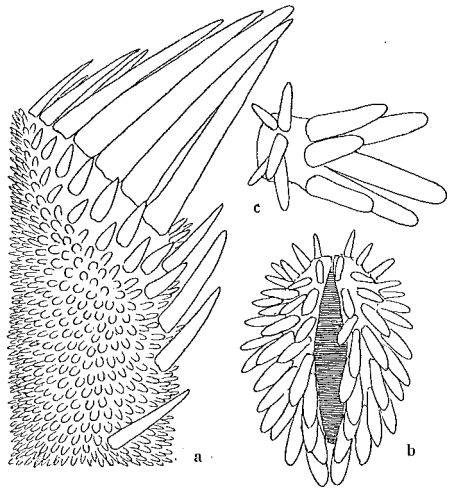


Fig. 2. *Astropecten primigenius*. a. Inferomarginal; b. mouthplates; c. adambulacral plate. All 11/1.

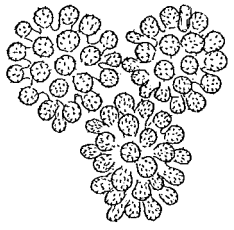


Fig. 3. *Astropecten primigenius*. Paxillæ. 21/1.

marginal plates and to carry at the point two short blunt spines on each side.

Adambulacral plates (Fig. 2.c) with three fairly robust furrow spines, the middle one slightly longer than the lateral ones. Outside these is a series of 3—4 subambulacral spines, of about equal size, and at the abradial edge of the plate there are 4—5 spines, not forming a regular series. — The mouth plates (Fig. 2.b) carry on the inner half each two fairly regular series of rather robust spines, while on the outer half the spines are more slender and less distinctly arranged in longitudinal series. On the adoral edge there are two fairly strong, but not much enlarged spines.

The intermediate plates are numerous; the proximal series continues to the outer third of the arms, one corresponding to each adambulacral plate. There are in all 4 series of intermediate plates; the second series ends off the interspace between the second and third inferomarginal, while the third and fourth series are confined to the interradial space. All the intermediate plates

are covered with slender, minute spinules, with a single enlarged spine in the middle.

The madreporite is small, not covered by paxillæ or grains, situated a distance of about its own diameter from the marginal plates. The papulæ are confined to a narrow belt along the interradial edge, continuing only halfway out on the arms. — Colour of the two, dried specimens light brownish.

It is evident that this most interesting species belongs to the "seriventral" group of species, the *Schayeri*-group of Döderlein, but representing a more primitive stage than any other species of the group hitherto known, on account of the much larger number of intermediate plates, the proximal series of which continues nearly to the end of the arm. The difference between the present species and the numerous species with only a single series of intermediate plates along each side continuing only for a short distance along the ambulacral furrow is so considerable that it may seem really questionable whether it can remain within the genus *Astropecten*. But, on the other hand, its general appearance is typical astropectinid [1]). If it ought to form a separate genus (— it cannot be referred to any other genus of Astropectinids hitherto established —) we should, evidently, unite all the other seriventral forms with it. But I do not think it desirable to take this step and prefer, therefore, to leave it in *Astropecten*.

4. *Psilaster acuminatus* Sladen.

Psilaster acuminatus. Sladen. 1888. "Challenger" Asteroidea, p. 225. Pl. XL.1-2. Pl. XLII.7-8.
— — Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 310.
— — Benham. 1909. Scientific Res. N. Z. G. Trawling Exped. 1907. Echinoderma. Rec. Canterbury Mus. I.2. p. 6.
— — H. L. Clark. 1916. Sealilies, Starfishes, etc. Biol. Res. „Endeavour" IV.1. p. 32.

[1]) It may not be superfluous to point out that, although the two specimens are dried, I have been able to confirm that the tubefeet are pointed, without a sucking disk. There is then no doubt that it really belongs to the Astropectinids.

Psilaster acuminatus. H. L. Clark. 1923. The Echinoderm Fauna of South Africa. Ann. S. Afr. Mus. XIII. p. 248.

Off White Island, 55 fms.; sandy mud. 1 specimen. 19/XII. 1914
Cloudy Bay, 19 fms. 2 specimens (Capt. Bollons).

Not feeling quite convinced that the present specimens be identical with Sladen's *Ps. acuminatus,* I sent one of them to Dr. H. L. Clark during his stay at the British Museum with the request that he would undertake to compare it with the type of that species. He kindly informed me that there can be no doubt of their identity, and accordingly the identification of these specimens with *Ps. acuminatus* is certain enough.

The reason for my hesitation in this identification was the fact that there is some discrepancy between the description and the figures, given by Sladen. He describes the inferomarginal plates as being partly naked ("covered with membrane"); but in Pl. XLII, fig. 8 they are represented as completely covered with rather coarse squamules, not at all naked — as are my specimens also.

The number of the marginal plates is stated by Sladen to be 40 in specimens of 65 mm R. In the specimens in hand the number of the superomarginals is 27 in two of them, measuring 36 and 46 mm R, and 32 in the third specimen, measuring 36 mm R. It thus appears that there ought not to be laid too much stress on the number of the marginal plates.

Regarding the distribution of this species there is some incertainty as to its occurence in South African seas (cf. H. L. Clark. Op. cit.). Only its occurrence in the New Zealand and the Australian Seas can be regarded as an established fact.

5. *Luidia varia* n. sp.

Pl. XIII. Figs. 13–14.

Little Barrier Isl., 30 fms. Shells. 29. XII. 1914. 2 (? 3) specimens (2 disks and some isolated arms).
Colville Channel, 35 fms. Sandy mud. 21. XII. 1914. Fragment of an arm.

Arms 7. R—ca. 150 mm; r—ca. 15 mm; R = ca. 10 r. Breadth of arm near base 20 mm. Arms robust, high and arched, only at the outer extremity somewhat flattened, tapering very gradually, the

extremity bluntly pointed. Ambulacral furrow very broad; tubefeet very large, bluntly pointed, apparently pluriseriate, but, as seen on a closer inspection, in reality in the normal two regular rows.

Paxillæ on the disk very crowded, not regularly arranged. Along the arms they are arranged in regular longitudinal series, 5 series along each side, on the proximal part of arms 6 series; on the middorsal area of arms the paxillæ are arranged without any order, or, at most, in indistinct longitudinal series; on the distalmost part of arms this area widens so as to occupy nearly the whole dorsal side, only the two lowermost longitudinal series of paxillæ remaining distinct until the end of the arm. The lateral paxillæ are quadrate, those of the middorsal area more or less irregularly rounded. The supramarginal paxillæ correspond in width each to an inferomarginal plate, and are of the same size as the lateral paxillæ; those of the middorsal area are of variable size, some of them being about as large as the lateral ones, while others are distinctly smaller.

Each paxilla generally carries in the middle 6—7 coarse, smooth grainlike spinelets arranged in a circle round a central one which may be slightly larger; the edge is bordered by ca. 20 more slender, slightly elongated spinelets (Fig. 4.d. left figure). One arm alone differs conspicuously from the others in the central spinelet on all the paxillæ, except the superomarginal ones, in the proximal third of the arms being elongated, so as to form a small, blunt spine (Fig. 4.d; right figure). As there is otherwise, at most, the merest indication of a central spine on a few of the middorsal paxillæ in the proximal part of the arms, it seems probable that this arm belongs to a third specimen. — The inferomarginal plates (Fig. 4.a) bear along the median line (3) 4—5, in the proximal part of the arm sometimes even 6 erect, stout, compressed spines, slightly curved, tapering to a blunt point; the three uppermost are the largest, ca. 3—4 mm long, equalling in length 2—3 marginal plates. These spines, as a rule, form fairly regular longitudinal series, not alternating as in the following species. A variable number of smaller, compressed spines irregularly placed among the larger ones, and along the edge of the plate a series of slender spinelets; only along the upper part of the plate a close fringe of fasciolar spinelets is found in the furrow, below the marginal spinelets.

The adambulacral plates (Fig. 4.b) carry three spines, forming a transverse series in continuation of the inferomarginal series of spines. The furrow spine is small, slightly curved, compressed, saber-like. The two outer spines are placed close together; the inner of them is the largest, about as large as the marginal spines,

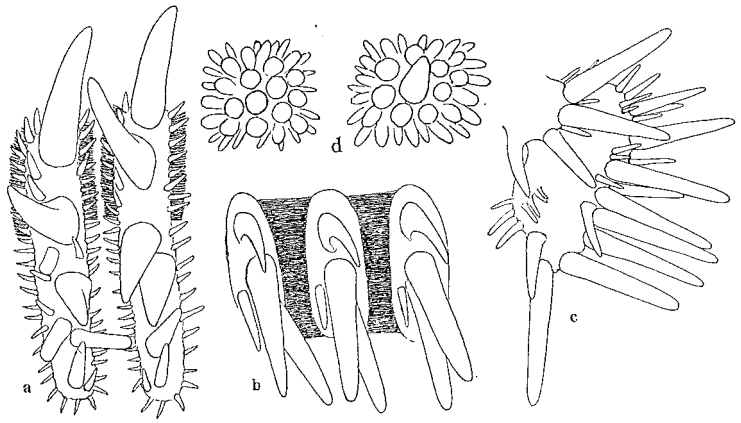


Fig. 4. *Luidia varia*. a. Inferomarginals; b. adambulacral plates (the adradial side is turned up, the distal side to the right); c. mouth plates (jaw) and first adambulacral plate, in side view; d. paxillæ (of two different specimens; cf. text). a—c. $^6/_1$; d. $^9/_1$.

slightly curved, not pointed. Adorally to these two spines is generally found one much shorter and slenderer spine, more rarely two. The adambulacral plates are separated from each other by a rather wide membranous space.

The mouth plates (Fig. 4.c) carry on each half an irregular double-series of spines which are stout and rather long in the proximal part, much shorter and slenderer in the distal part. A series of 4 small, slender spines is found orally along the vertical edge of the mouth plate, diminishing in size downwards, and an irregular group of 4—5 still slenderer spinelets is found on the middle of the vertical sidewall of the mouth plate. — The intermediate plates are small and only in a single series. Each carries a small group of, generally, 6—8 slender spinelets, one of them being sometimes slightly elongated. Farther out on the arm there are mostly only 3—4 spinelets on the intermediate plates; they are, especially in the interradial space, invested by a rather thick

skin, apparently of a glandular character. — The madreporite is almost, or even completely concealed by the paxillæ. — Pedicellariæ are completely wanting.

Colour creamy white, irregularly mottled with black, both on disk and arms, except on the oral side which is of a uniform whitish colour.

This species appears to be the nearest related to the Hawaiian species *Luidia hystrix* Fisher, from which it differs, however, in some important points. In *L. hystrix* the central spine of the paxillæ is much more prominent, and also the inferomarginal and adambulacral armature is somewhat different; then pedicellariæ occur on the intermediate plates in *L. hystrix,* while in *L. varia* they are completely wanting. — Also to *L. maculata* the present species bears some resemblance, but the numerous pedicellariæ of *L. maculata* and the less numerous inferomarginal spines, as also the total absence of a paxillary spine distinguish it markedly from the New Zealand species. Whether the difference in regard to the number of arms — 7 in the New Zealand species, 8 in *L. hystrix* and 7—8 in *maculata* — is a sufficiently constant character, remains to be seen, but the characters pointed out above are proof enough that the New Zealand species is not identical with any of the two said species or, indeed, any other species of *Luidia* hitherto known.

6. *Luidia neozelanica* n. sp.

Pl. XII. Fig. 5.

Luidia sp. Benham. 1909. Sci. Res. N. Z. G. Trawling-Exped. 1907. Echinodermata. Rec. Canterb. Mus. I,2. p. 6. Pl. X,4—5.

Off White Island, 55 fms. Sandy mud. 19. XII. 1914. 9 specimens (mainly broken).

Colville Channel, 35 fms. Sandy mud. 21. XII. 1914. 1 specimen (broken).

Arms 5. R—ca. 100 mm; r.—ca. 10 mm; R=ca. 10 r. (measured on the largest, broken specimen). R.=74 mm; r.=8 mm; R.=9.3r; (measured on the single fairly complete specimen, Pl. XII, Fig. 5). Evidently the length of the arms was, however, still somewhat greater in this specimen, the measured arm having apparently been regenerated. Another, not regenerated arm, with the point broken, is almost as long and must have been not inconsiderably longer. The arms are very narrow and almost imperceptibly tapering towards the point, which is, in the larger specimen, fairly blunt. Breadth of arm

at base, in the larger of the two specimens measured, 13 mm, in the smaller 8 mm. The general appearance of these two specimens thus is very different, the smaller having much slenderer arms. This difference is, probably, due partly to the fact that the larger specimen was in a ripe condition (male), the genital organs causing a swelling of the arms.

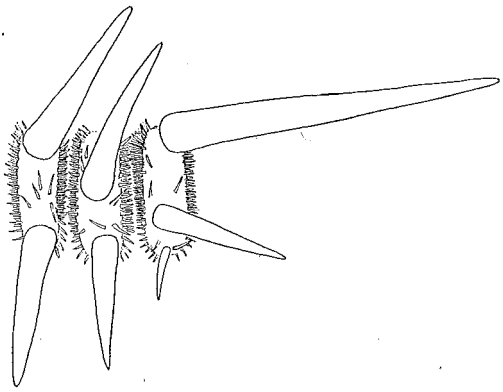


Fig. 5. *Luidia neozelanica*. Inferomarginals. 6/1.

Paxillæ on disk and middorsal area of arms small and crowded, without any regular order. Along sides of arms two longitudinal series of somewhat larger lateral paxillæ. Superomarginal paxillæ larger, crescent-shaped, each corresponding to one inferomarginal plate and to about two lateral paxillæ. About 3—6 central and ca. 10—12 marginal spinelets on the lateral paxillæ, 1—3 central, ca. 8—10 marginal spinelets on the middorsal paxillæ. These spinelets are very slender, finely thorny (Fig. 6.d). One of the central spines may be slightly elongated and more robust than the others. The madreporite small, nearly concealed by the paxillæ.

Inferomarginal plates armed with 2—3 prominent, pointed spines, alternating, the upper spine being on every second plate placed at the upper edge, on the other, intervening plates further downwards, off the interspace between the first and second spine of the former plates (Fig. 5). These plates with the spines placed lower down have generally only two spines. — The uppermost spine is the longest, ca. 7 mm, equalling about 5 marginal plates in length; the middle spine is somewhat shorter than the upper one, the lowermost only about half as long as the upper one. The plate is otherwise sparsely covered with very slender spinelets, surrounded by a rather thick, probably glandular skin. On the adradial end of the plate the spinelets are somewhat longer. A close fringe of capillary spinelets along the edge of the plates, continuing almost to the lower edge.

Adambulacral plates with mostly three spines, a smaller, curved, compressed, saber-shaped furrow spine and two larger outer spines, adorally to which are placed 2—3 smaller spines (Fig. 6.a); in younger specimens the outer (third) spine is very slender and inconspicuous. Mouth plates (Fig. 6.b) on each half with a regular

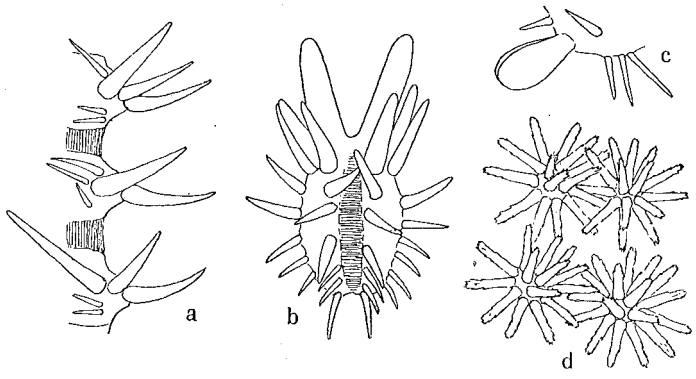


Fig. 6. *Luidia neozelanica*. a. Adambulacral plates; b. mouth-plates (jaw); c. pedicellaria on an oral intermediate plate; d. paxillæ a—b. $^{9}/_{1}$; c—d. $^{21}/_{1}$.

series of spines along midline and a similar marginal series, diminishing gradually in size outwards. A pair of strong teeth on the oral edge and under these a pair of large, two-valved pedicellariæ or two spines placed close together. — Intermediate plates very small and inconspicuous, in a single series, carrying very few slender spinelets, or a single large bivalved pedicellaria of a more or less clavate shape (Fig. 6.c); in the larger specimen these pedicellariæ occur on most of the plates, in the smaller ones only now and then.

Colour a uniform brownish; the tubefeet not dark. Base of marginal spines brownish.

The *Luidia* mentioned by Benham (Op. cit.) evidently belongs to this species, in spite of the fact that it is stated to have a larger central spine on the paxillæ. As mentioned above there is an indication of the same condition in one of my specimens.

The present species is very closely related to *L. asthenosoma* Fisher from the Californian coasts and to *L. orientalis* Fisher from the Chinese seas — so closely, in fact, that were these found together, one would hardly think of regarding them as distinct

species. Considering the fact, however, that they are known only from very restricted areas very wide apart, we are forced to regard the minor, apparently trivial differences to be observed as good specific characters, the more so as the species of this group (to which belong also *L. sarsi* and *L. africana)* are upon the whole distinguishable only through such apparently unimportant characters. (Cf. W. K. Fisher. Starfishes of the Philippine Seas, p. 168). Not having material of the two named species for a direct comparison with the species from New Zealand I do not think it advisable to state precisely the characters distinguishing the three species, as it could hardly be done satisfactorily from the descriptions alone. If the said three species are ultimately found to have a wider, continuous distribution, I should be inclined to regard them as representing only one species.

7. *Pentagonaster pulchellus* Gray.

Pl. XII. Figs. 6—10.

Pentagonaster pulchellus. J. E. Gray. 1840. A Synopsis of the Genera and species of the Class Hypostoma (Asterias Linnæus). Ann. Mag. Nat. Hist. VI. p. 280.

Stephanaster elegans. Ayres. 1851. Proc. Boston Soc. Nat. History IV. p. 118.

Pentagonaster — J. E. Gray. 1866. Synopsis of the species of Starfish in the British Museum. p. 11. T. 8 fig. 3.

— *abnormalis.* J. E. Gray. Ibidem, p. 11. T. 8. figs. 1—2.

— *pulchellus.* Hutton. 1872. Catalogue Echinod. New Zealand, p. 8.

— — Var. B. Hutton. 1872. Ibidem, p. 8.

— — E. Perrier. 1875. Revision de la collection de Stellérides du Mus. d'hist. nat. Paris. Arch. Zool. expér. V. p. 202.

Astrogonium pulchellum. H. Farquhar. 1895. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVI. p. 200.

— sp. H. Farquhar. 1897. A Contribution to the History of N. Z. Echinoderms. Journ. Linn. Soc. Zool. XXVI. p. 194.

— *pulchellum.* H. Farquhar. 1898. On the Echinoderm Fauna of N. Zealand. Proc. Linn. Soc. N. S. Wales. p. 310.

— *abnormale.* H. Farquhar. 1898. Ibidem, p. 310.

Pentagonaster pulchellus. Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawl. Exp. 1907. Rec. Canterb. Mus. I.2. p. 11.

— *abnormalis*. Benham. 1909. Ibidem p. 11. Pl. VIII. fig. 5.

Paterson Inlet, Stewart Isl. 18/XI. 1914. Under stones on the coast. 2 specimens.

Halfmoon Bay, 5—7 fms. Sand. 19/XI. 1914. 1 young specimen.

Queen Charlotte Sound. 3—10 fms. Hard bottom. 20/I. 1915. 1 specimen.

Wellington Harbour. 5—10 fms. 16/II. 1915. 1 specimen.

I have also specimens from Foveaux Strait (Prof. Benham), from off Otago, 20—30 fms. (Prof. Benham), and from Napier (collected by my brother, Mr. H. Mortensen, 1911).

A careful study of the fairly rich material in hand has led me to the conclusion that *Pentagonaster abnormalis* is not to be distinguished from *P. pulchellus*, and I have therefore united it with that species as a simple synonym only. Already Perrier (Op. cit.) states that in his opinion *P. abnormalis* is comprised within the range of variations of *P. pulchellus*. Farquhar (1895) thinks that "when good series of both forms are obtained and compared" the differences will prove sufficiently constant for regarding them as two distinct species, and later on (1897) he states that his examination of further material has convinced him that they are two distinct species. Benham, on the other hand (Op. cit. p. 12) is inclined to think "that the rarer *P. pulchellus* is merely a very abnormal variation of the common *P. abnormalis*", although his material does not appear to him to justify simply uniting them into one species. The material available to me seems to me to leave no doubt but that it is all only one single, very variable species. Although the form with the much swollen outer marginals, Gray's *pulchellus*, appears to be the rarer, the name *pulchellus*, being the first named of the two in Gray's work, is the one to be retained; *abnormalis* accordingly is to be dropped as a synonym only of *pulchellus*. It is a curious fact that the species was never properly described or figured, although mentioned fairly often in literature. Farquhar (1897) states to have drawn up a description of the species, but it was never published. It may therefore not be superfluous to give a somewhat more detailed description of it, accompanied with some figures to show structural details and also to demonstrate the variation in general shape.

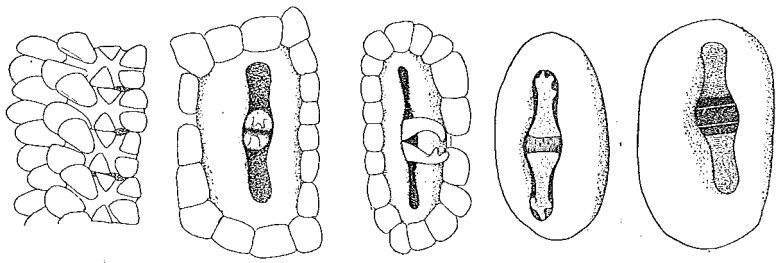
The general outline varies rather considerably, some (mainly the larger) specimens being almost regularly pentagonal, others having the interradial margins very concave and the arms fairly prominent. A few measurements will illustrate this:

R—54 mm, r—38 mm. R=1,4 r.
R—42 mm, r—22 mm. R=1,9 r.
R—26 mm, r—17 mm. R=1,5 r.
R—18 mm, r—10 mm. R=1,8 r.

The disk is covered with rounded plates, each surrounded by a circle of fine grains. Seen from the inside the plates are star-shaped, the pores of the papulæ lying in groups between the rays of these plates. The plates are more or less elevated, especially a regular median series along each ray and a rosette of 5—6 plates in the middle, round a central plate are generally distinctly elevated, knobshaped. The plates of the side areas of the rays may be more or less distinctly arranged in series parallel to the median series. — The madreporite is large and conspicuous, situated nearer the centre of the disk than the edge, and is often surrounded by three more prominent plates; but this is by no means constant, the surrounding plates being sometimes 4 or 5. The plates of the disk show a peculiar structure, being mottled with numerous small clear spots of a more glassy structure, different from the rest of the plate; probably these clear spots correspond to the "crystal bodies" in the plates of *Goniodiscus* o. a. (Cf. Döderlein. Über Krystallkörper bei Seesternen. Jen. Denkschr. VIII. 1898).

The marginal plates generally number only 4 in each interradial space, besides a pair of much larger plates at the end of the arms. They are more or less swollen, bean-shaped and surrounded by a regular series of small grains like those surrounding the plates of the disk. Sometimes a small plate is developed in the midline between the marginal plates, in the corner between each four adjoining plates; sometimes also a pair of small plates are developed close to the end-plates of the ray. The end-plates (— the term "apical plates" used by Hutton, Farquhar and Benham is not very fortunate —) may be very much enlarged and highly swollen, so as to be several times larger than the other marginal plates; but in other specimens they are much less enlarged,

sometimes only about twice the size of the other marginal plates. On seeing the two extremes together one would scarcely think it possible that they could belong to one and the same species; but all intermediate stages are found, and it is thus beyond doubt that we have here to do only with individual variations. On the point



a. b. c. d. e.

Fig. 7. *Pentagonaster pulchellus.* a. Adambulacral plates; b—e. interradial plates with pedicellariæ; in b. the pedicellaria is closed, seen directly from above; c. half side view, the pedicellaria closed; d. the open pedicellaria in its groove; e. an empty pedicellaria-groove; in d. and e. the grains surrounding the plates are omitted. a. $^{6}/_{1}$; b—e. $^{14}/_{1}$.

of the arms are found a very small terminal plate and one or two pairs of very small plates, evidently representing an outer pair of marginal plates.

The adambulacral plates (Fig. 7.a) carry two thick furrow spines, and outside these two other similar but thicker and shorter spines. Together with those of the opposite side of the furrow these spines form a close covering of the furrow, all the spines standing so close together as to be flattened against one another; they do not show any distinct serial arrangement. The abradial part of the adambulacral plates carry mostly 4 short, grainlike spines, the inner two of them triangular, closely appressed to the corresponding ones of the adjoining plates. — The mouthplates have an armature exactly like that of the adambulacral plates.

The interradial areas of the oral side covered with rather numerous, not regularly arranged plates, each surrounded by a circle of grains as are the plates of the aboral side; but the plates are somewhat smaller than the aboral ones, and generally less elevated; those in the middle of the area are somewhat larger than those along the edges. A various number of the plates along the edge or along the ambulacral furrow, sometimes nearly all the

interradial plates carry a pedicellaria, which is attached in the bottom of a sunk furrow in the plate. When open, the jaws of the pedicellariæ lie concealed in the sunk furrow; when closed, the jaws raise out of the furrow. The jaws have a few coarse teeth in the outer part (Figs. 7.b—e). In the middle of each furrow is seen, on removal of the pedicellariæ, a pair of narrow, raised ridges on which the jaws of the pedicellaria are mowing up and down (Fig. 7.e).

Quite exceptionally a single or a few pedicellariæ may be found also on the aboral side of the disk.

The young specimen from Halfmoon Bay, Stewart Isl., differs from the larger ones mainly in the shorter marginal plates; the two endplates are not yet very prominent, though already nearly the double size of the other marginal plates. On the oral interradial plates only a single pedicellaria has appeared.

The type specimen of this species is stated by Gray to have come from "China". Since the species has not later on been found in Chinese seas, we may well feel justified in assuming that the label of the type specimen was incorrect. Farquhar (1898) further states the species to occur at Australia, from where it is recorded by Tenison-Woods 1879 [1]. Since the species has not later on been recorded from Australia, it must be regarded as doubtful whether it really occurs in Australian Seas. The statement (Farquhar, 1898) of its occurrence in the East Indies evidently rests on the fact that "*Astrogonium*" *crassimanum* Möbius is included as a synonym of *P. pulchellus*. But that this is an error appears alone from the fact that *P. crassimanus* carries pedicellariæ on the plates of the aboral side of the disk. It agrees herein with the *Pentagonaster stibarus*, recently described by H. L. Clark from West Australia; (indeed, I do not see how the latter is to be distinguished from *P. crassimanus*).

The result then is that *Pentagonaster pulchellus* is not known with certainty to occur outside the New Zealand Seas. Here it appears to be fairly common off the South Island and Stewart Island, whereas it is not known to occur farther to the North than Napier. According to Farquhar it occurs also at the Chatham Islands.

[1]) J. E. Tenison Woods. A list of Australian Starfishes. Trans. & Proc. Philos. Soc. Adelaide. 1879. p. 91.

8. *Diplodontias dilatatus* (E. Perrier).

Pl. XII. Fig. 11.

Astrogonium miliare	Gray.	Hutton. 1872. Catalogue Echinod. N. Zealand; p. 7.
Pentagonaster dilatatus.		E. Perrier. 1875. Revision de la Collection de Stellérides du Mus. d'hist. nat. Paris. Arch. Zool. expér. & génér. V. p. 217.
Gnathaster	--	Sladen. 1889. "Challenger" Asteroidea; p. 286.
Goniodon	—	E. Perrier. 1894. Exped. Travailleur & Talisman. Échinodermes. p 244.
Gnathaster	—	H. Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. L. Soc. N. S.Wales. p. 311.
Goniodon	—	P. de Loriol. 1901. Notes pour servir à l'Ét. des Échinodermes. IX. p. 43. Pl. III. fig. 6.
—	--	H. Farquhar. 1907. Notes on N. Z. Echinoderms. Trans. N. Z. Inst. XXXIX. p. 126.
Diplodontias	—	W. K. Fisher. 1908. Necessary changes in the nomenclature of Starfishes. Smiths. Miscell. Coll. 52. p. 89.
Goniodon angustus.		R. Koehler. 1911. Description de quelques Astéries nouvelles. Rev. Suisse de Zool. XIX. p. 9. Pl. I.4—7.

Taylor's Mistake, Lyttelton. Rocks, at low water. 2 specimens, collected by Mr. W. R. B. Oliver.

No specimens were collected by the author.

As pointed out by W. K. Fisher, the name *Goniodon* proposed by Perrier for the genus established by him with this species as the genotype, is preoccupied (for a Mollusc), and it thus becomes necessary to adopt the name *Diplodontias* proposed by Fisher.

The species *angustus* established by Koehler is, in my opinion, only a synonym of *dilatatus*. According to Koehler *angustus* differs from *dilatatus* mainly in the shape of the arms, which are gradually diminishing in width towards the point, not widened in the point as is the case in *dilatatus;* further the madreporite is much larger and the adambulacral spines occupy a broader space in *angustus*. Of the two specimens in hand one has the shape of arms typical of *dilatatus*, the other that of *angustus*; in both specimens the madreporite is very large, as in *angustus*. In the specimen with shape of arms as in *dilatatus* the adambulacral spines are much less prominent and occupy a distinctly narrower space than in that

with the shape of arms as in *angustus*. These two specimens, in fact, show the characters of both *dilatatus* and *angustus* thus intermingled that we are forced to recognize both forms as one and the same species. This result is also thus far satisfactory, as it would seem beforehand somewhat remarkable that two species of this comparatively rare form should occur together at the New Zealand coasts. The variation in regard to the shape of its arms offers an interesting parallel to what obtains in *Pentagonaster pulchellus*.

De Loriol points out the existence of glassy warts surrounded by the usual grains on the outer marginal plates. I find these glassy warts likewise in my specimens, not alone on the marginals but also on the outer plates of the middorsal series. — Koehler describes and figures some larger round holes in the madreporite in one of his specimens. I do not see anything of the sort in my specimens and might venture to suggest that these holes are not a normal feature of the madreporite.

This species is not known outside New Zealand, and on the New Zealand coast it is hitherto known with certainty only from the locality given here and the two localities mentioned by Koehler, viz. Te Onepoto (Taylor's mistake, near Lyttelton), and "Wangawai", which would appear, according to the kind information of Professor Benham, to be a misprint for Wanganui, on the West coast of the South Islands.

9. *Asterodon miliaris* (Gray).

Pl. XIII. Figs. 7—8.

Astrogonium miliare. Gray. 1847. Proc. Zool. Soc. London. p. 80.
1866. Synopsis of the species of Starfish in the Brit. Mus. p. 10. Tab. I. fig. 3.
— *rugosum.* Hutton. 1872. Catalogue Ech. New Zealand. p. 7.
Pentagonaster miliaris. Perrier. 1875. Revision de la Coll. de Stellérides Mus. Paris. Arch. Zool. expér. V. p. 220.
Gnathaster — Sladen. 1889. Challenger Asteroidea; p. 286.
— *rugosus.* Farquhar. 1897. Contrib. Hist. N. Z. Echinoderms. J. Linn. Soc. Zool. XXVI. p. 194. Pl. 14. fig. 6.
— — Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 311.
— *miliaris.* Farquhar. 1898. Ibidem. p. 310.

Gnathaster miliaris. Farquhar. 1907. Notes on N. Z. Echinoderms. Tr. N. Z. Inst. XXXIX. p. 126.

Asterodon — Benham. 1909. Sci. Res. N. Z. G. Trawling Exp. 1907. Echinoderma. Rec. Canterb. Mus. I.2. p. 8.

No specimens were collected by the author, but two specimens have been presented to the Copenhagen Museum by Professor Benham, one from Foveaux Strait, the other from off Otago, 20—30 fms. These two specimens differ very conspicuously in shape, one having R=1.9 r (R—ca. 70 mm)[1]) the other R=2.2 r (R—49 mm); in the latter specimen the arms are also narrower and thus much more distinct than in the former, which is more pentagonal. Since, however, no other differences appear to exist between them, we must accept also the long-armed specimen as belonging to this species, though representing, evidently, a rather unusual form which may, perhaps, deserve the recognition as a distinct variety. This can, however, only be decided through the study of an extensive material.

Aside from this variation in regard to the general shape I have nothing to add to the description given by Benham (Op. cit.); but I think it may be useful to give a pair of figures of the long-armed specimen.

10. *Peridontaster Benhami* n. sp.

Pl. XII, Figs. 12—13.

Odontaster Grayi Bell. Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exped. Rec. Canterb. Mus. I.2. p. 7.

Foveaux Strait. 20 fms. 1 specimen (Captain Bollons).

This specimen is undoubtedly identical with the form referred by Benham to *Odontaster Grayi* (Bell), but, as suggested by Koehler in his Report on the Echinoderms of the "Deuxième Expédition Antarctique Française 1908—10" (p. 236), the identification with *O. Grayi* is not correct. As is pointed out by Benham (Op. cit.) the New Zealand form agrees in several respects better with *O. penicillatus* (Phil.) than with *O. Grayi;* this, together with the fact that *O. Grayi* is othervise known to occur only in

[1]) This specimen is so much curved that an exact measurement is impossible.

the Magellanic region, makes it the more remarkable that Benham did refer the New Zealand form to *O. Grayi*. The examination of the specimen presented to me by Captain Bollons and the direct comparison of it with a specimen of *O. Grayi* from the Magellanic region leaves no doubt but that the New Zealand form is a distinct species, which I take the pleasure of dedicating to Professor Benham. Unfortunately the specimen is not in the very best condition, but, together with the information given by Benham, it is sufficient for ascertaining the distinctness of the species and for stating the characters in which it differs from the allied species.

Is his splendid work on the Asteroidea of the Australasian Antarctic Expedition [1]) Koehler has given a very careful revision of the family of the Odontasteridæ (or Gnathasteridæ, which he maintains to be the more correct name). According to this the present species must be referred to the genus *Peridontaster* Koehler, which differs from *Odontaster* s. str. in having larger, but less numerous marginal plates and in the spinelets of the paxillæ being much shorter.

The specimen in hand is a young one, only half the size of the two specimens examined by Benham. R=17 mm, r—8.5 mm; R=2 r. The arms are thus distinctly more prominent than in Benham's specimens, which had R=1.87 r (by R=30 mm) and R=1.57 r (by R=33 mm); the facts thus known would seem to indicate that the shape becomes more pentagonal with age.

The plates of the aboral side of the disk rounded, smaller on the arms than on the centre of disk and in the interradial areas; the papulæ are confined to the arms and to the centre of the disk. The midradial series of plates is distinct, the lateral plates less distinctly arranged in longitudinal series, parallel to the midradial series. The latter series continues to the point of the arms, while, according to Benham, in one of his specimens the three-four last superomarginals meet in the dorsal midline; in the other (largest) specimen only the last pair of marginals meet and only in two of the arms. The spinelets of the dorsal plates are short, somewhat coarser on the arms than on the disk; especially on the

[1]) R. Koehler. Echinodermata Asteroidea. Australasian Antarctic Expedition 1911—14. Scientific Reports. Ser. C. Zoology and Botany. Vol. VIII.1. 1920.

interradial plates they are rather distant on account of the fact that rounded, glassy grains are developed on the plates, the spinelets being thus placed in the interspaces between these glassy grains. (Fig. 8). The number of the spinelets is rather different according to the size of the "paxillæ"; there are ca. 5—6 central and 10—15 marginal ones in the midradial plates, and about the same number also in the larger interradial plates. The madreporite is small, situated almost midway between the edge and the centre of the disk. There is a fairly distinct anal pore.

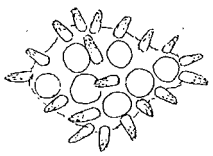


Fig. 8. *Peridontaster Benhami.* Dorsal plate; showing glassy grains among the spinelets. $^{28}/_{1}$.

The marginal plates are 8 to each side of arm, the outer one being still very small. They are rather tumid, separated by broad and deep furrows, and covered on the upper side by very short spinelets, not very closeset, as they are separated through glassy grains. On the low vertical sides the spinelets are somewhat coarser and more closeset, the glassy grains being here less numerous. The covering of the inferomarginal plates is like that of the superomarginals, only the spinelets on the vertical side slightly larger than those of the superomarginals. The unpaired marginal plate is of the same size as the adjoining marginals. — The larger of Benham's specimens also had only 8 marginals on each side of arm, while his smaller specimen had 10 marginals. The terminal plate is fairly large, somewhat triangular.

The armature of the adambulacral plates is somewhat difficult to make out on account of the poor preservation, but it appears that there are two subequal furrow spines, except on the two-three proximal plates, which have three, or even four of them. Apparently there are 3—4 pairs of outer adambulacral spines. The large, unpaired jawspine is somewhat compressed.

The plates of the interradii are arranged in two-three regular series, parallel to the adambulacral plates. The proximal ones are distinctly larger than the distal ones. They are sparsely covered with small spinelets, separated through small glassy tubercles. No pedicellariæ are found.

The present species differs very conspicuously from *Peridontaster Grayi*, especially in the covering of the paxillæ and of the marginal plates, which in the latter species consists of closeset grains; the

glassy tubercles, so prominent a feature in *P. Benhami,* appear not to exist at all in *P. Grayi.* Also the shape of the marginal plates is different, more tumid in the New Zealand species, and especially the furrow separating them is distinctly broader and deeper in the latter. The paxillæ of the aboral side are nearly all of the same size in *P. Grayi,* likewise a conspicuous difference from *P. Benhami.* Finally the presence of pedicellariæ in *P. Grayi* is a very noteworthy difference from the New Zealand species, in which pedicellariæ are not found. The arms are probably upon the whole more prominent in the New Zealand species — but this may prove to be a less constant character. — The only other antarctic species of this genus, *P. pusillus* (Koehler), is easily distinguished from *P. Benhami* a. o. through its fringe of elongated spines on the marginal plates.

Benham emphasizes the similarity between the New Zealand species and *O. penicillatus* (Phil.). That there is, however, no very close relation between these two species is at once evident from the fact that *penicillatus* belongs to the group of species characterized through having small, paxilliform marginal plates, which constitute the genus *Gnathaster* in the restricted sense (Koehler; op. cit. p. 194).

11. *Nectria pedicelligera* n. sp.

Pl. XIII. Figs. 5—6.

One specimen, collected at Gisbourne, on the East Coast of the North Island of New Zealand, was presented to Prof. Benham by the late Mr. H. Suter. Prof. Benham, who had noticed that it was different from *Nectria ocellifera,* as described by Sladen in the "Challenger" Asteroidea, sent me the specimen for study, for which kindness I beg to offer my sincere thanks. The type, and single known specimen of this interesting species is the property of the Otago Museum.

R—53 mm. r—19 mm; R=2.8 r. The arms are narrow, only very slightly tapering, with an obtuse point. The plates of the aboral side of the disk form elevated, table-shaped paxillæ, as typical of the genus *Nectria,* but they are of very different sizes, contrary to what obtains in the other species, *N. ocellata* and *ocellifera.* Off the base of each arm there is a group of 6—7 large paxillæ;

the groups are separated from each other through a double series of very much smaller interradial paxillæ; in the centre of the disk there is a rosette of 6 paxillæ, about half the size of those at the base of the arms and separated form these latter by some smaller paxillæ. The covering of the "tabulum" of the larger paxillæ consists of rather large, flattened grains, very closeset so as to be polygonal (Fig. 9.b). The marginal series consists of much smaller, rounded grains. In the smaller paxillæ also the grains of the tabulum are rounded. The paxillæ remain distinct only at the base of the arms; the outer half of the arms, or a little more, is covered by a close coat of grains, in which may be observed an indistinct arrangement in groups of larger, somewhat flattened grains surrounded by smaller, more rounded grains, corresponding to the paxillar arrangement on the disk, but there is no elevated paxillar shaft and the limitation of the groups is not distinct. The paxillæ of the disk are more closeset than in *N. ocellifera*, especially the large ones off the base of the arms are almost contiguous; the groups of papulæ between the paxillæ are, therefore, much smaller than in the other species. On the arms the papulæ continue about to the middle, the outer half of the arm being entirely without papulæ. The madreporite is small, slightly elevated, situated close to the central rosette of paxillæ.

The marginal plates are rather small and inconspicuous, covered with a uniform coat of grains. There are 26—27 marginal plates along the side of the arms. The terminal plate is rather large, rounded, covered with larger, flattened grains like those on the tabulum of the larger paxillæ. The papulæ along the midline between the marginal plates are developed only in the interradii and along about the inner third of the armsides.

The adambulacral plates carry each three, rather thick, not pointed furrow papillæ; outside these mostly a double series of each two similar, but shorter spines. On the adoral side of each plate is generally found a pedicellaria, consisting of 5—6 slender spines (Fig. 9.a). In a few cases, where the pedicellaria is wanting, there are three spines in the second series. — The jaws carry a marginal series of 6 thick spines, flattened against one another, the two innermost ones of which are distinctly the larger; the two spines at the point may lie so close together as to appear like

one large tooth. Inside the marginal series is another parallel series of 4 somewhat shorter spines, and in the outer part of the jaw is a double series of three still shorter spines, wich may bend against one another so as to have the appearance almost of a pedicellaria. The middle part of the jaw is naked.

The interradial plates are covered with rather coarse grains — or short spines — not regularly arranged. A few of them may carry a pedicellaria. Also on the marginal plates a pedicellaria may be found here and there on some of those in the interradii; it is found only on the proximal side of the plate. Pedicellariæ are also found on the shaft of the paxillæ on the disk (Fig. 9.b), on the larger as well as on the smaller ones. Generally only one pedicellaria is found on each paxilla, but in a few there are two of them. All pedicellariæ are of the same structure: 4—6 slender, slightly curved spines bending against one another, so that their points join.

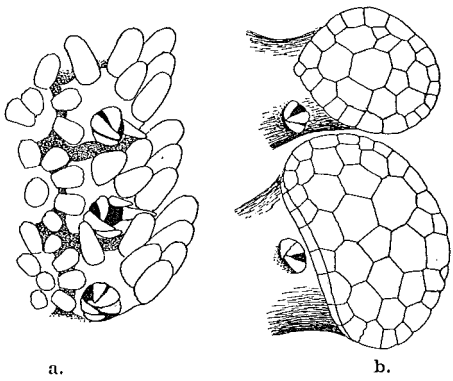


Fig. 9. *Nectria pedicelligera*. a. Adambulacral plates; b. paxillæ, half in side view, showing each a pedicellaria on the shaft. $^9/_1$.

There is a faint trace of reddish colour in the single, dried specimen.

That this is a very well characterized species is easily seen. It differs very markedly from *N. ocellifera* in the shape and arrangement of the paxillæ of disk and arms, in the greater number and smaller size of its marginal plates, and especially in its numerous pedicellariæ, such being found only quite exceptionally in *N. ocellifera*.

Regarding *N. ocellata*, it would appear to agree with *N. ocellifera* in the points which distinguish the latter from *N. pedicelligera*. (I confess that I do not feel quite convinced of the specific validity of *N. ocellata)*. The only other species of *Nectria* known, *N. monacantha* (H. L. Clark), differs so very markedly from both *N. ocellifera, ocellata* and *pedicelligera*, especially through the quite different character of its disk covering, that I do not feel convinced at all

that Fisher was right in referring this species to the genus *Nectria*. I would rather join H. L. Clark in holding that it might be made the type of a new genus between *Mediaster* and *Nectria* (H. L. Clark. "Endeavour" Echinoderms, p. 43).

12. *Ophidiaster kermadecensis* Benham.

Pl. XIII. Figs. 9—10.

Ophidiaster sp. Farquhar. 1897. Contrib. Hist. N. Z. Echinoderms. J. Linn. Soc. Zool. XXVI. p. 195.

— *kermadecensis*. W. B. Benham. 1911. Stellerids and Echinids from the Kermadec Islands. Trans. N. Z. Inst. XLIII. p. 148.

— — H. L. Clark. 1921. The Echinoderm Fauna of Torres Strait. Departm. Marine Biology Carnegie Inst. X. p. 78, 83.

One specimen, (R—65—67 mm), dredged off Cuvier Isl. in a depth of 20 fms., was presented to me by Captain Bollons. It agrees completely with the description of specimens from the Kermadec Islands given by Prof. Benham, and with specimens from the Kermadecs which I have received from Mr. W. R. B. Oliver. I have nothing to add to Benham's description, except the observation that the pedicellariæ are sometimes, through rarely, three valved (Fig. 10).

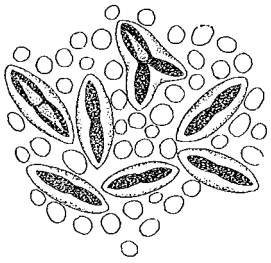


Fig. 10. *Ophidiaster kermadecensis*. Pedicellariæ and empty grooves of pedicellariæ. $^{21}/_{1}$.

Considering how few the Echinoderms common to New Zealand and the Kermadec Islands are, the finding of this sea-star in New Zealand seas is of no small zoogeographical interest.

13. *Asterina (Patiriella) regularis* Verrill.

Asterina (*Asteriscus*) *regularis*. Verrill. 1867. Notes on the Radiata in the Museum of Yale College. Trans. Conn. Acad. I. p. 250.

— *cabalistica*. Lütken. 1871. Forts. kritiske og beskr. Bidrag til Kundskab om Søstjernerne (Asteriderne). Vid. Medd. Naturh. Foren. Kbhvn. p. 242. Tab IV 1, 1a—b.

— *regularis*. Hutton. 1872. Cat. Echinodermata New Zealand p. 9.

Asterina regularis. Hutton. 1878. Notes on some New Zealand Echinodermata. Trans. N. Z. Inst. XI. p. 306.
— — Perrier. 1875. Revision coll. Stellérides Mus. Paris. Arch. Zool. expér. V. p. 299.
— — Farquhar. 1895. Notes on N. Zealand Echinoderms. Trans. N. Z. Inst. XXVII. p. 199.
— — Farquhar. 1897. Contrib. Hist. N. Zealand Echinoderms. Journ. Linn. Soc. Zool. XXVI. p. 196.
— — Farquhar. 1898. On the Echinoderm Fauna of N. Zealand. Proc. Linn. Soc. N. S. Wales. p. 312.
— — Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exp. 1907. Rec. Canterbury Mus. I. p. 15.
Patiriella — Verrill. 1913. Revision of the genera of Starfishes of the Subfam. Asterininæ. Amer. Journ. Sci. 4. Ser. 35. p. 480.
— — W. K Fisher. 1919. Starfishes of the Philippine Seas. Bull. U. S. Nat Museum. 100. p. 416.
Asterina — R. Koehler. 1920. Echinodermata Asteroidea. Austral. Antarct. Exp. 1911—14. Vol. VIII.1. p. 136.
Non: *Asterina regularis.* F. Jeffr. Bell. 1884. Echinodermata. Report Zool. Collect. H. M. S. "Alert." p. 131.

A considerable number of specimens were collected at the following localities; where no depth is indicated, it means that the specimens were collected under stones, at low water.

Mahia Peninsula, 18/XII. 14. Slipper Island, 20/XII. 14. Takapuna Beach, Auckland, 23/XII. 14. Rangitoto, Auckland, 27/XII. 14. Puhoi Rock, Hauraki Gulf, 29/XII. 14. Bay of Islands, 1/I. 15. North Cape, 3/I. 15. Plimmerton, 15/I. 15. Akaroa Harbour, 14/XII. 14, Paterson Inlet, Stewart Isl. 17/XI. 14. Further in Queen Charlotte Sound, 3—10 fms. 20/I. 15 and Paterson Inlet, 5—15 fms. 18/XI. 14.

The species appears to be distributed all round the New Zealand coasts, from North Cape to Stewart Island. Outside the New Zealand region it is not known.

The development of this species I had the opportunity of studying, while staying in Wellington in February 1915. It was found to have a typical pelagic larva. The genital openings are situated on the dorsal side. (Cf. the Author's "Studies of development and larval forms of Echinoderms" 1921; p. 187).

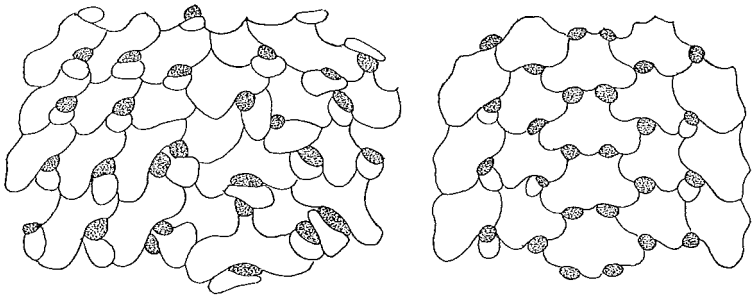
To the descriptions of this species hitherto given I may add

the following observations. The marginal spines of the jaws are fairly constantly 2 large inner ones on each half and 3—4 distinctly smaller ones outside these. Each half of jaw carries, about on its middle, a large and conspicuous, somewhat outwards curved spine, the two spines of the jaw forming together like a pair of horns. Rarely there are two such spines on each half of jaw, placed side by side. The furrow spines are generally three on a few of the inner adambulacral plates, two on those beyond; as a rule they are unequally developed, the outer one being the larger. The first pair of adambulacral plates (very rarely also the second pair) may carry two outer spines instead of one. The interradial plates of the oral side may be said to carry, as a rule, only one, strong spine; but not rarely those near the margin carry each two spines, and this may continue so far inwards as unto about the middle of the area. Sometimes also a few of the inner plates may carry two spines. Also the spines on the disk plates may vary not inconsiderably; they have, generally, distinctly the shape of short, more or less thorny, closeset spines, but sometimes they are coarse, rounded grains. As a rule the arms are quite distinct, but specimens may be found which are regularly pentagonal. The difference in outline is, however, for the greater part due to the fact that the interradial edge may bend inwards to a various degree on preservation.

Farquhar (Op. cit. 1897) has pointed out that this species is subject to considerable variation, and that several of these varying specimens "are so distinct from normal specimens of *A. regularis*, that if a series were found in a separate locality, a new species might safely be established for them". Among the specimens in hand there are two forms which I should, indeed, be very much inclined to regard as separate species. As I have, however, only little material thereof, I do not feel satisfied that they are really distinct species and therefore shall prefer to designate them only as varieties of *A. regularis*, leaving it to future researches to decide, whether they deserve to rank as separate species. In any case they appear to me so different from the typical form that it is unjustifiable simply to identify them as *A. regularis*.

Variety a. (Pl. XII. Fig. 17). Two specimens from Wellington, sent me by Mr. Farquhar 1911, together with some specimens of the typical form. The diameter is 25—26 mm. They are perfectly

pentagonal; this may, as stated above, be the case also in typical *A. regularis*, but a comparison of such specimens (Pl. XII. Fig. 16) with the variety shows that in these the outer part of the interradial area is flattened and fairly distinctly marked off from the somewhat elevated arms, while in the variety the whole interradial area forms a regular,



a. b.

Fig 11. *Asterina regularis.*
Dorsal skeleton of typical form (a) and of variety a (b). 9/1.

level plane. The plates along the dorsal side of the rays are arranged in very regular longitudinal series, while in the typical form the arrangement of these plates is generally more or less irregular, or the serial arrangement is indistinct on account of the numerous small secondary plates (Figs. 11.a—b). These latter are very sparsely developed in the variety, while, on the other hand, the primary plates are larger in the variety than in the typical form. The spines covering the disk plates are similar in both forms, but in the variety they cover only the proximal top part of the plate, leaving a naked distal part, which appears to be of a somewhat coarser structure. The marginal plates are slightly more elongate in the variety. The characters of the oral side are as in the typical form; one of the specimens has three furrow spines in more than half the length of the arm, the other has two furrow spines in nearly the whole length of the arm. — The colour of the two (dried) specimens is white.

Variety b. (Pl. XII. Fig. 18). Four small specimens from Paterson Inlet, Stewart Isl., found under stones on the coast (18/XI. 14). The largest is only 7 mm in diameter. Two of them are pentagonal, while the other two have the arms fairly distinct. What makes this form look rather different from the typical form is the

spine-covering of the aboral side, the spines being slender and divergent, while in the typical form — also in the young specimens (I have found them so small as 5 mm diameter) — they are thicker and closeset (Figs. 12.a—b). The characters of the oral side are essentially the same as in the typical form, only the spines

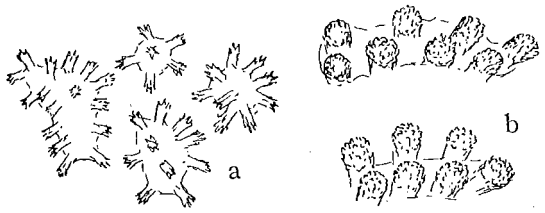


Fig. 12. *Asterina regularis.* Spinelets of dorsal plates in the variety b (a) and in the typical form (b). $^{23}/_{1}$.

are somewhat more slender, conical. Also the spines of the marginal fringe appear to be somewhat more elongate than in the typical form. Colour white.

The genital organs are as yet undeveloped, and, accordingly, the specimens are young, immature — be they now true *A. regularis* or a separate species. — It is worth mentioning that on collecting these specimens I was struck with their different aspect from the typical *regularis* and stated in my notebook that probably they were another species.

[Asterina (Patiriella) Gunnii Gray.*]*

Asterina Gunnii. Gray. 1866. Synopsis of the species of Starfish; p. 16.
— — Perrier. 1875. Revision Coll. Stellérides Mus. Paris. p. 298.

Perrier (Op.cit.) records this species from New Zealand, several specimens being found in the Paris Museum, partly from the voyage of Quoy & Gaimard, 1829, partly from the Michelin collection. When the species is omitted in Farquhar's lists of New Zealand Echinoderms it is probably due to fact that he has overlooked Perrier's statement, which was also overlooked by Sladen, who does not give New Zealand as a locality of this species in his "Challenger" Report.

The fact that this species has not been recorded afterwards from

New Zealand seas is rather remarkable, as it would appear from Perrier's statements to be fairly common there; it is hardly conceivable how such a littoral species of not very small size, and which must be expected to occur in fair numbers where it lives, could have been so entirely overlooked. It is therefore very tempting to suggest that the locality "Nouvelle Zélande" may be due to erroneous labelling. At any rate, I do not think it safe to include this species definitely in the New Zealand fauna, until new and incontestable records of its occurence there are at hand.

I would, however, recall a statement by Hutton (Notes on some New Zealand Echinodermata, with descriptions of new species. Trans. N. Z. Inst. 1878. p. 306) about a 6-rayed variety of *A. regularis* from Dunedin, "which can hardly be distinguished from *A. australis*". Possibly this may have been a true *A. Gunnii*. Also there is in the Copenhagen Museum a specimen of *A. Gunnii*, labelled Auckland (received from the Museum of Vienna in 1877). But here, again, there is no certainty that the label is correct. Then, moreover, this specimen differs from the typical *A. Gunnii* in having on the inner 3—4 adambulacral plates 3 outer spines, connected by a web and arranged in an oblique series; farther out there are only two outer spines. This recalls *A. novæ-zelandiæ;* also the furrow-spines are three. But then the interradial plates of the oral side carry only one spine each in the proximal part of the area, farther out two, while in *A. novæ-zelandiæ* especially the proximal plates carry each 3—4 spines. After all I am inclined to think that this specimen may ultimately prove, in spite of its 6 arms and the difference in the spines on the interradial plates, to belong to *A. novæ-zelandiæ*; to *A. Gunnii* it could hardly belong.

[Asterina (Patiria) novæ-zelandiæ Perrier*]*.

Asterina novæ-zelandiæ. Perrier. 1875. Revis. Coll. Stellérides Mus. Paris. p. 308.

— *neozelanica.* H. Farquhar. 1909. Further Notes on New Zealand Starfishes. Trans. N. Z Inst. XLI. p. 126.

— *novæ-zelandiæ.* Koehler 1917. Échinodermes (Astéries, Ophiures et Échinides) rec. par M. Rallier du Baty, aux îles de Kerguelen, en 1913—14. Ann. Inst. Océanogr. VII. p. 48. Note.

Asterina novæ-zelandiæ Koehler. 1920. Echinodermata Asteroidea. Australasian Antarctic Exped. Zool. VIII. p. 135. Pl. XXXV. figs. 9—10.

Non: *Asterina novæ-zelandiæ*. Goto. 1914. Monogr. Japan. Asteroidea. Journ. Coll. of Sci. Tokio. XXIX, p. 643. Pl. XIX. 279.

It was suggested by Farquhar (A contribution to the history of New Zealand Echinoderms. Journ. Linn. Soc. London. Zool. XXVI. 1897. p. 196) that Perrier's *Asterina novæ-zelandiæ* might be only an abnormal form of *Asterina regularis*. The original description as well as the additional information and, especially, the figures of the type specimen given by Koehler do not, however, leave any doubt but that this species is entirely distinct from *A. regularis*. But how is it possible that such a large and conspicuous littoral starfish has never been found again? The New Zealand shores certainly have been so much explored that it is hardly conceivable how this species could have been entirely overlooked. I cannot help suggesting that the referring of this species to the New Zealand fauna may be due to an erroneous labelling in the old collection.

14. *Asterina (Asterinopsis) aucklandensis* Koehler.

Pl. XII. Figs. 14—15.

Asterina fimbriata Perr. Benham. 1909. The Echinoderms, other than Holothurians. The Subantarctic Isl. of New Zealand. I. p. 295.

— *aucklandensis*. Koehler. 1920. Echinodermata Asteroidea. Austral. Antarct. Exped. Zoology. VIII. p. 135.

Several specimens found under stones at low water, on the shore of Figure 8 Island and Masked Island, Carnley Harbour, Auckland Islands. 2—3/XII. 1914.

As pointed out by Koehler (Op. cit) the *Asterina* of the Auckland Islands has no nearer relation to the Magellanic *Asterina fimbriata* Perrier, to which it was referred by Benham. In fact it belongs to quite another group of Asterinas than does *A. fimbriata*, viz. the genus *Asterinopsis* of Verrill, *A. fimbriata* belonging to the *Patiriella*-group. As the description given by Benham needs several additions and also a few corrections I think it preferable to give a complete description of the species.

The arms are short, the whole outline being sub-pentagonal, in marked contradistinction to the other species of the *Asterinopsis*-group, especially *A. penicillaris* Lmk. from the Cape region, with its long, narrow arms. The largest specimen in hand measures 28 mm R, 20 mm r; thus R = 1.4 r. The smallest specimen measures 6 mm R, 5 mm r.

In the aboral skeleton the secondary plates are few and small, confined mainly to the proximal part of the rays. The primary plates of the midradial line are distinctly smaller than those in the parallel lateral series; the serial arrangement of the plates in the midline is, in the larger specimens, generally distinct only in the proximal part, the distal part of the ray showing a quite irregular arrangement of the midradial and the adjoining lateral plates. As pointed out by Benham there is a larger, crescentic plate at the base of each ray, which forms together with some similar interradial plates, a more or less prominent circle round the centre of the disk, close to which the small madreporite is situated. Each plate bears a bundle of very slender, closeset spinelets, the number of which amounts to about a hundred on the larger plates; the larger bundles are more or less distinctly crescentic, the concavity being directed inwards (Fig. 13.c). The spinelets on the marginal plates are not longer than those on the aboral plates.

The adambulacral plates are stated by Benham to carry four furrow-spines. I find that generally there are 5—6 furrow-spines, rarely even 7, but sometimes only 4. They are united by a web and form on each plate a comb, situated obliquely, the distal end of the comb turning towards the furrow (Fig. 13.b). The outer adambulacral spines generally form another comb, parallel to that at the furrow, only of somewhat smaller spines, and outside these there are some other, smaller spinelets, irregularly arranged or sometimes also forming a more or less distinct comb. — The jaws carry along their inner edge a close comb of spines, the inner ones the largest; they are generally erect, forming like a fence (Fig. 13.a). Generally there are 7—8 spines to each half of the jaw. Outside these each half of jaw carries a group of spines, arranged in a more or less distinct comb. The interradial plates of the oral side carry a close tuft of ca. 10 slender spinelets on their

proximal angle. They are arranged in very regular series in the usual way.

The colour in life is a beautiful claret colour.

The eggs of this species are large and yolky, which indicates that it has a direct development. On the other hand the fact that the genital openings lie on the aboral side makes it almost certain

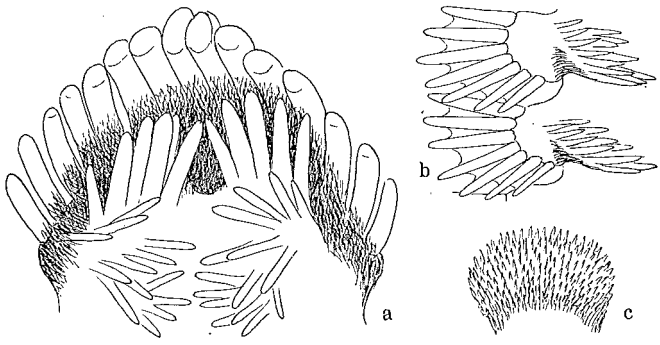


Fig. 13. *Asterina aucklaudensis.*
a. Jaw; b. adambulacral plates; c. paxilla. 18/1.

that this species does not protect its brood. It is probable, therefore, that the eggs, in spite of their rather large size, float free in the water.

This species is known only from the Auckland Islands. Whether it is really confined to this small area would seem rather improbable. It may well be expected to occur also at the Campbell Island and perhaps also at Stewart Island and Macquarie Island.

In view of the doubt reigning as to the occurrence of the species *Asterina gunnii* and *novæ-zelandiæ* at the New Zealand coasts the attention of collectors should be called especially to these species. It may therefore be useful to give here a key to the species of *Asterina* known to occur in or recorded from the New Zealand region, in order to facilitate recognizing the species observed. There may perhaps also be a possibility of finding *Asterina exigua* at the New Zealand coasts, and likewise the two varieties of *A. regularis* described above may perhaps prove to be distinct species. Thus the Asterinids of New Zealand may well deserve attention.

1. Adambulacral plates with only one outer spine 2
   — — three or more outer spines..... 3
2. The jaws with a pair of prominent, horn-like outer spines; five more rarely six, rays ..... *A. regularis.*
   No outer spines on the jaws. Six rays ..... *A. gunnii.*
3. Furrow-spines three; outer adambulacral spines three. *A. novæ-zelandiæ.*
   — generally 5—6; outer adambulacral spines numerous ..... *A. aucklandensis.*

15. *Stegnaster inflatus* (Hutton).

Pl. XIII. Fig. 11.

Pteraster inflatus. Hutton. 1872. Catologue Echinod. New Zealand. p. 10.
Palmipes — Perrier. 1875. Revision Collect. Stellérides Mus. Paris. p. 291.
Stegnaster — Sladen. 1889. "Challenger" Asteroidea. p. 778.
— — Farquhar. 1895. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII. p. 199.
— — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales, p. 312.
— — Farquhar. 1909. Further Notes on New Zealand Starfishes. Trans. N. Z. Inst. XLI. p. 126. Pl. XII.

1 specimen was collected on the rocks of Island Bay, Wellington, 17/II. 1915. Further I have received from Mr. W. R. B. Oliver some specimens collected at Rangitoto, Takapuna and Browns Bay, Hauraki Gulf.

To the very careful description given by Perrier I would only add that the inwards pointing spines on the oral interradial plates are peculiar in being glassy, not of the structure common in starfish spines. (Fig. 14). This also holds good of *Stegnaster Wesseli* (Perr.), the type species of the genus.

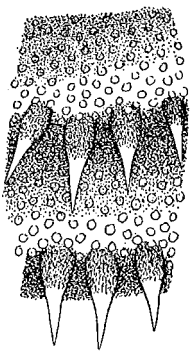


Fig. 14. *Stegnaster inflatus.* Part of oral interradial area, with the peculiar glassy spines. 21/1.

Perrier writes that this species appears to "soulever ordinairement la partie centrale de son corps, de manière que les extrémités des bras et les bords du corps reposent seuls sur le sol; l'animal

prend ainsi une forme renfleé on pyramidale". The specimen which I collected myself was attached to the rock with its whole oral surface, but on being preserved it assumed the peculiar inflated shape. It would thus appear rather to be a post mortem phenomenon, not its normal position. One might perhaps suggest the inflation to have some connection with brooding habits. But about this nothing at all is known — that is for future observations on living specimens.

The species is known to occur only at the New Zealand coasts, and only from Hauraki Gulf in the North to Timaru in the South.

I may recall here the interesting comparison of this species with the remarkable group of fossil starfishes, the *Sphærites*, made by Schöndorf ("Die Organisation und systematische Stellung der Sphæriten". Arch. f. Biontologie. I. 1906. p. 299); it should, however, be pointed out that the resemblance is only apparent, the body of *S. inflatus* being in reality very flat, the high shape of specimens in collections being due to preservation, while in *Sphærites* it is the body itself which is very high, semiglobular.

16. *Henricia lukinsii* (Farquhar).

Pl. XIII. Figs. 1—2.

Cribrella ornata Perr. H. Filhol. 1885. Recueil de Mémoires, Rapports et Documents .... Pass. de Vénus sur le Soleil. III. Mission île Campbell. Chapitre X. Echinodermes. p. 572.

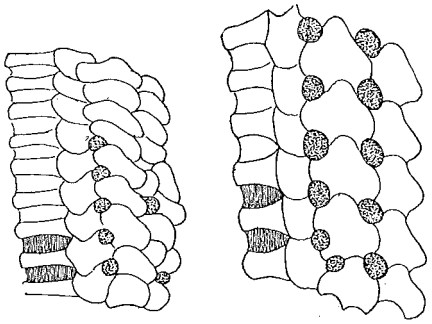
— *lukinsii.* Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. p. 190.

— — Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 314.

Henricia ornata Perr. (partim, Set A). Benham. 1909. The Echinoderms, other than Holothurians. The Subantarctic Islands of New Zealand. I. p. 298.

Several specimens from Figure 8 Island and Masked Island, Carnley Harbour, Auckland Islands, 30/XI—3/XII. 1914, and from Perseverance Harbour, Campbell Island, 8/XII. 14; found under stones, at low water. One specimen was found, together with *Ophiomyxa brevirima*, in the base of a large *Macrocystis*, cast ashore; the specimen was noticed to be still alive.

This species is very characteristic through its short, blunt arms and through the adambulacral armature, which consists of a single transverse series of fairly robust spines, invested by a rather thick coat of skin. The spines on the adjoining plates are likewise arranged in single transverse series in direct continuation of the adambulacral series, the serial arrangement thus continuing from the ambulacral furrow on to the side of the arms. Though not always quite regular, this series-arrangement is, upon the whole, a very conspicuous feature of the present species. Another noteworthy feature is the existence of a very distinct median depression on the oral side in each interradial area; the two genital openings are situated at the outer end of this depression. One might suggest that these depressions have some connection with the brooding habits of this species (which are, however, totally unknown). In regard to the skeletal structure it should be noticed that the series of oral intermediate plates is fairly regular, reaching somtimes well beyond, sometimes hardly to the middle of the arm. The marginal plates form fairly regular and distinct series, though sometimes there is some disorder to a various extent, especially in the superomarginal series, in the proximal part of the arm, so that they are hardly discernible from the dorsal skeleton (Fig. 15.a).[1])



a. b.

Fig. 15. Skeletal plates from side of arm of *Henricia lukinsii* (a) and *H. compacta*, var. *aucklandiæ* (b). The series of plates are from left to right in each figure: adambulacrals, intermediate, inferomarginals, superomarginals. The muscles between the adambulacrals are drawn only in the two lowermost pairs. 9/1.

It should still be pointed out that the statement in Farquhar's description of the type specimen that there is a very large compact group of spinelets in the centre of the disc, apparently covering the dorsocentral plate, does not hold good of my specimens, which

[1]) It is by no means always easy to decide what is the intermediate and what the marginal series of plates, especially not without denuding the arm.

show the spinelets of the disk arranged in the same way as upon the arms, in groups of some 5—8 spinelets. Probably the single compact group of spinelets of the type specimen is a result of contraction due to poor preservation.

It appears that *H. lukinsii* does not grow to any large size. The largest of the fairly numerous specimens which I collected measures 22 mm R; Benham's largest specimen was 24 mm R.

This species was referred by Benham to *Henricia ornata* (Perr.) relying on the fact that Filhol (Op. cit.), evidently on the authority of Perrier himself, records his specimens from the Campbell Island under this name. I cannot, however, accept this identification. A direct comparison of these specimens from the Auckland-Campbell Islands with specimens of *H. ornata* from S. Africa, as also with the figures of this latter species given by Koehler in his Report on the Starfishes of the "Scotia" Expedition leaves, in my opinion, no doubt of their specific distinctness.[1]) Benham further is inclined to regard the various antarctic species: *simplex* Sl., *præstans* Sl., *pagenstecheri* Studer and *hyadesi* Perr. as identical with *H. ornata*, relying on the opinions expressed by Bell, Ludwig, Leipoldt, Meissner and Koehler. Without entering on a discussion of the validity of these various forms I may state that I am not at all inclined to regard them all as only one and the same species. Not having access to the species described by Sladen I sent a specimen of the Auckland form to my friend Dr. H. L. Clark, who was just staying at the British Museum with the object of studying the Echinoderm collection there, with the request that he would compare it with those species. He kindly informed me that the Auckland form is quite unlike any of these species, and that he must regard at least *præstans* and *obesa* as distinct species. That *ornata* is, in my opinion, a perfectly distinct species I have already stated. Further I have, through the courtesy of Professor Joubin and Professor H. Lohmann received specimens

[1]) It appears that also Perrier himself has afterwards come to the conviction that the species from Campbell Island is not identical with *H. ornata*. Among the specimens sent me from the Paris Museum there is one named *Cribrella campbellensis* E. Perrier. This is a specimen of *H. Lukinsii*, quite typical, only with one arm bifid. Perrier's name never having been published, not even as a nomen nudum, it cannot replace the name *lukinsii* of Farquhar.

of *H. hyadesi* Perr. from the Paris Museum and of *H. pagenstecheri* from the Hamburg Museum and have thus had the opportunity of forming my own opinion about the relation of these two species to the Auckland Isl. form. *H. hyadesi* with its long, slender arms, and with its not mono-serially arranged adambulacral and marginal spines is so different from the Auckland form that it is seen at a glance that they are entirely different. *H. pagenstecheri* has a considerable superficial resemblance to the Auckland form, so that one might well at first sight think them one and the same species. A closer examination, however, reveals some noteworthy differences. The adambulacral spines are monoserially arranged as in the Auckland form, but the spines of the marginal plates are not thus arranged so that we have not here the arrangement of the spines in transverse series from the ambulacral furrow up to the side of the arms so characteristic of the Auckland form. Further the inner adambulacral spine in *pagenstecheri* is fairly large, horizontally directed across the furrow, almost joining that from the opposite side in the midline, each pair of the tubefeet thus, as it were, being confined within a separate compartment. In the Auckland form the inner ambulacral spine is directed vertically, no such compartment being formed. Also the interradial areas are more naked in *pagenstecheri* and the depression hardly so distinct. Although agreeing that the Auckland form shows a rather considerable resemblance to this Magellanic species, *pagenstecheri,* the characters pointed out seem to me so important that there can be no question of regarding these two forms as one and the same species. I must thus maintain *H. lukinsii* Farquhar as a perfectly distinct species, which is as yet known only from the Subantarctic Islands of New Zealand.

17. *Henricia compacta* (Sladen).

(?) *Henricia occulata* Penn. (?) Hutton. 1872. Catalogue N. Z. Echinodermata, p. 7.

Cribrella compacta. Sladen. 1889. "Challenger" Asteroidea, p. 543. Pl. XCVI. 1—2; XCVIII. 3—4.

— — Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX, p. 191.

— — Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 314.

Cribrella compacta. Benham. 1909. Subantarctic Islands of New Zealand. I. p. 300. Note.

Three specimens from the Chatham Island, received from Mr. W. R. B. Oliver, may well be referred to this species, as is done by Farquhar and Benham.

It would appear to be this species which is recorded from the Cook Strait, under the name of *Cribrella ornata,* by Filhol. (Cf. Benham, Op. cit.). As I have no specimens from this locality myself, and as the specimens from the Chatham Islands at my disposal are in a very poor state of preservation, I shall refrain from any discussion of this species.

Farquhar (Op. cit.) thinks that Hutton's *Henricia oculata* belongs to this species, while Hutton himself (Trans. N. Z. Inst. 1878, p. 306) declares it to be *Echinaster fallax* M. Tr. (= *luzonica* M. Tr.). It is no very important matter, which is the correct identification. If Hutton is right, his specimen is certainly not of New Zealand origin.

18. *Henricia compacta,* var. *aucklandiæ* n. var.

Pl. XIII, Figs. 3—4.

(?) *Cribrella ornata.* H. Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. p. 190.
— — H. Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 314.
Henricia — (partim; Set B.) Benham. 1909. The Echinoderms, other than Holothurians. The Subantarctic Islands of New Zealand. I. p. 298.

Masked Island, Carnley Harbour, Auckland Isl.; under stones, at low water. 3/XII. 14. 3 specimens.
Figure 8 Island, Carnley Harbour, Auckland Isl. 2/XII. 14. 6 specimens. Chatham Islands. Rocks between the tides. (W. R. B. Oliver). 2 specimens.

In his Report on the Echinoderms of the Subantarctic Islands (p. 298—300) Benham states that the specimens of "*Henricia ornata*" from the Auckland-Campbell Islands may be divided into two sets, A and B, the former with a single, the latter with a double row of spines on the adambulacral plates. My material of

Henricias from there likewise forms two such groups. But while Benham regards all as belonging to one and the same species, I think they represent two distinct species, viz. *Henricia lukinsii* — Benham's "Set A" — and the form here designated as *Henricia compacta,* var. *aucklandiæ* — Benham's "Set B". It is true that some of the younger specimens of *H. lukinsii* look rather intermediate, because of their arms being slender as in the present form. But the adult specimens are so different in general aspect and in some structural details that they can, in my opinion, decidedly not be referred to the same species.

The present form differs from *H. lukinsii* in the arms being much longer and slenderer, not swollen at the base. The incisions at the base of the arms and the depression in the oral interradial areas, so characteristic of *lukinsii,* are lacking. The spines on the adambulacral, intermediate and marginal plates stand in groups, not monoserially arranged as in *lukinsii.* However, these groups may form more or less distinct vertical series. The spines of the intermediate plates form a distinct group on each plate, while in *lukinsii* these spines are contiguous with the adambulacral spines, the intermediate series being therefore distinctly discernible only on denuding the arm. In the present form the intermediate series of plates is distinct nearly to the end of the arm or at least in the proximal two thirds. Both series of marginal plates distinct and regular. (Fig. 15.b).

The differences here pointed out seem to me to leave no doubt but that this form is entirely distinct from *H. lukinsii.* Whether it is then to be referred to *H. compacta* or it represents a third species I do not venture to decide, my material of both these forms being altogether too insufficient. There is no doubt that the Auckland form is nearly related to *H. compacta,* but it differs rather markedly from this species in the spinelets being less robust and fewer in each group. Also the madreporite is much more distinct in the Auckland form than in my specimens of *compacta.* — In short, until a rich and well preserved material of both forms becomes available, enabling us to form a definite judgment of the constancy of the differences between these two forms, I think it the safest course to designate the Auckland Isl. form as a variety of *H. compacta.*

19. *Calvasterias Suteri* (de Loriol).

Asterias rupicola. Hutton. 1878. Notes on some New Zealand Echinod. Trans. N. Z. Inst. XI. p. 306.

Stichaster Suteri. De Loriol. 1894. Notes pour servir à l'étude des Échinodermes. Rev. Suisse de Zool. II. p. 477. Pl. XXIII 2.

— *littoralis.* Farquhar. 1895. Notes on New Zealand Echinoderms. Trans N. Z. Inst. XXVII. p. 206. Pl. XIII.2.

— *Suteri.* Farquhar. 1897. Contrib. Hist. N. Z. Echinoderms. J. Linn. Soc. Zool. XXVI. p. 197.

— — Farquhar. 1898. Echinoderm Fauna of N. Zealand. Proc. Linn. Soc. N. S. W. p. 313.

— — Benham. 1909. Subantarctic Islands of New Zealand. Echinoderms, p. 302.

Stichorella — Koehler. 1920. Echinodermata Asteroidea. Australasian Antarct. Exped. 1911—14. Vol. VIII. p. 87—89. Pl. XXII.1, 2, 4. LXII.3. LXIII.1.

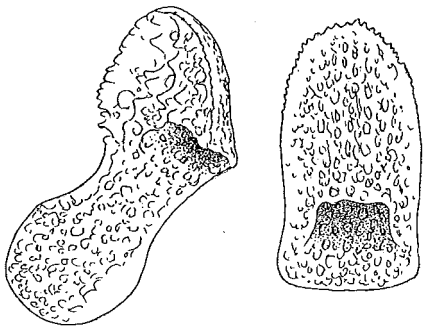
Calvasterias— W. K. Fisher. 1922. Notes on Asteroidea. III. Ann. Mag. Nat. Hist. 9. Ser. X. p. 597.

While no specimens of this species were collected on the New Zealand coasts, the author found one specimen on a floating *Lessonia* 1 mile E. of Auckland Island, 28/XI. 1914. — Some specimens collected at Godley Head, near Lyttelton, on rocks, at low tide, were received from Mr. W. R. B. Oliver.

The genus *Stichorella,* established by Koehler for this species, is maintained by Fisher to be synonymous with *Calvasterias* Perrier; it appears to me that Fisher is perfectly right herein. To the careful descriptions by de Loriol, Farquhar and Koehler I need only add a few remarks on the pedicellariæ.

Koehler (Op. cit. p. 88) states that the crossed pedicellariæ present no peculiar features except that of their basal part being rather strongly developed relatively to the length of the valves. I do not agree that this is the only peculiarity of these pedicellariæ. The valves are rather peculiar in being of a much less elaborate structure than usually found in the crossed pedicellariæ. Only very few teeth are developed on the blade and arranged without any definite order. The edge is irregularly serrate and no regular series of teeth follow inside, as otherwise usual in this sort of pedicellariæ. The blade also is more distinctly concave than usual, and the shaft is of reticulate structure, not glassy as is otherwise the case in the crossed pedicellariæ. (Fig. 16.a). Upon the whole, it is evident

that these pedicellariæ are of a very primitive structure, and therefore of considerable morphological interest, indicating the way in which the elaborate structure of the crossed pedicellariæ has developed. The straight pedicellariæ (Fig. 16.b) are very small and simple, with finely serrate edge.



a. b.

Fig. 16. *Calvasterias Suteri.* Valves of pedicellariæ; a. of crossed, b. of straight form. 150/1.

Benham records this species from Macquarie Island. As pointed out by Koehler (Op. cit. p. 97) this is probably a mistake; the specimen examined by Benham most probably belongs to the species *Parastichaster Mawsoni* Koehler. Thus, *S. Suteri* is known with certainty only from the South Island of New Zealand, Stewart Island and the Snares Island. But the interesting fact here recorded of a living specimen (young) being found on a floating *Lessonia* in the open sea off the Auckland Island makes it probable that the species will be found also in other places in the subantarctic area of New Zealand.

20. *Calvasterias lævigata* (Hutton).

Pl. XIII. Fig. 12; Pl. XIV. Figs. 3—10.

Asterias rupicola, var. *lævigatus*. Hutton. 1879. Notes on a Collection from the Auckland and Campbell Isl. Trans. N. Z. Inst. XI. p. 343.

Stichaster suteri, var. *lævigatus*. Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. p. 189.

— — — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 313.

— — — Benham. 1909. Subantarctic Islands of New Zealand. Echinoderms. p. 302.

Calvasterias lævigata. W. K. Fisher. 1923. A preliminary Synopsis of the Asteriidæ, a family of Sea Stars. Ann. Mag. Nat. Hist. 9. Ser. XII. p. 606.

Port Ross, Auckland Islands. Under stones, at low tide. 26/XI. 1914. Several specimens.

Masked Island, Carnley Harbour. Under stones, at low tide. 29/XI. 1914. Several specimens.

Figure 8 Island, Carnley Harbour. Under stones, at low tide. 2/XII. 1914. 7 specimens.

Adams Island, Carnley Harbour. Under stones, at low tide. 29/XI. 1914. 3 large specimens.

Perseverance Harbour, Campbell Island. Under stones, at low tide. 8—10/XII. 1914. Several specimens.

While Farquhar and Benham regard this form as a variety only of *C. Suteri,* Fisher gives it the rank of a distinct species. I must decidedly agree with Fisher in this view. The reason for regarding it only as a variety of *C. Suteri* the said authors find in the fact that sometimes a median row of spines is distinctly developed on the arms, as also some spines on the disk. This is perfectly true; it is even not at all rare that all the plates of the aboral side carry spines, the whole of the aboral side, disk and arms, being thus covered by a fairly close coat of spines. (This does not depend upon age, as we find young specimens with numerous spines and large specimens quite destitute of spines). But contrary to the very characteristic, regular arrangement of these spines in *C. Suteri,* the spines in the present species are quite irregularly arranged; at most there is a distinct midradial series, consisting of single spines, while in *C. Suteri* the midradial spines are placed in very regular groups. Also the spines are smaller in the present species than in *C. Suteri*, whereas their microscopical structure is essentially the same in both. (Koehler. Op. cit. Pl. XXII.4). The spines of the inframarginal plates are not rarely 3, sometimes even 4, in an oblique series, against 2 in *C. Suteri*; however, they are more commonly 2, even in large specimens, also in the present species. — In regard to the pedicellariæ I do not find any noteworthy differences between the two species, either in structure or arrangement. The teeth of the crossed pedicellariæ may be somewhat larger than in *C. Suteri*; but this is no constant character.

I made the interesting observation that this species protects its brood in the same way as do so many other sea-stars, the young being attached in great bundles around the mouth of the mother specimen (Pl. XIII. Fig. 12). The fact that in all the

specimens observed the young ones are all in very nearly the same stage of development, evidently just ready to leave the mother, made me think that possibly the eggs might develop within the stomach or in a special brood pouch, as is the case in *Granaster nutrix* Studer and in *Leptasterias groenlandica* (Steenstr.). I did, however, not observe anything to support this suggestion in the several specimens which I opened. — It would be very interesting to know, whether *Calvasterias Suteri* protects its brood in the same way. That it has not typical pelagic larvæ, as suggested by Koehler (Op. cit. p. 88), has been made fairly evident by Fisher (Notes on Asteroidea. Ann. Nat. Hist. 9. Ser. X, p. 597), who found its eggs to be of the large, yolky type. As my own alkoholic specimens happen to be males I can give no new evidences as to this point.

A small specimen of this species is found in the collection of the Copenhagen Museum, which was received, unidentified, from the Paris Museum, 1877. This proves that the species was found there already by Filhol, though not mentioned in his report.

21. *Stichaster australis* (Verrill).

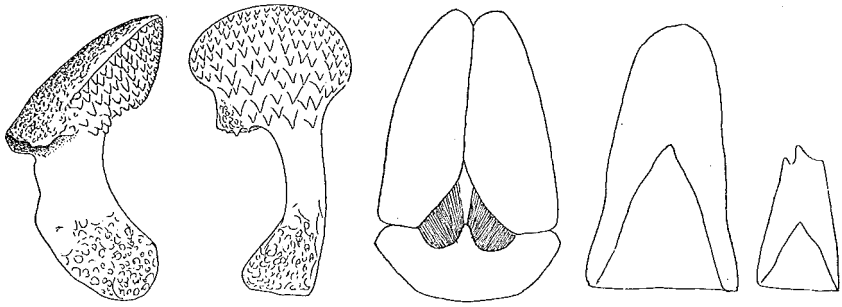
Pl. XIV. Fig. 1—2.

Cœlasterias australis.	Verrill.	1867. Descriptions of new Starfishes from New Zealand. Trans. Conn. Acad. I. p. 247.
—	—	Hutton. 1872. Catalogue Ech. New Zealand; p. 5.
Stichaster	—	Sladen. 1889. "Challenger" Asteroidea, p. 431.
—	—	Farquhar. 1895. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII. p. 202.
—	—	Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 313.
Cœlasterias	—	Koehler. 1920. Echinodermata Asteroidea. Australasian Antarctic Expedition. VIII.$_1$. p. 54, 91.

Several specimens were collected on the rocks, at low tide, at Cape Maria van Diemen; 4/I. 1915. They were found attached in all sorts of crevices in the rocks, attaching themselves so strongly that they were torn to pieces, if one tried to detach them without the aid of a knife — as already stated by Farquhar (1895). Evidently, they are especially adopted to living on rocks exposed to a violent surf. They were found to feed on the mussels (*Mytilus*)

living in the same localities. The fact that their eggs are small, transparent and very numerous indicates that they do not protect their brood, but have a typical pelagic larva.

The species having never been figured, I think it desirable to give some figures of it. Also a few additional remarks may be



Figs. 17—18. *Stichaster australis*. Pedicellariæ.
17. Valves of crossed pedicellariæ, in side (a) and front view (b). 18. Straight pedicellariæ, in outline. a. whole pedicellaria, showing the closing muscles; b. valve, seen from the inside; c. valve of a small form, seen from inside.
Fig. 17 $^{100}/_{1}$; Fig. 18 $^{33}/_{1}$.

given to Verrill's description, which, otherwise, is so careful as to leave little to be desired.

The arms vary in number from 10—13, the number 11 or 12 being the more common; only one specimen was found to have 13 arms. In the younger specimens the arms are rather cylindrical, only slightly tapering; only in the larger specimens they can be said to be inflated (probably on account of the genital organs, when these contain ripe sexual products). The largest specimen which I have seen (a dried specimen in poor condition from Kawhia) measures 24 cm in diameter (Verrill's type specimen was 29 cm in diameter). The relation between R and r varies from ca. 2—2.4. The larger spines of the inframarginal plates are stated by Verrill to be arranged in a single row; I find this serial arrangement rather indistinct. His statement that these spines are much larger than the interambulacral (= adambulacral) ones is to be thus understood that they are thicker than these latter, while they are considerably shorter.

The crossed pedicellariæ (Figs. 17.a—b) are interesting in having

the teeth developed to an unusual degree, completely covering the inside of the blade. The straight pedicellariæ (Figs. 18.a—c) are short, simple, rather robust; the smaller ones may have some more or less distinct, coarse teeth at the point.

This species is known to occur only at the coasts of New Zealand, from North Cape to Millford Sound. According to Koehler (Op. cit. p. 91) it is found also at the Auckland Island; but this, evidently, is due to a confusion of the town of Auckland, from where the type specimen came, with the Auckland Island.

22. *Allostichaster polyplax* (Müll. & Troschel).

Asteracanthion polyplax.	Joh. Müller & F. H. Troschel. 1844. Beschreibung neuer Asteriden. Arch. f. Naturgesch. p. 178.
Asterias —	E. Perrier. 1875. Revision de la Collection de Stellérides Mus. Paris. Arch. Zool. expér. & génér. V. p. 63.
Stichaster —	Sladen. 1889. "Challenger" Asteroidea, p. 432.
Tarsaster neozealanica.	Farquhar. 1895. Notes on N. Zeal. Echinoderms. Trans. N. Z. Inst. XXVII. p. 207. Pl. XII. $_{15-23}$.
Stichaster polyplax.	Farquhar. 1897. Contr. Hist. New Zeal. Echinoderms. Journ. Linn. Soc. Zool. XXVI. p. 196.
— —	Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 313
— —	Farquhar. 1909. Further Notes on N. Z. Starfishes. Trans. N. Z. Inst. XLI. p. 129.
— —	Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exped. Rec. Canterb. Mus. I. p. 15.
Asterias —	H. L. Clark. 1913. The Echinoderms of the Western Australian Museum. Rec. W. Austr. Mus. I. p. 151.
Allostichaster —	H. L. Clark. 1916. Report on the Sea-Lilies etc. obtained by the "Endeavour". Biol. Res. Fishing Experiments "Endeavour". IV.$_1$. p. 70.
— —	R. Koehler. 1920. Echinodermata Asteroidea. Australasian Antarctic Expedition. VIII.$_1$. p. 83. Pl. XVIII.$_{7-11}$. Pl. LXI.$_2$.

Slipper Island. 20/XII. 14. 1 specimen.
Mahia Peninsula. 18/XII. 14. 1 specimen.
Plimmerton. 15/I. 15. 4 specimens.
Paterson Inlet, Stewart Island. 18. XI. 14. 1 specimen.

All were taken on the rocks at the shore, at low tide.

I have nothing of importance to add to the descriptions of this species hitherto given. Regarding its relation to *Allostichaster insignis*, see under that species.

23. *Allostichaster insignis* (Farquhar).

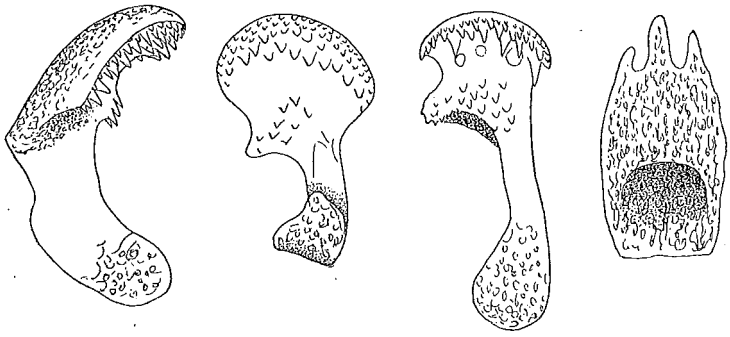
Stichaster insignis. Farquhar. 1895. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII. p. 203. Pl. XIII.$_1$.
— — Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. p. 188.
— — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 314.
— — Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exp. Rec. Canterb. Mus. I. p. 15.
Allostichaster — Koehler. 1920. Echinodermata Asteroidea. Australasian Antarct. Exp. VIII.$_1$. p. 85. Pl. XX.$_{2-7}$. Pl. LXV.$_2$.

Masked Island, Carnley Harbour, Auckland Isl. On the rocks, at low tide. 3/XII. 14. 6 specimens.
Figure 8 Island, Carnley Harbour, Auckland Isl. On the rocks, at low tide. 2/XII. 14. 3 specimens.
Port Ross, Auckland Islands; ca. 10 fms. 25/XI. 14. 2 specimens.
Stewart Island, ca. 20 fms. 16/XI. 14. 1 specimen.
Queen Charlotte Sound. 3—10 fms. 20/I. 15. 2 specimens.
Wellington Harbour, 5—10 fms. 16/II. 15. 2 specimens.
Off Albatross Point. 25 fms. 11/I. 15. 5 young specimens.

The species being hitherto recorded only from Wellington to off Otago, it is interesting to have extended its area of distribution down to the Auckland Islands. The specimens from off Albatross Point being very young, its occurrence to the North of the Cook Strait is still uncertain.

Although typical forms of *insignis* and *polylax* are easily distinguished, it is by no means always easy to distinguish the two species from one another. As a rule the spines of *A. insignis* are thicker and coarser than those of *A. polyplax*, but specimens perfectly intermediate in this regard are not rare. The arrangement of the spines on the superomarginal plates varies so considerably in both species, that no reliable difference is to be found herein; neither does the armature of the adambulacral and inframarginal plates and of the whole aboral side, nor the shape of the marginal

plates afford any reliable specific differences. The main difference apparently lies in the number of arms, *A. polyplax* having as a rule 8 arms, *A. insignis* only 6; but specimens with 7 arms occur in both species, and here especially the difficulty of distinguishing one species from the other sets in. Also specimens vith 5 arms,



a. b. c. d.

Fig. 19. Valves of pedicellariæ of *Allostichaster insignis* and *polyplax*. a—b. of crossed pedicellariæ of *A. insignis*, in side view (a) and from the inside (b); c. valve of crossed pedicellaria of *A. polyplax*, from the inside; d. valve of straight pedicellaria of *A. polyplax*, from the inside. 150/1.

evidently such as have never divided, may occur in both species. As a rule it may be said that *A. polyplax* has more slender arms than *insignis*, and also the colour appears to be different, *A. insignis* being generally red or purple, *A. polyplax* dark gray or brownish. The pedicellariæ generally are more numerous in *polyplax*, and also in their structure a slight difference is to be noted, the teeth of the valves of the crossed pedicellariæ being somewhat less numerous, but somewhat longer in *polyplax* (cf. Figs. 19.a—c). The straight pedicellariæ are, in both species, small, generally with the valves ending in three points (Fig. 19.d). In larger specimens the papulæ are more numerous in *insignis* than in *polyplax*.

A. insignis is the more southern of the two species, and not known to occur outside the New Zealand seas, while *A. polyplax* is widely distributed also along the Australian coasts. It is, however, worth noticing that an evidently very close relative of *A. insignis* occurs in the Magellanic region, viz. *Allostichaster inæqualis* Koehler.[1]) — It appears that *A. insignis* grows to a considerably

[1]) R. Koehler. Astéries et Ophiures. Further Zool. Res. of the Swedish Antarctic Expedition 1901—1903. I. 1923. p. 50—52.

larger size than *A. polyplax*. (Benham records one of R = 88 mm; my largest specimen has R = 50 mm.) — Upon the whole, it is beyond doubt that the two species are perfectly distinct, though — as is evident from the facts here pointed out — rather closely related.

24. *Sclerasterias mollis* (Hutton).

Pl. XIV. Figs. 13–14.

Asterias mollis. Hutton. 1872. Catalogue Echinod. New Zealand; p. 4.
— — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 316.
— — Benham. 1909. Sci. Res. N. Z. G. Trawling Exp. Echinoderma. Rec. Canterb. Mus. I.2. p. 19.
Eustolasterias mollis. W. K. Fisher. 1923. A Preliminary Synopsis of the Asteriidæ, a family of Sea-Stars. Ann. Mag. Nat. Hist. 9. Ser. XII. p. 255.
Sclerasterias — W. K. Fisher. 1924. The genus Sclerasterias Perrier. Bull. Inst. Océanogr. Nr. 444.

No specimens of this species were collected by the author; but two specimens, taken off Otago in a depth of 20—30 fms. were presented to the Copenhagen Museum by Professor Benham. One of them is in a fairly good state of preservation, though broken. As the species has never been figured I think it desirable to figure this specimen.

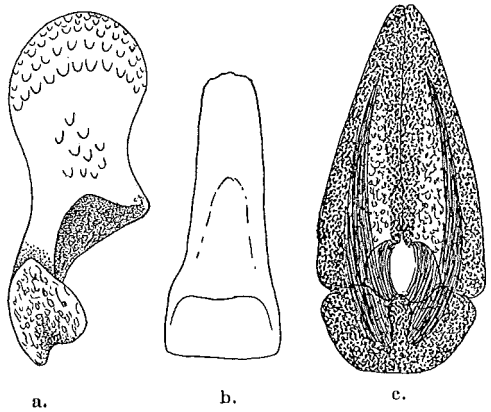


Fig. 20. *Sclerasterias mollis*.
a. Valve of crossed pedicellaria, from the inside; b. valve of straight pedicellaria (in outline) from the inside; c. large, straight pedicellaria; note the large muscles. a. 150/1; b—c. 45/1.

Although a detailed description of the species does not exist, it seems to me not appropriate to try to supply such description on the base of the material available, especially because I have no possibility of comparing it with the other species referred to this genus, which makes it

difficult to point out the characters which distinguish it from the other species of the genus. Only the pedicellariæ may be figured (Figs. 20.a—c). — From the other New Zealand sea-stars of the Asterias-group this species is distinguished at a glance trough having only five arms. It is till now known only from the South Island of New Zealand, from Lyttelton to Dunedin.

25. *Astrostole scabra* (Hulton).

Pl. XIV. Figs. 11—12.

Margaraster(?) *scaber.* Hutton. 1872. Catalogue Ech. New Zealand, p. 5.
Asterias (Strolasterias) scabra. Farquhar. 1895. Notes on N. Z. Echinoderms. Trans. N. Z. Inst. XXVII, p. 202. Pl. XIII. 3—4.
Asterias scabra. Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. Z. Wales. p. 315.
Astrostole scabra. W. K. Fisher. 1923. Preliminary Synopsis of the Asteriidæ. Ann. Mag. Nat. Hist. 9. Ser. XII. p. 255.

Mahia Peninsula; 18/XII. 14. 2 specimens.
Island Bay, Wellington; 17/II. 15. several specimens. All of them were found on the rocks, at low tide.

As was the case with the preceding species the present species

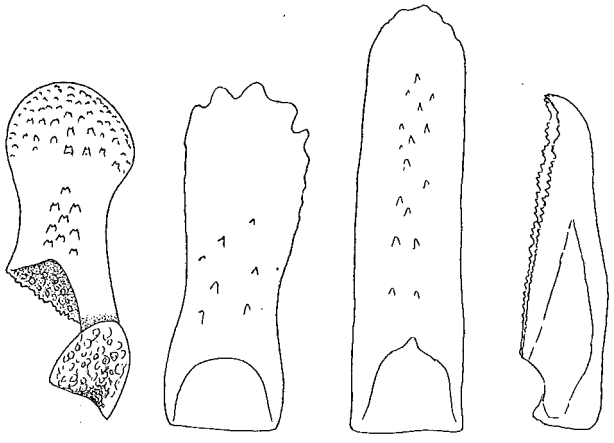


Fig. 21. Valves of pedicellariæ of *Astrostole scabra* (a—c) and *Coscinasterias calamaria* (d). a. valve of crossed pedicellaria, from the inside; b—c. of straight pedicellariæ, from the inside; d. valve of straight pedicellaria, side view. a. $^{133}/_{1}$; b—d. $^{40}/_{1}$.

has never been figured either, so it may not be superfluous to give figures of it. For the rest only a few remarks on the pedicellariæ need be made, the figures published by Farquhar (Op. cit.) being not very adequate. The straight pedicellariæ are very prominent in the larger specimens, the larger ones widened and partly more or less serrate along the outer edge. Those on the disk, especially, are serrate and in the same time somewhat shorter and more robust; those along the ambulacral furrows are longer and somewhat more slender, and not serrate in the point. They are generally provided with some scattered teeth, or thorns, on the inside (Figs. 21.b—c). The crossed pedicellariæ are very characteristic in the teeth on the valves being finely serrate (Fig. 21.a).

Like the preceding species *A. scaber* is known only from a very restricted area of the New Zealand coast, viz. from Mahia Peninsula to Akaroa. — Fisher has made this species the type of his genus *Astrostole*.

26. *Coscinasterias calamaria* (Gray).

Asterias calamaria. Gray. 1840. Synopsis of the Genera and species of the Class Hypostoma (Asterias Linn.). Ann. Mag. Nat. Hist. 1. Ser. VI. p. 179.

Coscinasterias muricata. Verrill. 1867. Descr. new Starfishes from New Zealand. Trans. Conn. Ac. I. p. 249.

— — Hutton. 1872. Catalogue Ech. New Zealand. p. 6.

Asterias calamaria. Perrier. 1875. Revision Collect. Stellérides Mus. Paris. Arch. Zool. expér. & genér. V. p. 43.

— — Loriol. 1885. Catalogue raisonné des Echinodermes. Maurice. II. Stellérides. Mém. Soc. Phys. & Hist. nat. Genève. $XXIX._4$. p. 4. Pl. $VII._{1—2}$

— — Farquhar. 1895. Notes on New Zealand Echinoderms. Trans. N. Z. Inst. XXVII. p. 200.

— — Farquhar. 1898. Notes on New Zealand Starfishes. Trans. N. Z. Inst. XXX. p. 187.

— — Farquhar. 1898. On the Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales, p. 315.

— — Farquhar. 1909. Further Notes on New Zealand Starfishes. Trans. N. Z. Inst. XLI. p. 128.

— — Benham. 1909. Sci. Res. N. Z. G. Trawling Exp. Echinoderma. Rec. Canterbury Mus. $I._2$. p. 18.

Coscinasterias — H. L. Clark. 1909. Sci. Res. Trawling Exp. "Thetis". Mem. Austral. Mus. IV. p. 531.

Asterias calamaria. H. L. Clark. 1914. The Echinoderms of the West Australian Museum. Rec. W. A. Mus. I. p. 151.

Coscinasterias — H. L. Clark. 1916. Report . . . . . Sea-Lilies "Endeavour". Biol. Res. "Endeavour". IV. p. 72.

-- — H. L. Clark. 1923. Some Echinoderms from West Australia. J. Linn. Soc. Zool. XXXV. p. 244.

North Cape; under stones, at low tide. 3/I. 15. 6 young specimens.
Slipper Island; on rocks, at low tide. 20/XII. 14. 2 specimens.
Plimmerton; under stones, at low tide. 15/I. 15. 1 specimen.
Wellington Harbour, 5—10 fms. 16/II. 15. 2 specimens.
Queen Charlotte Sound, 3—10 fms. 20/I. 15. Several specimens.
Stewart Island, 20 fms. 16/XI. 14. 2 young specimens.

The var. *reischeki* of Farquhar (1909) I have no material for forming a definite opinion about; but I am rather inclined to think that it is only a local form of this variable species and hardly entitled to the rank of a distinct variety.

The statement by the same author (loc. cit., 1909) that it "appears probable that the young of this species have only 2 arms at first, and the number increases with age unto 10 or 11" is so contrary to all what we know of Echinoderm development that it would for this reason alone have to be rejected as impossible. It is beyond any doubt that this species divides through autotomy; also the arms are very easily lost and again regenerating. These facts together perfectly account for the instances of specimens with any number of young, regenerating arms.

The crossed pedicellariæ are very similar to those of *Sclerasterias mollis*. The straight pedicellariæ have some more or less distinct, coarse teeth at the point and the side-edges rather distinctly serrate (Fig. 21.d).

Farquhar's suggestion (Op. cit. 1895) that this species may protect its brood is shown to be wrong through the fact that I have proved it to have typical pelagic larvæ. (Studies of the development and larval forms of Echinoderms. 1921. p. 192).

IV. Holothurioidea.

The history of the New Zealand Holothurians is not so intricate as that of the sea-stars and the sea-urchins; the Holothurians being no fancy objects of collectors, as are the latter, unduly labelled specimens from old collections are, as a rule, not met with. On the other hand trouble arises from the fact that careful descriptions and exact, detailed figures of the calcareous deposits in their body wall are absolutely necessary conditions for making the diagnoses sufficient for recognizing the species. The older descriptions do not as a rule fulfil these requirements, and therefore we remain in uncertainty about several of the old species. This applies in a high degree to the descriptions given by Hutton, the first author to describe Holothurians from New Zealand.

In his "Catalogue of the Echinodermata of New Zealand" 1872 Hutton describes the following 8 species, all new to science: *Holothuria mollis, Thyone longidentis, Thyone brevidentis, Th. caudata, Synapta uncinata, S. inæqualis, Chirodota* (?) *alba* and *Molpadia coriacea,* In the paper "Notes on some New Zealand Echinodermata" (Trans. N. Z. Inst. XI. 1878) he adds three more new species: *Cucumaria thomsoni, Labidodesmus turbinatus* and *Holothuria robsoni,* while a new genus, *Pentadactyla,* is established for *Thyone longidentis. Chiridota* (?) *alba* is transferred to *Echinocucumis, Holothuria mollis* is stated to approach *Stichopus,* and *Molpadia coriacea* to be, probably, a *Caudina.* — With the exception of the two Synaptas, not a word is said about the calcareous deposits of the skin of any of these species, and not a figure is given.

In 1881 T. Jeffrey Parker publishes a short description, without figures, of a new *Chiridota, Ch. dunedinensis.* In the "Challenger" Holothurioidea, II., 1886, Théel describes two new species from New Zealand: *Stichopus sordidus* and *Thyonidium rugosum,* while a third species, *Chiridota australiana* Stimpson, is recorded as being doubtfully from New Zealand (Port William. (New Zealand, Falkland Island?)).

The real foundation of our knowledge of New Zealand Holothurian fauna was, however, laid by Dendy in his fundamental paper "Observations on the Holothurians of New Zealand" (Journ. Linn. Soc. London Zool. XXVI. 1897). He had the opportunity of of reexamining the types of all Hutton's species, with the except-

ion of *Holothuria robsoni*, *Cucumaria thomsoni* and *Labidodesmus turbinatus* and thus was able to give the information wanted regarding the calcareous deposits a. o. of those species. He could then also give the proof that Théel's *Stichopus sordidus* was the same as Hutton's *Holothuria mollis*, and that Théel's *Thyonidium rugosum* was the same as Hutton's *Thyone (Pentadactyla) longidentis*, with which species also Hutton's *Thyone caudata* was found to be identical. In the same paper three new species from New Zealand are described, viz. *Cucumaria Huttoni*, *Colochirus ocnoides* and *Colochirus calcarea*.

H. Ludwig (Holothurien d. Sammlung Plate. Zool. Jahrb. Suppl. IV. 1898) declares Dendy's *Colochirus calcareus* a synonym of *Coloch. brevidentis* Hutton, and in another paper in the same year (Holoth. d. Hamburg. Magalhaens. Sammelreise) shows that the *Chiridota australiana* mentioned by Théel is in reality *Trochodota purpurea* (Lesson), the locality being the Falkland Islands, not New Zealand.

In the "Report on the Holothurioidea collected by Prof. Herdman at Ceylon in 1902"[1]) Joseph Pearson identifies a Ceylon Holothurian with Hutton's *Labidodesmus turbinatus*, Herdman having compared for him his description and figures with the type specimen in the British Museum and found no objection to this identification. Since, however, the calcareous deposits of the type specimen had been dissolved, there is, in fact, no guarantee whatever, that the identification is correct, and, moreover, zoogeographical reasons are decidedly against such identification. As there is hardly any possibility for identifying with full certainty any New Zealand species with Hutton's *Labidodesmus turbinatus*, we may perhaps rather leave that name to the ceylonese species described by Pearson under that name, designating it *Cucumaria turbinata* (? Hutton) Pearson, the species then disappearing from the New Zealand fauna.

The next contribution to the New Zealand Holothurian fauna is due to R. Perrier, who describes in 1905 in his paper "Holothuries antarctiques du Mus. d'hist. nat. Paris"[2]) the following new species: *Cucumaria Filholi*, *Phyllophorus anatinus* and *Caudina pulchella*, as also a new variety, *brevicauda*, of *Caudina coriacea*. —

1) W. A. Herdman. Report on the Pearl Oyster Fisheries. I. 1903.

2) Ann. Sc. nat. Zool. 9. Sér. I. 1905.

In his monograph on "The Apodous Holothurians" 1907 H. L. Clark declares *Caudina coriacea* to be identical with *Caudina chilensis* (Joh. Müller).

In another most important paper by Dendy & Hindle, "Additions to our knowledge of the New Zealand Holothurians" (Journ. Linn. Soc. Zool. XXX. 1907) all the new species described by Perrier are declared to be identical with species described by Hutton. In this paper are further described the following new species: *Stichopus simulans, Phyllophorus dearmatus, Pseudocucumis bicolumnatus, Chirodota gigas* (Chatham Island), *Chirodota geminifera* and *Rhabdomolgus novæ-zealandiæ*. For the latter species a new genus, *Kolostoneura,* was established by S. Becher in 1909.[1])

Finally in 1909 Dendy described in his report on the Holothurians in the "Subantarctic Islands of New Zealand" a new species, *Chirodota benhami* and a new variety, *carnleyensis* of *Cucumaria brevidentis*, while *Cucumaria leonina* Sunper is recorded as new to the New Zealand fauna. In the same year Benham, in his report on the Echinoderma of the N. Z. G. Trawling Expedition describes the new species *Molpadia dendyi* and adds *Molpadia marenzelleri* Théel, hitherto known only from the Deep-sea off New Zealand (700 fms.) to the New Zealand fauna.

In the present paper the following 10 new species are described: *Holothuria neozelanica, Cucumaria amokuræ, C. Farquhari, C. Bollonsi, C. leoninoides* (the species determined by Dendy as *C. leonina*), *Psolidiella nigra, Psolus neozelanicus, Chiridota nigra, Ch. carnleyensis* and *Trochodota Dendyi*, while one, *Pseudopsolus maquariensis* (Dendy) is added, with some doubt, to the New Zealand fauna. Also a new variety, *microurna*, of *Trochodota dunedinensis* is described. Further *Cucumaria calcarea* and *Caudina coriacea* are reestablished as separate species, while *Stichopus simulans* is declared synonymous with *St. mollis, Chiridota benhami* and *geminifera* synonymous with *Trochodota dunedinensis*, and *Synapta inæqualis* with *Protankyra uncinata.* A new genus, *Psolidiella*, is established.

The type-specimens of Hutton's *Holothuria Robsoni, Cucumaria thomsoni* and *Labidodesmus turbinatus* being found in the British Museum, I applied to Dr. C. C. A. Monro for a bit of skin of

[1]) Siegfried Becher. Die systematische Stellung des Rhabdomolgus novæ-zealandiæ. Arch. zool. expér. & génér. 5 Sér. I. 1909.

these species in order that I might be able, perhaps, through a study of their calcareous deposits to settle these questionable species. It proved that in all of them the calcareous bodies have been dissolved. The peculiar wrinkling of the epidermis in *C. thomsoni* enabled me to recognize this species in a pair of well preserved specimens, which I dredged at Stewart Island in 1914. This species proves to be a *Pseudocucumis*, which will thus keep the name *Pseudoc. thomsoni* (Hutton). *Labidodesm. turbinatus* has meantime, as stated above, been — probably wrongly — identified by Pearson with a ceylonese species and thus disappears from the New Zealand fauna, at least for the present. *Holothuria robsoni* can no longer be recognized, and, be it now, as has been maintained, a synonym of *St. mollis* or not, is a *species delenda*, no longer to be taken into account.

The corrected list of New Zealand Holothurians, not including those from the Kermadecs or from the Deep-Sea off New Zealand, then looks as follows, in modern nomenclature:

1. **Stichopus mollis** (Hutton) (= *Stichopus sordidus* Théel, *St. simulans* Dendy & Hindle).
2. **Holothuria neozelanica** n. sp.
   (*Holothuria robsoni* Hutton; species delenda, no longer recognizable).
3. **Cucumaria brevidentis** (Hutton) (**non** = *C. calcarea* Dendy).
4. „ „ var. **carnleyensis** Dendy.
5. „ **calcarea** (Dendy) (**non** = *C. brevidentis* (Hutton)).
6. „ **leoninoides** n. sp. (**non** = *C. leonina* Semper).
7. „ **amokuræ** n. sp.
8. „ **Farquhari** n. sp.
9. „ **Bollonsi** n. sp.
10. „ **alba** (Hutton) (= *C. Filholi* R. Perrier).
11. „ **ocnoides** (Dendy).
12. „ **Huttoni** Dendy.
13. **Phyllophorus longidentis** (Hutton) (= *Thyone caudata* Hutton, *Thyonidium rugosum* Théel, *Phyllophorus anatinus* R. Perrier).
14. **Phyllophorus dearmatus** Dendy & Hindle.
    (*Labidodesmus turbinatus* (? Hutton) Pearson; Ceylon, not New Zealand).

15. **Pseudocucumis Thomsoni** (Hutton).
16. „ **bicolumnatus** Dendy & Hindle.
(?)17. **Pseudopsolus macquariensis** (Dendy).
18. **Psolidiella nigra** n. g., n. sp.
19. **Psolus neozelanicus** n. sp.
20. **Caudina coriacea** (Hutton) (= *C. pulchella* R. Perrier, *C. coriacea*, var. *brevicauda* Perrier; **non** = *C. chilensis* (Joh. Müll.).)
21. **Molpadia marenzelleri** Théel.
22. „ **Dendyi** Benham.
23. **Protankyra uncinata** (Hutton) (= *Synapta inæqualis* Hutton).
24. **Chiridota gigas** Dendy
25. „ **nigra** n. sp.
26. „ **carnleyensis** n. sp.
(*Chiridota australiana* Stimps. — not New Zealand).
27. **Throchodota dunedinensis** (Parker) (= *Chiridota geminifera* Dendy & Hindle, *Ch. benhami* Dendy).
28. **Trochodota dunedinensis**, var. **microurna** n. var.
29. „ **Dendyi** n. sp.
30. **Kolostoneura novæ-zealandiæ** Dendy & Hindle).

The "Index Faunæ Novæ Zealandiæ" gives 21 species of Holothurians as belonging to the New Zealand fauna. If we eliminate the deep-sea forms, the problematic or synonymous species *Holoth. robsoni*, *Cucum. turbinata* and *Synapta inæqualis* and also *Pseudopsolus macquariensis*, by that time known only from Macquarie Island, the list is reduced to 11 species. As the list of Holothurians now known to occur in New Zealand seas comprises 30 species and varieties, the increase in our knowledge of New Zealand Holothurian fauna since the publication of the "Index" is rather noticeable. Still, we may well feel confident that the list is as yet far from complete, and that a thorough investigation of the New Zealand seas, especially the deeper parts of the Cook Strait, the North Cape Region and the West Coast of the South Island, will yield many an interesting discovery.

From a purely morphological point of view none of the new forms here described are of special interest; in this regard *Cucumaria Farquhari* may well be said to stand foremost among them, the reduction of its tubefeet to the middle part of the trivium re-

presenting an interesting specialization analogous to that found in *Psolus*. From a biological point of view the most interesting form is *Psolidiella nigra*, which, evidently, is specially adopted to life on coastal rocks, though hardly in places exposed to heavy surf.

Of the species enumerated above I had no opportunity of studying the following three: *Pseudocucumis bicolumnatus*, *Molpadia Marenzelleri* and *M. Dendyi*.

1. *Stichopus mollis* (Hutton).

Holothuria mollis. Hutton. 1872. Catalogue Echinod. New Zealand; p. 15.
— — Hutton. 1878. Notes on some New Zealand Echinod. Trans. N. Z. Inst. XI. p. 308.
Stichopus sordidus. Théel. 1886. "Challenger" Holothurioidea. II. p. 167. Pl. VIII$_3$.
Holothuria victoriæ. Bell. 1887. Studies in Holothurioidea. VI. Proc. Zool. Soc. p 534. Pl. XLV.$_7$.
Stichopus mollis. Dendy. 1896. Observ. Holoth. New Zealand J. Linn. Soc. Zool. XXVI. p. 46. Pl. 7.$_{73-82}$.
— — Whitelegge. 1897. On Stichopus mollis. Rec. Austral. Mus. III.$_2$. p. 50.
— — Farquhar. 1898. Echinod. Fauna New Zealand. Proc. Linn. Soc. N. S. W. p. 326.
— — Ludwig. 1898. Holoth. Hamburg. Magalhaens. Sammelreise; p. 7.
— — R. Perrier. 1905. Holoth. Antarct. Mus. Paris. Ann. Sc. Nat. Zool. 9. Sér. I. p. 83.
— — Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. J. Linn. Soc. Zool. XXX. p. 96. Pl. 12.$_{12}$.
— *simulans*. Dendy & Hindle. Ibidem, p. 97. P. 11.$_5$.
— *mollis*. W. Erwe. 1913. Holoth. Südwest-Küste Austral. in: Hartmeyer & Michaelsen: Fauna S. W. Australiens. IV. p. 387. Taf. VII$_{22}$.
— *simultans* (sic!) W. Erwe. Ibidem. p. 388 Taf. VIII$_{23.a-d}$.
— *mollis*. Joshua. 1914. Victorian Holothurioidea. Proc. R. Soc. Victoria. 27. p. 2.
— *simulans*. Joshua. Ibidem. p. 3.
— *mollis*. H. L. Clark. 1922. The Holothurians of the genus Stichopus. Bull. Mus. C. Zool. LXV. p. 60.
— *simulans*. H. L. Clark. Ibidem, p. 69.

Paterson Inlet, Stewart Island; 5—15 fms. 17/XI. 1914. Several specimens.
Queen Charlotte Sound; 3 – 10 fms. 20/I. 1915. 8 specimens.
Wellington Harbour; 5—10 fms. 16/II. 1915. 2 specimens.
Plimmerton; the coast, at low water. 15/I. 1915. 1 specimen.

The specimens from Stewart Island are somewhat lighter coloured than those from the other localities, and their dorsal papillæ upon the whole less prominent, the dorsal side being sometimes quite smooth. As, however, no other differences have been observed, I have no doubt in referring also these Stewart Island specimens to this well known species. To the various descriptions quoted above I would add only the fact that the short branches of the tentacles are supported by numerous very strong, spinous, curved rods (Fig. 22.f). Similar rods may be found, more or less numerous, along the radial water-vessels.

Ludwig (Op. cit. 1898) has suggested that Hutton's *Holothuria robsoni* may be the same as the present species, and ever since it has been taken for granted that it is so. There is, however, no proof whatever of this suggestion, and since the calcareous bodies of the type specimen have been dissolved, there is no longer any possibility for settling the question. *Holoth. robsoni*, therefore, being no longer recognizable, is a species delenda, no more to be taken into account.

As regards *Stichopus simulans* Dendy & Hindle I have come to the result that it is certainly identical with *St. mollis*. Among the specimens from Stewart Isl. I found two to contain the peculiar foliaceous spicules ("rosettes" in usual nomenclature) described by Dendy; in one of them I observed only very few of them, in the other I found them numerous in one small spot of the skin, but could not detect them in any other place. These two specimens are, otherwise, so perfectly alike the rest of the specimens from this locality that it would seem quite absurd to regard them as a separate species. I may opinion there can be no doubt but that the said foliaceous spicules ("rosettes") belong typically to *Stichopus mollis*, only they are exceedingly variable as to the number in which they occur, being sometimes very numerous in places or, perhaps, in the whole of the skin, sometimes very scarce, sometimes apparently totally absent. The latter case would seem to be the most common.

In the same place where the numerous foliaceous spicules were found, as stated above, also a number of thin, spinous rods occur, lying quite without order among the other spicules (Fig. 22.e). They are partly lying so close that one is reminded of a piece of a monaxonid sponge. But there is no possibility for doubting that they

do really belong to the Holothurian and they may thus be regarded as typically belonging to this species, like the foliaceous spicules, but like these latter of very variable (rare) occurrence.

Stichopus juv.

From Paterson Inlet, Stewart Isl., 5—15 fms., mud, there is a very small specimen of a *Stichopus*, only 9 mm long (somewhat contracted) which I must hesitate in simply referring to *Stichopus*

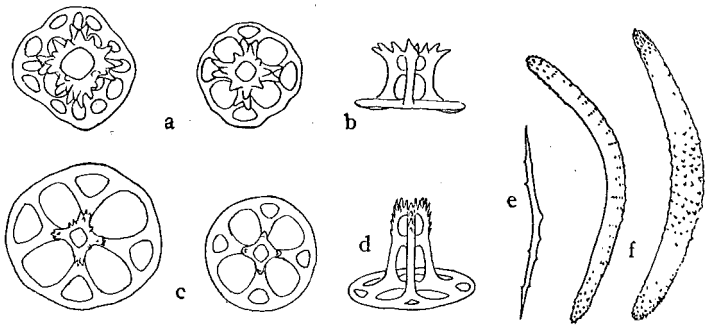


Fig. 22. Spicules of *Stichopus mollis*.
a—b. Tables of adult specimen, from above (a) and in side view (b); c—d the same from a young specimen; e. spinous rod from the skin; f. thorny rods from the tentacles. a—e. 230/1; f. 60/1.

mollis. It is white, differing thus very markedly in colour from the dark brown or black *St. mollis*; this, however, may easily be imagined to be only a character of youth. More important is the difference in the spicules. These are tables, as in *St. mollis*, but the spire is more elongate and the spines of the crown distinctly more numerous and smaller than in the adult *St. mollis;* also the disk is more regular round in the young specimen (Figs. 22.c—d. to compare with Figs. 22.a—b). In view of the small size of this specimen it is clear that any other differences which might be pointed out between this specimen and the adult *St. mollis* may be due to age. But it does seem rather enigmatical why the tables of the young should be so characteristically different from those of the adult.

So long as we know only the one species of *Stichopus*, *S. mollis* from New Zealand, it lies at hand to suppose that this is really the young of this species; but the marked differences pointed out must make us put off simply declaring it to be so, until inter-

mediate stages — or direct observations of the postembryonic development of the species — have given the definite proof.

2. *Holothuria neozelanica* n. sp.

2 Miles E. of North Cape; 55 fms. 2/I. 1915. 1 specimen.

The specimen, which is very strongly contracted, measures 10.5 cm in length and ca. 5 cm in breadth. It is of a dirty grayish

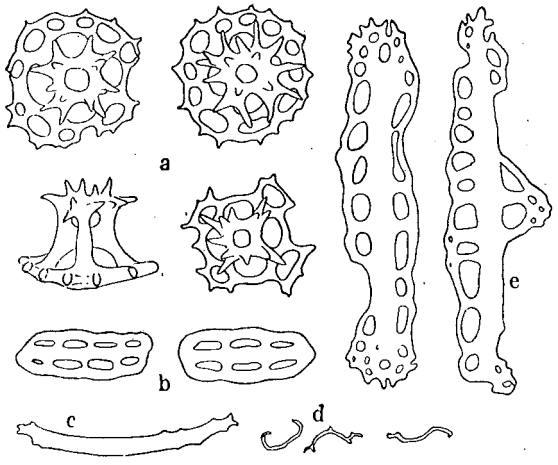


Fig. 23. Calcareous deposits of *Holothuria neozelanica*. a. Tables, from above and in side view; b. buttons; c. rod from tentacle; d. rods from the finer branches of the tentacles; e. spicules of tubefeet. a—b. 205/1; c—e. 160/1.

colour, whith indistinct small, white spots irregularly scattered. Ventral side hardly distinguishable. Suckers small, yellow, not serially arranged, scattered all over the body, only slightly more numerous on the ventral side. Apparently no papillæ on the dorsal side. Tentacles only 16, of medium size. Only 1 Polian vesicle; stone canals in a small bundle. Cuvierian organs present.

Calcareous deposits tables and buttons; both sorts very numerous, forming a close layer in the whole of the body. The tables (Fig. 23.a) are thorny along the edge of the disk; the crown carries some twelwe spines. The buttons (Fig. 23.b) smooth, with generally 6—8 holes. All sorts of irregularities in the buttons rather common. The spicules of the tubefeet rods with bilaterally arranged holes (Fig. 23.e). The larger spicules of the tentacles coarse, a

little spinous, slightly curved rods (Fig. 23.c); those of the finer branches quite irregular, thin, scarcely branched rods (Fig. 23.d).

Although the calcareous bodies are not of a very characteristic type, this species is rather unique through the exceptional number — 16 — of the tentacles, 18 (17) being otherwise the lowest number in the species hitherto known, with the sole exception of *Holothuria Heilprini* Ives from the Gulf of Mexico[1]) which is stated to have only 10 tentacles, and the rather problematical *Ananus holothurioides* Sluiter[2]), which is stated to have 13 tentacles. Of course, it is impossible to judge from the single specimen in hand whether the number of tentacles is constantly 16 in this species; but this number is, in any case, so unusually low that it is very probably not simply a variation of the usual number 20, but really a specific character of this form.

3. *Cucumaria brevidentis* (Hutton).

Thyone brevidentis. Hutton. 1872. Catalogue N. Z. Echinoderms; p. 16.
Pentadactyla — Hutton. 1878. Notes on some N. Z. Echinod. Trans. N. Z. Inst. XI. p. 307.
Colochirus — Dendy. 1897. Observ. on the Holothurians of New Zealand. Journ. Linn. Soc. Zool. XXVI. p. 40. Pl. 5. Figs. 54—61.
— — Farquhar. 1898. Echinod. Fauna of N. Zealand. Proc. Linn. Soc. N. S. W. p. 325.
Cucumaria — R. Perrier. 1905. Holoth. antarctiques Mus. Paris. Ann. Sc. Nat. Zool. 9. Sér. I. p. 110.
— — Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. J. Linn. Soc. Zool. XXX. p. 99.

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1) I. E. Ives. Echinoderms from the Northern Coast of Yucatan and the Harbour of Vera Cruz. Proc. Acad. Nat. Sc. Philad. 1890. p. 318.

2) C. Ph. Sluiter. Über einige Holothurien von der West-Küste Java's. Natuurk. Tijdschr. voor Nederl. Indie. XL. 1880.

I would suggest that the explanation of this peculiar animal is this, that it is a specimen which has just been dividing itself. In E. Deichmann's record of the selfdividing *Actinopyga difficilis* ("On some cases of multiplication by fission and of coalescence in Holothurians". Papers from Dr. Th. Mortensen's Pacific Expedition. IX. Vidd. Medd. Dansk Naturh. Foren. Bd. 73. 1922) it is pointed out that the radial muscles on the division are cut straight off, much as it is seen in *Ananus* (comp. Fig. 2 of Deichmann's paper with Pl. III. Fig. 1 of Sluiter's paper); and also in *Actinopyga difficilis* the posterior end of the body is completely closed immediately after division, until a new anal opening is formed.

Non: *Colochirus calcareus* Dendy.
— — *brevidentis*. Ludvig. Holoth. d. Samml. Plate. Zool. Jahrb. Suppl. IV. p. 442. Taf. 26$_{22-29}$ (= *Cuc. calcarea*.)

Cape Maria v. Diemen; rocky coast, among algæ. 4. I. 1915. Several young specimens.

Slipper Island; the coast, at low water. 20/XII. 1914. 12 specimens, together with specimens of *Cuc. calcarea*.

Masked Island, Carnley Harbour, Auckland Isl.; on rockwall, among *Melobesia*. 3/XII. 1914. Several specimens.

The reasons for maintaining this species as different from *Cucumaria calcarea* (Dendy) are given under the latter species.

4. *Cucumaria brevidentis*, var. *carnleyensis* Dendy.

Cucumaria brevidentis (Hutton), var. *carnleyensis*. Dendy. 1909. On a small collection of Holothurians from the Auckland Island. The Subantarctic Islands of New Zealand. I. p. 149. Pl. VI.2.a–l.

Figure 8 Island, Carnley Harbour, Auckland Isl.; under stones, at low water. Several specimens. 2/XII. 1914.

Masked Island, Carnley Harbour, Auckland Isl. On rockwall, among *Melobesia*. 3/XII. 14. Numerous specimens, mainly young.

Perseverance Harbour, Campbell Island; under stones, at low water. 8/XII. 1914. 1 specimen.

Paterson Inlet, Stewart Isl., 5—15 fms. 1 young specimen. Another specimen from Stewart Isl., though without exact locality and date, was received from Prof. Benham, as also two specimens of this species, labelled Macquarie Island (wrongly identified as *Pseudopsolus macquariensis* (Dendy)) collected by Mr. A. Hamilton (see below, p. 335, 358).

The specimens from Masked Island were found in great numbers, together with the typical form and with *Cuc. leoninoides*, among the beautiful Melobesias, which were covering the vertical rockwall there. Mostly they were of a fine red colour, looking, indeed, like strawberries, as described by Dendy (Op. cit.). The specimens found under stones at the shore generally had some of the lateral tubefeet very much extended, the outline of the body becoming thereby often quite irregular, as if it were extended with needles. They were always rather flattened, closely appressed to the stones with their underside, which forms a fairly distinct sole.

The largest specimens have a size of 4—4.5 cm in a contracted state, thus, when fully extended, at least ca. 6 cm. The contracted specimens often have a very characteristic appearance trough the

body wall not closing above the retracted anterior end but forming a deep, round funnel, at the bottom of which the contracted tentacles are just seen (Fig. 24).

The colour is usually pink on the dorsal side, differing thus conspicuously from the typical form, which is dark, nearly black, at the anterior end on the dorsal side.

Those specimens from Masked Island, which I refer to the typical form, are well distinguished from the variety, besides by their dark, blackish colour, through the fact that the tubefeet of the dorsal radii are not scattered over the interradii, or at most in a very slight degree, while according to Hutton and Dendy they are scattered over the interradii in the typical *brevidentis*, as is the case in the var. *carnleyensis*. Thus it is not beyond doubt whether it is correct to refer these specimens to the typical *brevidentis*. As I have no larger specimens of the typical *brevidentis* from localities, where the variety does not occur, I am not in a position to give all the information wanted as regards the characters distinguishing the variety from the typical form. The calcareous deposits are alike in both, and in their internal anatomy there would appear to be no difference either.

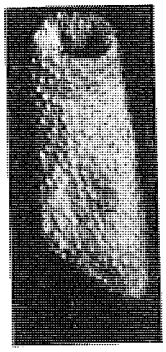
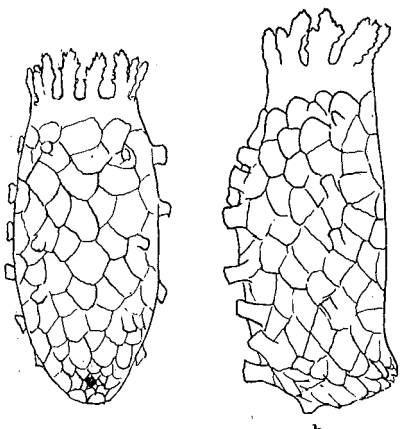


Fig. 24. *Cucumaria brevidentis*, var. *carnleyensis*. Large specimen in a contracted state. Nat. size.

Nevertheless, there can hardly be any doubt but that they represent two distinct forms, perhaps rather two separate species, the proof thereof being afforded by the young ones; my material of these consists of some specimens of the typical form from a size of 2 mm (from Cape Maria van Diemen, where the variety does not occur) and of numerous specimens from a size of only 1.5 mm of the variety (from Masked Island, Carnley Harbour). In the youngest specimens of the typical form the skin contains a number of larger, smooth plates of varying sizes, which do not fit together so as to form a close mail; the outer layer of the skin is full of the fine, delicate cups characteristic of the species. In the variety the skin contains similar smooth plates; but these are larger, of a uniform size, and fit together, partly even overlapping, so as to form a close mail, recalling the covering of a *Psolus* (Fig.

25.a—b). Further, the cups are as yet much less numerous than in the young of the typical form. This stronger development of the larger plates in the variety forms a very conspicuous character distinguishing the younger stages of the two forms. While in the variety they remain very distinct until a size of, at least 7—8 mm length, they are hardly discernible beyond the very youngest stages, 2—3 mm length, in the typical form.

The young stages also give interesting information about the successive development of the various sorts of calcareous corpuscules. In the smallest specimens, 1.5 mm long, of the variety the large plates alone are as yet developed. On the dorsal side the cups have just begun to form over the edges of the larger plates. At a size of ca. 3 mm length the cups form a close layer in the skin, outside the large plates, but the buttons have not yet made their appearance. This latter sort of corpuscules, which is thus the last to develop, does not make its appearance until later, when, at a size of ca. 6—8 mm length, the larger plates begin to draw apart from one another, so as to leave naked interspaces between them. In these interspaces the buttons are formed; it appears that no large plates are formed during the growth of the animal, the adult possessing only the same number of them as was found in the smallest young, and, consequently, while in the young specimens these large plates form a close mail, they lie widely scattered in the skin of the adult, discernible only as small spots, the skin being otherwise filled up with the small, knobbed buttons. — In the typical form, where the large plates do not form a close mail in the young stages the buttons begin to appear already at ca. 3—4 mm length. — Not rarely the large plates of the variety have a thickening at the overlapping point so as to be slightly spinous. Those around the anterior end are often somewhat prolonged so as to form valves



a. b.

Fig. 25. Young specimens of *Cucumaria brevidentis*, var. *carnleyensis*; a. from above; b. in side view. 12/1.

which close over the retracted tentacles. Also those around the anal opening are somewhat elongate, forming anal teeth; these latter remain, more or less distinct, also in the adult specimens.

The occurrence of this species at Macquarie Island is of considerable zoogeographical interest, and a striking parallel to the occurrence of *Pseudopsolus macquariensis* at Stewart Island, as recorded in the present paper. The coincidence is, however, so remarkable that I cannot withhold the suggestion that it might perhaps be due to an intermingling by the labelling, so that the *Pseudopsolus* came really from the Macquarie Isl., the *Cuc. brevidentis* from Stewart Island. In any case, I would not think it definitely proved that *C. brevidentis* occurs at Macquarie Island, and, inversely, *Pseudopsolus macquariensis* at Stewart Island, until new facts are available. It must be conceded, however, that such distribution is by no means unlikely; both forms being littoral they might easily be transported from one place to the other by means of the large algæ, among the roots of which they may live attached.

The statement of the occurrence at Juan Fernandez of *Cuc. brevidentis* (Ludvig. Op. cit.) is due to a mistake. The Juan Fernandez-specimens are really *Cuc. calcarea* Dendy (see under that species).

5. *Cucumaria calcarea* (Dendy).

Colochirus calcarea. Dendy. 1897. Observ. Holoth. N. Z. Journ. Linn. Soc. Zool. XXVI. p. 38. Pl. 5. 44—53.

— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. W. p. 325.

— *brevidentis.* Ludvig. 1898. Holoth. d. Samml. Plate. Zool. Jahrb. Suppl. IV. p. 442. Taf. 26. 22—29.

Non: *Cucumaria brevidentis* (Hutton).

Slipper Island; the coast, at low water. 20/XII. 1914. 30 specimens, together with specimens of *Cuc. brevidentis.*

Paterson Inlet, Stewart Island; 5—15 fms. 17/XI. 1914. 1 specimen.

The largest specimen, from Slipper Island, is 20 mm long, the tentacles not retracted. The specimen from Stewart Isl. is of the same length, but very much contracted and accordingly was considerably larger in life, probably some 30 mm long.

Ever since Ludwig in 1898 (Op. cit.) declared Dendy's *Colochirus calcarea* to be identical with *Cuc. brevidentis* (Hutton) it

has been unanimously agreed by all authors dealing with these species, also by Dendy himself, that *C. calcarea* is nothing but a synonym of *brevidentis*. I am not inclined to agree with this, and think that only the fact that Dendy failed to emphasize in a sufficient way the differences existing in the calcareous deposits of

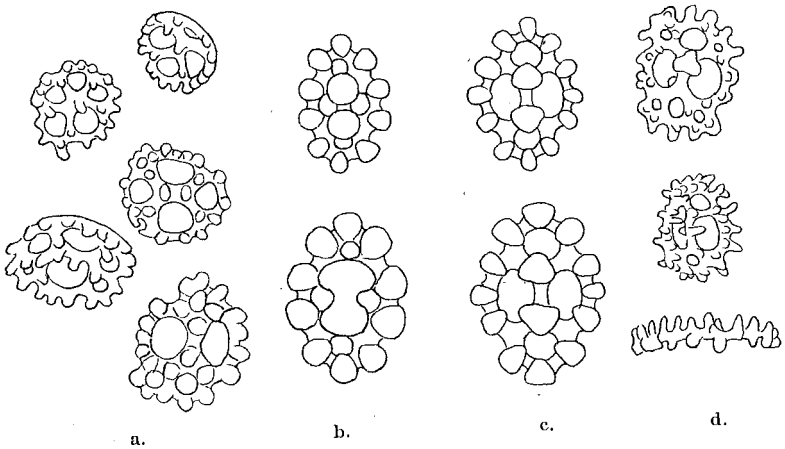


Fig. 26. Calcareous deposits of *Cucumaria brevidentis* and *C. calcarea*. a. Cups, in various positions, b. buttons of *C. brevidentis*; c. buttons, d. cups, from above and in side view (lowermost figure) of *C. calcarea*. a. and d. $^{470}/_{1}$; b. and c. $^{100}/_{1}$.

the two species caused Ludwig and, after him, the other authors to deny the specific validity of *calcarea*.

In the general appearance it is certainly not easy to find characters to distinguish the two species, at least in a preserved state and rather poor condition, as are, unfortunately, my specimens. The only noteworthy difference which I can find is in the colour, *calcarea* being perfectly white, *brevidentis* generally of a faint blackish tint in the anterior end, mainly on the tentacles and the thinwalled, retractile part (the "introvert"). However, this colour is no quite constant feature in *brevidentis* and thus forms no quite reliable character. Whether any differences are to be found in the internal anatomy I am unable to ascertain on account of the unsatisfactory state of preservation of my material. In the shape of the calcareous ring I do not see any marked difference between the two forms. But then the calcareous deposits offer so marked and constant characters that one may always at a glance tell one species from the other (cf. Fig. 26).

The buttons of *C. calcarea* have the two lateral holes considerably larger than the terminal ones, while in *brevidentis* the holes are all of nearly the same size; upon the whole the buttons are more slender and elegantly shaped in *calcarea* than in *brevidentis*. Also the knobs along the edge of the buttons are more numerous (12) in *calcarea* than in *brevidentis* (10) (Figs. 26.b—c). This I find to be a perfectly constant character, and on looking over preparations of the calcareous deposits of the two species one cannot help being struck with the difference and it must seem impossible that specimens containing so strikingly different calcareous bodies could belong to one and the same species. (The figures represent the typical form of the buttons; forms with more holes and knobs, often rather irregular, are by no means rare, but also in these the original type is nearly always discernible). The buttons are also much more numerous in *calcarea* than in *brevidentis*, the skin being of quite a chalky consistence in the former. On the other hand, the larger plates of the skin are very much scarcer in *calcarea* than in *brevidentis*, sometimes apparently wholly wanting.

Further, the cups are different in the two species. In *calcarea* they are provided with numerous knobs on both sides, in *brevidentis* they are knobbed only on the upper side, the underside being smooth (Figs. 26, a, d).

From the description and figures of the calcareous bodies of the specimens from Juan Fernandez recorded by Ludwig under the name of *Coloch. brevidentis* it seemed very probable that these specimens really belonged to *C. calcarea* and not to *brevidentis*. Dr. W. Arndt of the Berlin Museum having kindly sent me one of these specimens I am in a position to say definitely that they are not *brevidentis;* the calcareous spicules agree completely with those of *calcarea* and thus the Juan Fernandez form must, for the present at least, be referred to *C. calcarea*. As it is a littoral form, which can be transported on floating algæ, the occurrence of the species at New Zealand and Juan Fernandez is not so very surprising. But it is to be expected that it will prove to occur also on the other subantarctic localities.

6. *Cucumaria leoninoides* n. sp.

Cucumaria leonina Semper. Var. Dendy. 1909. On a small collection of Holothurians from the Auckland Islands. The Subantarctic Isl.s of New Zealand. I. p. 146. Pl. VI.1.a–c.

Non: *Cucumaria leonina* Semper.

Masked Island, Carnley Harbour, Auckland Isl. On rock wall with Melobesia. 30/XI—3/XII. 14. Numerous specimens.

Figure 8 Island, Carnley Harbour, Auckland Isl; under stones, at low water. 2/XII. 14. Several specimens.

Perseverance Harbour, Campbell Isl.; under stones, at low water. 9/XII. 14. 5 specimens.

1 Mile E. of the Auckland Isl., on floating Lessonia. 28/XI. 14. 2 specimens.

No doubt this species is nearly related to the South American *Cucumaria leonina* Semper, to which it was referred by Dendy, who regards it, at most, as a variety of this species. There can, however, in my opinion, be no question but that the New Zealand form is a perfectly distinct species, which I shall designate as *Cuc. leoninoides*, this name hinting both at its history and its affinity with the South American species. Otherwise, it bears also distinct relations to the Kerguelen form, *Cuc. lævigata* (Verrill), from which it differs, however, conspicuously in not being brood-protecting.

A detailed description is given by Dendy and thus need not be given here again; it may suffice to point out the characters which distinguish this species from *C. leonina.*[1])

The calcareous deposits are of the type characteristic of *C. leonina* and related species, and are arranged in the same way: the serrate end of the plates overlapping and making the skin just a little bit rough or, as seen in the microscope on cleared up pieces of skin, even finely spinous. However, they are well distinguished from those of *leonina*, being considerably broader and with a larger number of holes outside the four primary ones (Fig. 27.a to com-

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1) Dendy expresses, with full right, I think, serious doubts as to the correctness of regarding Semper's *Cucumaria dubiosa* and *Cuc. leonina* as one and the same species, as is done by Ludwig, Lampert and Perrier. This question does not, however, concern us here directly. The name chosen for the Auckland Isl. species will be appropriate, even in case it is ultimately proved that the two said species are not identical and that the South American species should be named *Cucumaria dubiosa* Semper, the relation to the true *leonina* being equally close.

pare with Fig. 27.c, representing such body from *C. leonina*). Further, no other sort of plates occurs in the skin of the New Zealand species, a conspicuous difference from *C. leonina*, in which latter species plates, not drawn out into a serrate point (buttons), occur in considerable number, among those of the above mentioned form. The calcareous

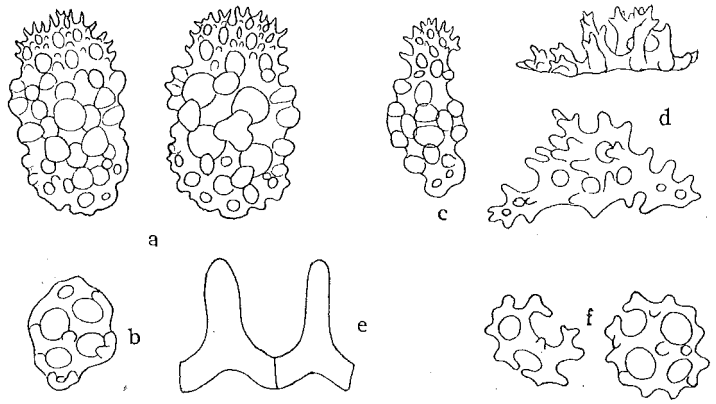

Fig. 27. Calcareous deposits from the skin (a) and the introvert (b) of *Cucumaria leoninoides*; from the skin (c) and the introvert (d) of *C. leonina;* radial (left) and interradial (right) of calcareous ring of *C. leonina* (e); cups of "*Ocnus vicarius*" (f). a—d. $^{105}/_{1}$; e. $^{10}/_{1}$; f. $^{390}/_{1}$.

bodies of the thin-walled "introvert" are nearly smooth plates, not serrated in one end; in *leonina* these plates are a sort of rudimentary tables, as stated by Ludwig. This is, again, a conspicuous difference between the two species (Figs. 27.b and d).

Finally, the large, smooth plates found in the deeper layer of the skin in *C. leonina* appear to be wholly wanting in the New Zealand species.

In the interior anatomy there is an important difference in the number of the Polian vesicles, there being constantly two in the New Zealand species, 3—4 in *leonina*. It is a curious fact that the oesophagus is often protruded through the mouth on preservation, looking like a long proboscis. — On opening specimens of *leoninoides* reddish-yellow oil drops are seen to flow out; the intestine and genital organs are orange-coloured, as is the whole inside of the body, on account of the thick, yellowish peritoneal layer which covers it all. This gives a striking impression of the specimens being very fat.

The largest specimens are 35 mm long, preserved in a well extended state, the thickness only 5 mm. The youngest specimens found are 3 mm long. Great numbers of this species were found, together with *C. brevidentis*, var. *carnleyensis*, among the leaves of *Melobesia antarctica* on the steep rockwall of Masked Island in Carnley Harbour, the body being pressed in between the leaves of the algæ, only the anterior end protruding (Fig. 28). Although I have made no notice of the colour of the living specimens I mean to remember fairly clearly that it was yellowish-white, as it is in the preserved specimens. A more or less distinct reddish spot is found on the oral disk at the base of each pair of tentacles.

I may take the opportunity here of saying a few words about *Ocnus vicarius* Bell. This species was stated by Lampert[1]) to be a synonym only of *C. leonina*, which has been unanimously accepted by all the authors dealing with these forms after him. On looking up the description and figures given by Bell[2]) of his *O. vicarius* I could not help doubting the correctness of identifying it with *C. leonina* and therefore applied to Dr. C. C. Monro, who very kindly sent me a small piece of skin of the type of *O. vicarius*. The examination of the calcareous deposits shows beyond any doubt that it is not a synonym of *C. leonina*. The figures given by Bell are perfectly correct and show that there is no thorny prolongation on the calcareous bodies, such as is characteristic of *leonina*. Further, I find that besides the two sorts of bodies figured by Bell there are also numerous small cups (Fig. 27.f) lying in the epidermis, this latter sort lacking entirely in *C. leonina*.

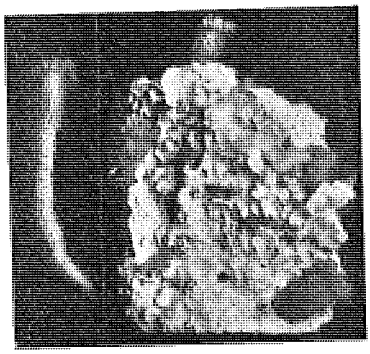

Fig. 28. *Cucumaria leoninoides*; a wholly expanded specimen (to the left) and some specimens in a piece of Melobesia. Nat. size.

1) K. Lampert. Die während d. Exped. S. M. S. "Gazelle" 1874—76 von Prof. Th. Studer gesammelten Holothurien. Zool. Jahrb. Abt. f. Syst. IV. p. 826.

2) F. Jeffr. Bell. Studies in Holothurioidea. II. Descriptions of new species Proc. Zool. Soc. 1883. p. 59. Pl. XV.2.

Accordingly it is out of question that *O. vicarius* could be identical with *C. leonina*. As a matter of fact it is nearly related to *C. brevidentis*, perhaps identical with that species. The difference seen in the cups of *brevidentis* and *vicarius* (Fig. 26.a, 27.f) is not so important, samples with equally numerous cups as in *vicarius* being also found in *brevidentis;* the fact that the cups of *vicarius* are knobbed only on the outer side, as in *brevidentis*, is of more importance.

Since the type of *O. vicarius* had no locality, it will hardly be possible ever to recognize the species with full certainty. Still it is a simple act of justice towards this much criticized author to point out that in this case it was his critics, who were wrong.

7. *Cucumaria amokuræ* n. sp.

Carnley Harbour, Auckland Island; 45 fms. Sandy mud. 6/XII. 1914. 4 specimens.

Paterson Inlet, Stewart Island; 5—15 fms. Mud. 17/XI. 1914. 2 specimens.

The largest of the specimens from Carnley Harbour (the type), measures 9 mm in length, by 5 mm in thickness (the tentacles retracted). One of the specimens from Stewart Island is 11 mm long, by 8 mm thick, strongly contracted; this specimen would probably be about 20 mm long when fully expanded. The shape of the body is sausage-shaped, whith rounded ends. In the smaller

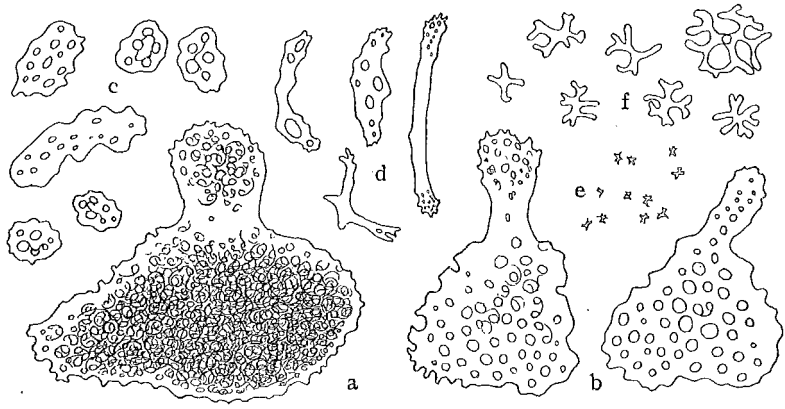

Fig. 29. Calcareous deposits of *Cucumaria amokuræ*.
a. Large scale from the dorsal side; b. from the sides of the body; c. buttons; d. rods from the tubefeet, the longer one to the right from a tentacle; e. small x-shaped bodies (cups); f. the same more enlarged. a—e. $^{66}/_{1}$; f. $^{800}/_{1}$.

specimens, which have the tentacles expanded, the anterior end is bent slightly upwards. Anus subdorsal.

The ventral pair of tentacles distinctly smaller than the others. Tubefeet of the trivium in two rather close series; those of the bivium also biserial, but rather distant; a few scattered, small tubefeet may be found in the middorsal interradius. The skin is rather delicate on the ventral side, hard and rough on the dorsal side, in correspondance with the different development of the calcareous bodies in the bivium and the trivium. The epidermis is very thin and delicate, somewhat slimy, mud-particles being often fastened to it. The calcareous deposits are of two (or three) kinds. In the epidermis are found numerous very fine x-shaped bodies, somewhat irregular, only ca. 0.03 mm (Fig. 29.e—f). More rarely some of the branches are coalesced; such cases make it evident that these bodies must be regarded as rudimentary cups. The deposits of the deeper layer of the skin are larger plates of various forms. In the ventral part of the body they are simple, smooth and lie more or less widely apart. Towards the sides of the body they gradually become somewhat dorsad produced (Fig. 29.b); in the dorsal part of the body these plates are very large and coarse, scale-like, the prolongation forming a coarse, erect spine (Fig. 29.a). The plates are overlapping with their edges, the overlapping edge looking white, whereas the rest of the plate remains transparent; this gives the dorsal side of the skin a curious aspect of being coarsely reticulate. — In the larger specimen from Stewart Island numerous small, smooth or slightly knobbed plates (buttons, Fig. 29.c), are found along the edges of the larger plates, or in the interspace between the latter, in the places where these do not lie so close together.

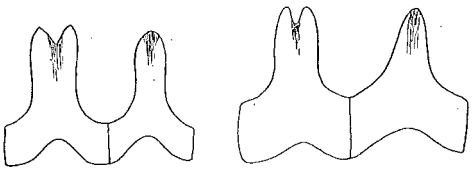

Fig. 30. Radial and interradial from calcareous ring of *Cucumaria amokuræ* (a) and *C. Farquhari* (b). 22/1.

The deposits of the tubefeet are of the usual shape, elongate, slightly branched rods (Fig. 29.d). Those of the tentacles are considerably larger. Anal teeth not distinct.

The calcareous ring well developed, both radial and interradial pieces with an anterior prolongation (Fig. 30.a). There is one Polian vesicle and one stone canal. Genital tubes short, unbranched. Oesophagus without muscular thickening. The retractors are attached about in the middle of the body.

Colour of the living specimens yellowish, in alcohol white. The larger specimen from Stewart Island is reddish.

This species does not appear to be more nearly related to any species hitherto known.

8. *Cucumaria Farquhari* n. sp.

2 Miles E. of North Cape, N. Z. 55 fms. Hard bottom. 2/1. 1915. 2 specimens.

The larger specimen, which is well extended, measures 13 mm in length, by about 4 mm in thickness. The shape of the body is about cylindrical, the ventral side, however, more or less flattened; a short, upwards turned tail end. The anterior end not upwards turned.

The ventral pair of tentacles distinctly smaller than the rest of them. The tubefeet of the trivium arranged in fairly regular double series along each radius; they are, however, developed only in the main part of the body, lacking entirely in the anterior and posterior end. The part carrying the tube feet thus forms a more or less pronounced sole. Tubefeet entirely lacking on the dorsal side.

The calcareous deposits are of three kinds: large, coarse, overlapping scales, buttons and small cups. The large scales, which make the thick skin hard and rough, show a peculiar structure: smooth, rounded, somewhat elevated knobs, surrounded by smaller holes, connected by narrow tubes or canals (Fig. 31.a); in the anterior and posterior part of the body and on the dorsal side they are prolonged into a short, prominent thorn, which gives rather the impression of a grain; in fact, the body covering recalls the grainy scaling of a *Psolus*. Towards the anal opening the thorn of the scales becomes somewhat more elongated; the anal teeth rather indistinct on account of these thorns. On the ventral side the plates are not thus prolonged into a thorn. The buttons (Fig. 31.b), which have a few round knobs, are found mainly along the edges of the larger plates. The cups (Fig. 31.d—e), which lie in great numbers in the epidermis, are somewhat spinous, with rounded thorns. The

spicules of the tubefeet (Fig. 31.c) are of the usual type, as are also those of the tentacles. It is worth noticing that cups are also found in the walls of the tubefeet, nearly up to the sucking disk, which latter is provided with a well developed end-plate.

The calcareous ring is rather stout (Fig. 30.b); the posterior notch is rather deeper in the interradials than in the radials. There is one Polian vesicle and one stone canal. The retractor muscles are attached about in the middle of the body. The oesophagus is very short and somewhat muscular immediately behind the water vascular ring. The genital coeca are short, unbranched, containing only a few, large, oval eggs, and having a somewhat moniliform appearance.

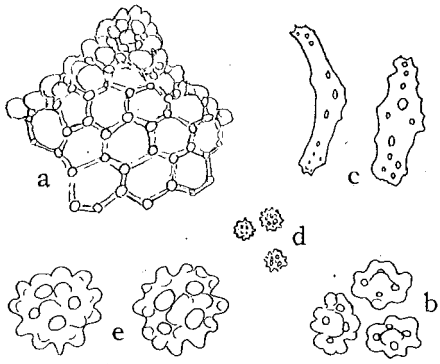

Fig. 31. Calcareous deposits of *Cucumaria Farquhari*. a. Part of a large scale; b. buttons; c. spicules of tubefeet; d. cups; e. same more enlarged. a. $^{60}/_{1}$; b—d. $^{44}/_{1}$; e. $^{360}/_{1}$.

The larger specimen is slightly blackish on the dorsal side, especially at the anterior and posterior end, otherwise white.

This species bears a considerable resemblance to the Japanese species *Cucumaria tegulata* Augustin (— which has, I do not think justly, been declared synonymous with *C. capensis* Théel —). The shape and size is very much the same, as is also the arrangement of the calcareous deposits, while the shape of the latter shows minor, but distinct specific differences. The main difference is, however, found in the arrangement of the tubefeet; while in the New Zealand species these are confined to the trivium, and even here are lacking in the anterior and posterior part of the body, in the Japanese species the tubefeet are found in all the radii, in the whole length of the body. But also in the latter species they are much more numerous in the middle part of the trivium, which has somewhat the appearance of a sole. The step from the condition found in the Japanese species to that found in the New Zealand species is, in reality, not very great, though of great interest from a morphological and a classificatory point of view.

I have the pleasure of dedicating this interesting species to

Mr. Farquhar, to whom science is indebted for so many valuable contributions to the knowledge of the New Zealand Echinoderm fauna.

9. *Cucumaria Bollonsi* n. sp.

Cape Maria van Diemen; among algæ on the rocky shore. 4/I. 1915. 6 specimens (together with *C. brevidentis*).

The largest specimen, which is strongly contracted, measures only 5 mm in length, by 3 mm in thickness. The rest of the specimens are quite young, only 3—4 mm long, fully extended.

The body simply sausage-shaped, anterior or posterior end not upwards turned. The ventral pair of tentacles much smaller than the rest of them. Tubefeet of the trivium in close, double series, in the largest specimen even with an indication of a pluriseriate condition in the lateral radii; this, however, is probably due only to the strong contraction of the body. In the bivium the tubefeet are arranged in a rather distant double series along each radius, and some smaller scattered ones are found also in the middorsal interradius.

The skin is very delicate and thin, and contains three sorts of calcareous deposits: plates, buttons and cups. The plates (Fig. 32.a) are small and perfectly smooth; they are found only very sparingly so as not at all to lend any strength to the skin. Somewhat more numerous are the buttons (Fig. 32.b), which are small, ovoid, typically with four holes and now and then a few smooth knobs; they may occur also in the walls of the tubefeet and generally lie like a wreath round the retracted dorsal feet. In young specimens the buttons are very scarce, while the plates are a little more numerous. In the larger specimen it is just the inverse, evidently because no new plates are formed, while new buttons are developing later on, during growth. By far the most numerous sort of calcareous bodies are the cups, which are very characteristic. In the main they are x-shaped bodies, more or less irregular (Figs. 32.c); in a few of them the branches coalesce so as to show them to be rudimentary cups. Around the anal opening are larger plates, forming rather distinct anal teeth. The spicules of tubefeet and tentacles of the ordinary type (fig. 32.d); the sucking disk is provided with a large round end-plate.

The calcareous ring is well developed, about as in *C. amokuræ*. There is one Polian vesicle and one stone canal. A muscular thickening of the very short oesophagus is indicated, immediately behind the watervascular ring. The retractor muscles are attached about midway in the body. The genital organs are short, unbranched tubes. They contain fairly large eggs in the larger specimen, which must then be supposed to be nearly adult.

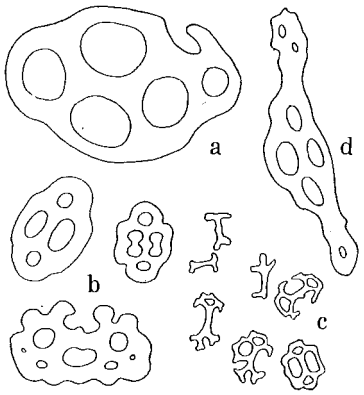

Fig. 32. Calcareous deposits of *Cucumaria Bollonsi*. a. Plates; b. buttons; c. cups; d. spicule of tubefoot. $^{280}/_{1}$.

The colour of the larger specimen is blackish on the dorsal side, otherwise white; the young ones are white.

The species appears to bear some relation to *Cucumaria parva* Ludwig, from which it is, however, very easily distinguished through its calcareous bodies. Whether it is viviparous, as *Cuc. parva*, or not, remains to be seen, the single nearly adult specimen being, of course, insufficient for giving definite proof of this.

I dedicate this characteristic species to Captain Bollons, who, through his zeal and interest in dredgings, has done so much to promote the knowledge of the marine fauna of New Zealand.

10. *Cucumaria alba* (Hutton).

Chirodota ? alba. Hutton. 1872. Catalogue N. Z. Echinod., p. 17.
Echinocucumis alba. Hutton. 1878. Notes on some N. Z. Echinod. Trans. N. Z. Inst., XI. p. 307.
Colochirus — Dendy. 1896. Observ. Holoth. New Zealand. Journ. Linn. Soc. Zool. XXVI. p. 35. Pl. 4. 21—32.
— — Farquhar. 1898. Echinoderm Fauna of N. Z. Proc. Linn. Soc. N. S. W. p. 325.
Cucumaria — Ludwig. 1898. Holothurien d. Hamburg Magalh. Sammelreise; p. 29.
— *Filholi.* R. Perrier. 1903. Sur deux nouvelles espèces d'Holothuries de la Nouv.-Zélande. Bull. mus. d'hist. nat. p. 144.
— *alba.* R. Perrier. 1905. Holoth. antarct. Mus. d'hist. nat Paris. Ann. sc. nat. Zool. 9. Sér. I. p. 85.

Cucumaria Filholi. R. Perrier. 1905. Ibidem; p. 88. Pl. V. $_{10-12}$.
— *alba.* Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. Journ. Linn. Soc. Zool. XXX. p. 98.

Colville Channel, 35 fms.; sandy mud. 21/XII. 1914. 3 specimens.
Tiri-Tiri, 15 fms.; mud. 28/XII. 1914. 4 specimens.
Paterson Inlet, Stewart Island; 5—15 fms.; mud. 17/XI. 1914. 2 specimens (in very poor condition).

Further, I have received from Captain Bollons some specimens from Cloudy Bay, 19 fms. Also some specimens from Akaroa Harbour were received previously from Mr. Suter.

I have nothing to add to the descriptions of the authors quoted, except mentioning that the eggs are unusually small for a Dendrochirote, only ca. 0.$_2$ mm, and lie crowded in the genital coeca, in marked contrast especially to *Cucumaria Farquhari*, with its few, more than 1 mm long (oval) eggs lying, bead-like, in a single series in the genital tubes. This must mean a conspicuous difference in their development; one is even tempted to suggest that *Cuc. alba* may perhaps have typical pelagic larvæ, though such are otherwise unknown in the order of the Dendrochirota.

Concerning the *Cucumaria Filholi* of Perrier I agree perfectly with Dendy & Hindle that there is not the slightest reason or possibility for regarding it as distinct from *C. alba*; it cannot even be maintained as a separate variety.

The new localities, Tiri-Tiri, Colville Channel and Stewart Island, given here indicate that this species will prove to occur along the whole of the New Zealand coasts, while it is not known to occur outside the New Zealand region.

11. *Cucumaria ocnoides* (Dendy).

Colochirus ocnoides. Dendy. 1896. Observ. Holoth. New Zealand. Journ. Linn. Soc. Zool. XXVI. p. 36. Pl. 4. $_{33-43}$.
— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. W. p. 325.
Cucumaria — Ludwig. 1898. Holoth. Hamburg. Magalh. Sammelreise; p. 30.
Ludwigia — Reiffen. 1901. Über eine neue Holothuriengattung. Zeitschr. wiss. Zool. LXIX.
Cucumaria — Perrier. 1905. Holothuries antarct. Mus. d'hist. nat. Paris. Ann. Sc. nat Zool. 9. Sér. I. p. 96. Pl. I.$_{9-13}$, Pl. V.$_{13}$.

Cucumaria ocnoides. Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. Journ. Linn. Soc. Zool. XXX. p. 100.

Wellington Harbour, 5—10 fms. 16/II. 1915. 1 large specimen (posterior half only). I have further received a small specimen from Captain Bollons, dredged in Cloudy Bay, 19 fms. Also, I have a fragment (anterior end) of a specimen from Akaroa Harbour, from Mr. Suter.

The species being hitherto known only from the type-locality, off New Brighton, the new localities given here somewhat extend the area of its distribution. There can, however, hardly be any doubt that it will prove to have a much wider distribution in New Zealand seas.

To the descriptions given by the authors quoted I would add only one point, viz. that the cups of the epidermis produce a very characteristic grainy appearance of the scales. When this is not seen, as in some specimens from New Brighton Beach in hand, it is due, evidently, to the cups having been rubbed off.

I perfectly agree with Perrier and Dendy & Hindle in rejecting the genus *Ludwigia* established by Reiffen (Op. cit.) for this species. It is perfectly evident that this species is closely related to *Cucumaria alba,* though quite distinct from the latter species. Of course, it is highly probably, that, when once a thorough revision of the whole genus *Cucumaria* is undertaken — or rather of all the Cucumariidæ — a number of separate genera will have to be established, and then also forms like *alba* and *ocnoides* will be removed from the genus *Cucumaria* in a restricted sense. But such revision will be a very great task, which can only be accomplished by a competent specialist in this group, and not by some young student, who gets some little material from his Professor with the object of making his doctoral thesis of it.

For the rest I may call attention to the fact that the name *Ludwigia* is preoccupied for a longicorn beetle (Pic. Matériaux pour servir à l'étude des Longicornes. I. 1891, p. 47).

12. *Cucumaria Huttoni* Dendy.

Cucumaria Huttoni. Dendy. 1896. Observ. Holoth. N. Z. Journ. Linn. Soc. XXVI. p. 32. Pl. 3_{19-20}.

Cucumaria Huttoni. Ludwig. 1898. Holoth. Hamburg. Mag. Sammelreise. p. 39.
— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. W. p. 324.
— — R. Perrier. 1904. Holoth. Antarct. Mus. d'hist. nat. Paris. Ann. Sci. nat. Zool. 9. Sér. I. p. 93.

1 specimen from Portobello (Otago Harbour), received from Prof. Benham.

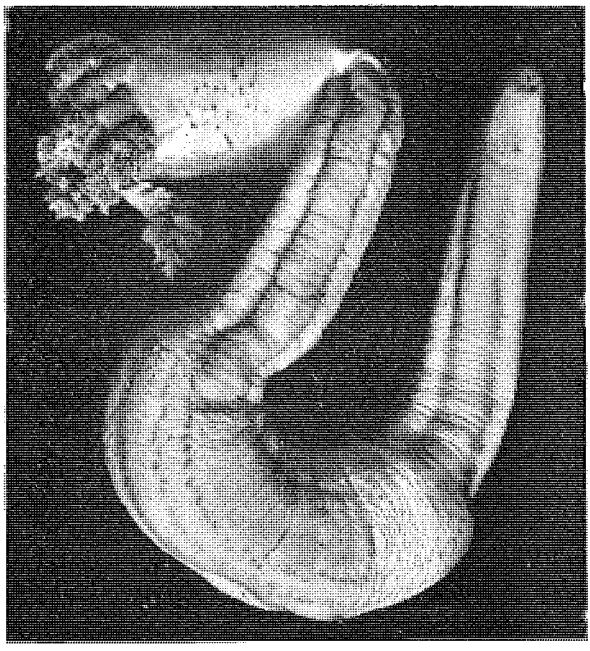

Fig. 33. *Cucumaria Huttoni* Dendy. Natural size.

The specimen, which has the tentacle-crown very finely expanded (Fig. 33), while the body itself appears to be rather contracted, measures ca. 175 mm in total length. It is strongly curved, with a swollen median part and a narrower anterior and posterior part, both upwards directed; these three parts of the body are of about equal length. In the middle part the tubefeet, which are completely retracted, form three distinct, fairly regular double series in the trivium, the two series of each radius being rather distant; in the dorsal radii the tubefeet are much more inconspicuous, being much more scarce, and form only a single, irregular zigzag-series. But the existence of tubefeet in the dorsal ambulacra is important to

notice, in view of the fact that both Dendy and Ludwig failed to discover them. Probably Perrier has seen them, as he states to have found tubefeet in the lateral regions of the dorsal side; in fact, the dorsal ambulacra are nearer the ventro-lateral ambulacra than to the dorsal midline in the swollen middle part of the body, while in the anterior and posterior body parts all the ambulacra are equidistant. Thus, in the middle part of the body the middorsal interradius is unusually broad. In the anterior and posterior body parts the ambulacra form very conspicuous furrows, apparently wholly devoid of tubefeet, excepting the base of the posterior part, where a few tubefeet are distinctly seen. The introvert is wholly without tubefeet. The tentacles of equal size. No anal papillæ.[1])

The calcareous deposits, according to Dendy, would appear to be only of one kind, but of various size. Ludwig states that there are larger scales of an elongate-oval shape, upto 1 mm long, between and below which are lying very numerous, smaller, rounded plates of various sizes, conform to the figure given by Dendy. Perrier appears to have observed only the one form figured by Dendy. In the specimen examined by me the calcareous deposits are of two distinct kinds. The larger form (Fig. 34) is elongate-oval, or even rectangular in shape, formed by a very close mesh-work of the sort usual in the thicker plates of Echinoderms. But these plates are bent, saddleshaped, one end implanted deep in the

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[1]) Ludwig has found a circle of cylindrical anal papillæ in two broken off caudal portions, which he refers to this species, while he did not observe any anal papillæ in his two complete specimens; he therefore suggests that in these apparently complete specimens the point of the tail end had really been lost. The explanation of this discrepancy (— also Dendy, who has studied a fresh specimen, states that there are no anal papillæ —) is this that the two tail ends examined by Ludwig were not of *C. Huttoni*, but of *C. ocnoides*, in which latter there is a circle of cylindrical papillæ around the anal opening. I am in a position to offer this explanation not as a suggestion, but as a fact, having had, through the kindness of Professor R. Hesse, Bonn, the said objects for direct comparison with my specimens.

The tail end of *C. ocnoides* appears to be liable to break off, when the animal which, evidently, lies buried deep in the ground, with the ends just protruding above the bottom surface, is hit by the dredge. Also the present author has obtained such a broken off tail end of this species in the dredge.

skin, the other end protruding; these protruding ends, which are finely spinulose, overlap, and these are the scales to be seen in the skin which produce the scaly appearance distinct even to the naked eye. Furthermore the arrangement of these scales is fairly regular, transverse to the longitudinal axis of the body, and thus

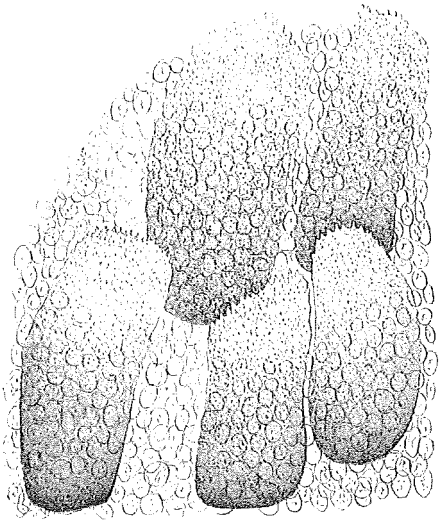


Fig. 34.

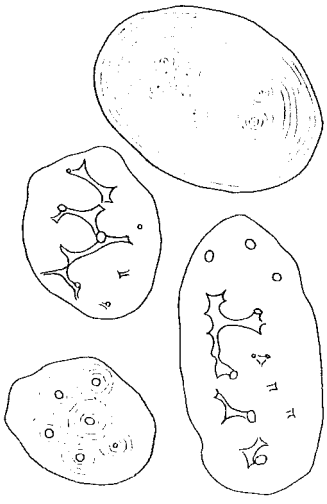


Fig. 35.

Fig. 34. Part of skin of *Cucumaria Huttoni*, showing the large, saddle-shaped plates and the small buttons. $^{35}/_{1}$. Fig. 35. Buttons of *Cuc. Huttoni*. $^{170}/_{1}$.

that from the ventral midline they imbricate towards the dorsal side, meeting from the two sides in the dorsal midline. This arrangement becomes less distinct towards the ends of the body, and at the tail end they all imbricate caudad. Between these larger scales the skin is filled up by a great number of small, oval or round plates of the structure described by Dendy and Perrier, measuring ca. 0.1—0.3 mm in greatest diameter. The holes in them are few and small and may entirely obliterate, leaving only fine concentric lines, the plates representing then small, glassy buttons (Fig. 35). Also along the edges fine concentric lines are often seen.

The introvert is entirely without calcareous deposits. The tube-feet are, as stated by Ludwig, entirely devoid of calcareous deposits, excepting the small terminal disk. The tentacles contain ir-

regular plates of various size. — The introvert is irregularly spotted with small yellowish-brown spots; such may also be observed on the tentacles.

In the internal anatomy the only difference from the type appears to be the existence of 5 long and slender Polian vesicles, while Dendy found only two of them and Ludwig even only one.

The differences in the calcareous deposits which, according to the above description, exist between this specimen and those described by the three authors quoted are rather conspicuous, it is true. However, it seems perfectly clear that the discrepancies do not mean real differences between the various specimens described. From Ludwig's description it would seem that he has found them very nearly as here described. Unfortunately, his specimens, as I am informed by Professor R. Hesse, are not to be found and thus a reexamination has not been possible. On the other hand I have had from the Museum of Vienna, through the kindness of Professor C. Attems, one of the specimens of Perrier for reexamination, and it proved to agree very well with my specimen, the only difference being that the large, imbricating scales do not show the same regular arrangement. Also the small plates are somewhat different, being less glassy, with more holes than in my specimen. Of course, it would be desirable to have the type specimen also reexamined. But until that has been done and direct proof has been given that it does not agree with the specimens examined by Perrier and myself, being devoid of the large scales, I must refer, in accordance with Perrier and Ludwig, these specimens to *Cucumaria Huttoni*.

13. *Phyllophorus longidentis* (Hutton).

Thyone longidentis. Hutton. 1872. Cat. Echinod. N. Z. p. 16.
— *caudata.* Hutton. 1872. Ibidem; p. 16.
Peutadactyla longidentis. Hutton. 1879. Notes on some N. Z. Echinod. Trans. N. Z. Inst. XI. p. 307.
Thyone — Théel. 1886. "Challenger" Holoth. II. p. 141.
Thyonidium rugosum. Théel. Ibidem, p. 95, Pl. V.5.
— *caudatum.* Théel. Ibidem, p. 147.
— *longidentis.* Dendy. 1896. Observ. Holoth. N. Z. Journ. Linn. Soc. Zool. XXVI. p. 42. Pl. 6. 62—69.
— — Farquhar. 1898. Echinod. Fauna N. Z. Proc Linn. Soc. N. S. W. p. 326.

Phyllophorus longidentis Ludwig. 1898. Holoth. Hamburg. Mag. Sammelreise; p. 49.

Thyonidium anatinum. R. Perrier. 1903. Sur deux esp. nouv. d'Holoth. Nouv. Zélande. Bull. Mus. d'hist. nat. Paris. p. 142.

Phyllophorus anatinus. R. Perrier. 1904. Holoth. antarct. Mus. d'hist. nat. Paris. Ann. Sc. nat. Zool. 9. Sér. I. p. 112. Pl. $V._{1,9}$.

— *longidentis.* Dendy & Hindle. 1907. Add. knowl. N. Z. Holoth. Journ. Linn. Soc. Zool. XXX. p. 101. Pl. $13._{18.a-d}$.

— — Benham. 1909. Echinoderma. Sci. Res. N. Z. G. Trawling Exped. Rec. Canterbury Mus. $I._{9}$ p. 28.

Akaroa Harbour, 3 fms; mud. 15/XII. 1914. 1 specimen.

I have nothing to add to the careful descriptions given by Dendy, Perrier and Dendy & Hindle, would only emphasize my perfect agreement with Dendy & Hindle in regarding Perrier's *Phyllophorus anatinus* as a synonym only of *Ph. longidentis.*

Among some various material from Akaroa Harbour, received from Mr. Suter in 1899, is also a very young specimen of this species, ca. 10 mm long. It is strongly curved and has very much the shape of an *Echinocucumis,* the more so as the tubefeet are very indistinct (perhaps on account of the rather poor preservation). There is, however, no doubt that it belongs to *Ph. longidentis.* It is noteworthy that its spicules are almost exclusively of the beautiful cruciform type figured by Dendy (1896; Pl. 6, figs. 64 and 67), while those of the larger specimen taken by the author in 1914, are much more irregular in shape, hardly a single regularly cruciform spicule being met with. (This specimen was found adhering to the anchor of the ship. There was, unfortunately, no opportunity of making any dredgings here).

14. *Phyllophorus dearmatus* Dendy & Hindle.

Phyllophorus dearmatus. Dendy & Hindle. 1907. Additions to our knowledge of New Zealand Holothurians. Journ. Linn. Soc. Zool. XXX. p. 103. Pl. $11._{7-8}$; Pl. $12,_{15}$; Pl. $13,_{20}$.

— — E. C. Joshua. 1914. Victorian Holothurioidea Proc. R. Soc. Victoria. 27. p. 4.

Wellington Harbour, 5—10 fms; hard bottom. 16/II. 1915. 2 specimens.

In spite of some rather important differences from the description given by Dendy & Hindle the two specimens in hand must evidently be referred to this species, which was known hitherto only in the single specimen obtained by Mr. Suter in Akaroa Harbour.

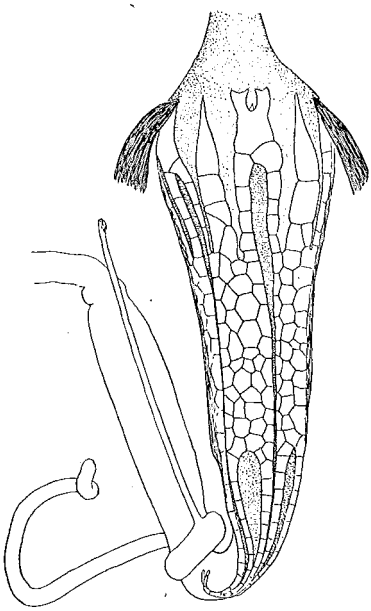


Fig. 36. Pharynx and calcareous ring of *Phyllophorus dearmatus*. Two of the retractor muscles are indicated, the one in front is wholly removed. Posteriorly the pharynx is seen continuing into the (forwards directed) oesophagus, which is surrounded at its base by the watervascular ring, from which proceed the long, straight stone canal and the long, slender Polian vesicle. $^6/_1$.

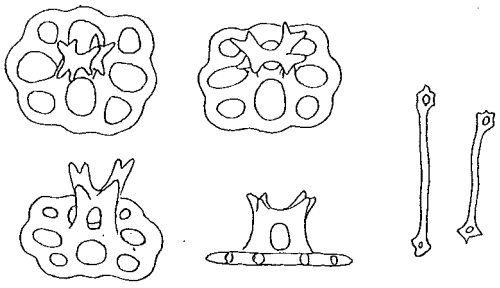
The most conspicuous difference is found in the shape of the calcareous ring. As a comparison of the figure given here with that of Dendy & Hindle (Pl. 11, fig. 8) will show, the interradials differ very markedly from those in Dendy & Hindle's figure. I cannot give any explanation of the difference but must simply state that in both my specimens the calcareous ring has the shape shown in fig. 36.

The tentacles of the type specimen were twenty; one of my specimens has only 18 tentacles, only 4 pairs of the large tentacles being developed. This is probably simply an individual abnormality. They are more or less unequally developed in all pairs; the ventral pair is considerably smaller than the others.

While the skin of the body is totally devoid of spicules, as was also the type-specimen, I find spicules well developed in the anal extremity of the present specimens. They are tables, with a spire of two columns, ending in some 8—12 thorns. The disk has generally 8 holes, 4 inner, somewhat larger and 4 outer, smaller ones, alternating with the former. The edge of the disk is perfectly smooth (fig. 37.a). No distinct anal teeth. The tentacles contain rather numerous spicules, thin rods with a hole or two in each end (Fig. 37.b). The tubefeet are devoid of

spicules, except those of the posterior extremity, in which the tables continue unto the end-plate.

The body is more regularly fusiform than in the type speci-



a. b.

Fig. 37. Calcareous deposits of *Phyllophorus dearmatus*. a. Tables, from above and in side view; b. rods from the tentacles. 275/1.

men; one of my specimens has a distinct, but short caudal appendage. This, however, is certainly due to contraction on preservation.

It appears (Joshua, Op. cit.) that this species is widely distributed also along the southern coasts of Australia.

15. *Pseudocucumis Thomsoni* (Hutton).

Cucumaria thomsoni. Hutton. 1878. Notes on some New Zealand Echinodermata. Trans. N. Z. Inst. XI. p. 307.

— (?) — Dendy. 1896. Observ. Holoth. N. Z. Journ. Linn. Soc. Zool. 26. p. 34.

— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. W. p. 324.

Stewart Island, 20 fms; hard bottom. 16/XI. 1914. 3 specimens.

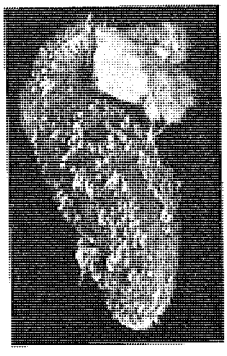


Fig. 38. *Pseudocucumis Thomsoni.* Nat. size.

There can be no question but that these specimens really belong to Hutton's *Cucumaria thomsoni.* They agree perfectly with the original description; moreover, I have had for comparison, through the kindness of Dr. C. C. Monro, a piece of skin of the type specimen, which is preserved in the British Museum, and find it to agree with my specimens in the characteristic feature: the strong wrinkling of

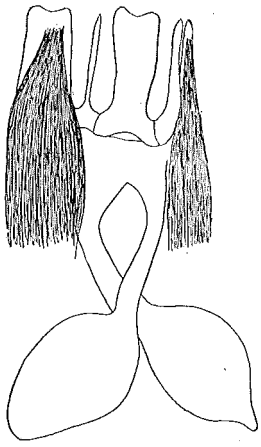
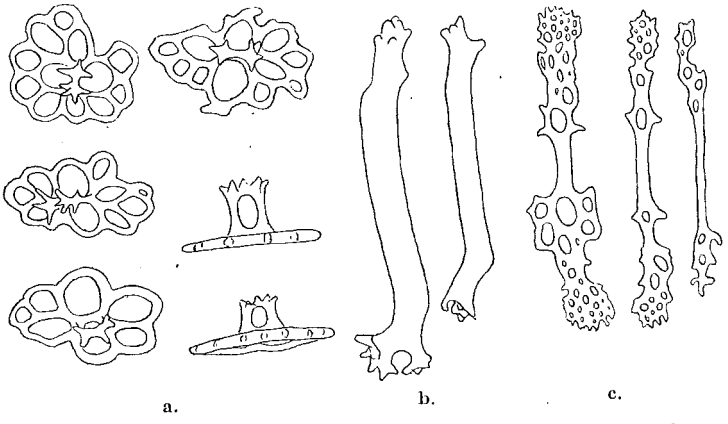


Fig. 39. Calcareous ring and Polian vesicles of *Pseudocucumis Thomsoni*. Two of the retractor muscles drawn, the one in the middle removed. 4/1.

the epidermis, one of the few characters emphasized in the short description given by Hutton. — It will be necessary to give a complete description of the species.

Two of the specimens are about 5 cm long, fairly well extended (Fig. 38); the third is only 9 mm long, much contracted. The two larger specimens are brownish, the tubefeet whitish; the anterior end (the introvert) and the tentacles white. The general shape is, as stated by Hutton, fusiform. The tubefeet are disposed in close series along each radius, not spreading over the interradii. The tentacles are in one of the specimens well extended; they are 25, disposed in two circles, an outer circle of 15 larger, much branched, an inner circle of 10 smaller ones. The dorsal pair of tentacles in the outer circle conspicuously smaller than the others; between their bases the genital duct opens on a rather large papilla. In the other larger specimen, with the tentacles retracted, I cannot find more than 18 of them. In the younger specimen only 15 tentacles are found, evidently all belonging to the outer circle, the



a. b. c.

Fig. 40. Calcareous deposits of *Pseudocucumis Thomsoni*. a. Tables, from above and in side view; b. rods from the tentacles; c. spicules from mouth-papillæ. 276/1.

tentacles of the inner circle having thus not yet appeared. — The entrance to the mouth is finely papillate, whereas no circle of papillæ surrounding the circles of tentacles is found, such as is the case in *Ps. bicolumnatus* Dendy & Hindle, the other New Zealand species of the genus *Pseudocucumis*.

The calcareous ring is simple, the interradial pieces small and slender (Fig. 39). The powerful retractor muscles are attached about in the middle of the body. There are two large Polian vesicles (Fig. 39), joining at the base, and one short stone-canal with a complicate, folded, madreporic head. Genital coeca numerous, fine, intermingling, but hardly branching. The respiratory trees well branched. The oesophagus is somewhat widened in its lower part, where it passes into the intestine; it is distinctly papillate here (on its outer surface), the papillæ not passing on to the intestine.

Calcareous deposits exceedingly scarce, only very rarely a rudimentary one may be found in the skin; in the anterior, introverted part they are slightly more common and better developed. They are tables (Fig. 40.a), with a somewhat irregular disk and a small spire of two columns. The tubefeet have a well developed terminal disk-plate, but otherwise no spicules at all. In the tentacles are found fairly numerous fine rods (Fig. 40.b) in the branches, but none in the stem. The papillæ of the mouth contain finely branched, elongate spicules (Fig. 40.c).

From *Pseudocucumis bicolumnatus* this species is very well distinguished through several characters: The calcareous deposits are very numerous in *bicolumnatus* and also different in structure (with a round disk); the shape of the calcareous ring is different in the two species (cf. Pl. 11. 6.a of Dendy & Hindle's paper), and there is only one Polian vesicle in *bicolumnatus*.

16. *Pseudopsolus macquariensis* (Dendy).

Psolus macquariensis. Dendy. 1896. Observations on the Holothurians of New Zealand. Journ. Linn. Soc. Zool. XXVI. p. 41. Pl. 7.70—72.

— — Farquhar. 1898. Echinod. Fauna of New Zealand. Proc. Linn. Soc. N. S. W. p. 325.

Pseudopsolus — Ludwig. 1898. Holoth. Hamburg. Magalh. Sammelreise; p. 49.

Pseudopsolus macquariensis. R. Perrier. 1904. Holoth. Antarct. Mus. d'hist. nat. Paris. Ann. Sc. nat. Zool. 9. Sér. I. p. 111.

Stewart Island. 2 specimens, collected by Professor Benham.

To the very careful description given by Dendy and Ludwig I have but very little to add.

As stated above (p. 335) under *Cucumaria brevidentis*, var. *carnleyensis*, there is some reason for believing that the labelling of these specimens is unreliable, and that they really came from Macquarie Island. Otherwise, the occurrence at Stewart Island of this species would not be very surprising, as it might easily be transported on large algæ, being a littoral form.

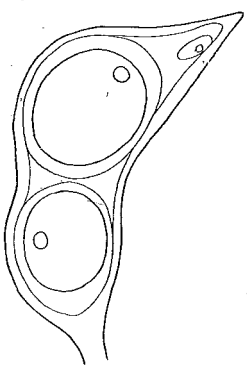


Fig. 41. Genital coecum of *Pseudopsolus macquariensis.* 15/1.

Calcareous deposits, like those figured by Dendy, are found in the latero-dorsal interradii, though rather sparingly, in one specimen; in the other I did not find any. Tentacles and tubefeet entirely devoid of spicules as stated by Ludwig.

The interesting fact that this species is hermaphroditic was discovered by Ludwig, who also pointed out that the hermaphroditism is successive. My specimens afford some interesting information about this point. The younger of the specimens, 13 mm long (tentacles extended) has some few (7) female genital coeca, 3—4 mm long, each containing two very large, somewhat oval eggs, about 1.5 mm in diameter, and one or two young eggs in the pointed end of the tube (Fig. 41). Besides, there are about the same number of quite small genital coeca, each with two young eggs, and further two young male genital coeca. In the second specimen, 19 mm long (also fairly well extended), there is a number of long male genital coeca, filling out the body cavity, and a number of very short, female genital coeca with quite small eggs — as found by Ludwig. This proves that the species at first produces eggs, then sperma, and then, evidently, again eggs.

Psolidiella n. g.

Body *Psolus*-like, with a distinct ventral sole, which is, however, not limited from the rest of the body through a sharp edge. Outside the sole the body all over provided with tubefeet which do not show any serial arrangement. Calcareous deposits not in the shape of distinct, overlapping scales. The posterior part of the intestine, with its mesentery, in the left ventral interradius.

Genotype: *Psolidiella nigra* n. sp.

Though superficially resembling a Psolid this form does not really belong to the *Psolus*-group, as is shown beyond any doubt through the fact that the posterior part of the intestine is in the left ventral interradius. As has been pointed out by Hj. Østergren the situation of the posterier part of the intestine appears to be of primary importance for the subdivision of Dendrochirotes, the Cucumariids and the Phyllophorids having it in the left, the Psolids having it in the right ventral interradius.

The species here made the type of the new genus *Psolidiella* I was at first inclined to refer to the genus *Psolidium*, until the discovery of the situation of the hind part of its intestine in the left ventral interradius revealed the fact that it is a Cucumariid, not a Psolid. The species hitherto referred to *Psolidium* show very great diversity in shape; some of them resemble true *Psolus* in shape and scaling, others are more *Cucumaria*-like in shape and devoid of a true scale-covering; the suggestion therefore lies at hand that all these various forms do not really belong to one and the same genus. The type of the genus *Psolidium*, *Ps. dorsipes* Ludwig, (— I have been able to examine a specimen[1]) belonging to the Paris Museum, and beg herewith to offer my best thanks to Professor L. Joubin for his kindness in lending me the specimen for examination —) agrees with true Psolids in regard to the situation of the intestine. It is to be expected that the other species

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[1]) The specimen unfortunately had been opened just in the critical point, the posterior end of the right ventral interradius, and part of the intestine removed. Enough, however, remained to show beyond doubt that the posterior part of the intestine really lies in the right ventral interradius, not in the left.

of *Psolidium* resembling it in shape and scaling will prove to agree with *Ps. dorsipes* also in the character of the intestine. These then must remain in the genus *Psolidium*. The more *Cucumaria*-like forms will probably be found to agree with *Psolidiella* in the character of the intestine, and it may well be suggested that they may be referred to this latter genus. Not having material for examining the question in detail I must content myself with these suggestions, leaving it to others, who are more fortunate in having access to material of these forms, to give the proof of my suggestion.

It is, of course, possible that some of the characters mentioned in the description of the species ought really to be included in the diagnosis of the genus; this cannot be decided, until more species have been shown definitely to belong to this genus.

17. *Psolidiella nigra* n. sp.

Paterson Inlet, Stewart Island; on rocky shore. 6/IV. 1924, (Sten Vallin). 3 specimens.

Largest specimen 23 mm long (tentacles retracted). Shape of body *Psolus*-like, with a well marked off ventral sole and a short caudal prolongation (Fig. 42). Tubefeet arranged in about four, somewhat irregular, crowded series in the radii of the ventral sole; in the middle part of the median radius they stand less closely and only in two series. At the anterior end of the sole the ventrolateral series of tubefeet turn inwards so as to join those of the midventral series, thus forming a definite anterior border of the ventral sole. At the posterior end of the sole they are similarly arranged, but here a small naked space is left between the median and the lateral series. Through this arrangement of the tubefeet the ventral sole becomes very distinctly limited; the limitation is further emphasized through the colour, the ventral sole with its tubefeet being white, while the body otherwise is black. In the body wall itself there is no sharp limit between the ventral sole and the sides of the body. The tubefeet of the three ventral radii do not con-

a. b.

Fig. 42. *Psolidiella nigra*. a. From above, b. from below. Nat. size.

tinue anteriorly or posteriorly beyond the sole. Outside the sole the whole body is closely covered with small whitish tubefeet, which give the otherwise black body a finely spotted appearance. Even at the anterior and posterior end no serial arrangement of these tubefeet is discernible. No anal teeth.

Tentacles 10, black, subequal. Calcareous ring simple, well developed (Fig. 43.d.) Retractor muscles short, attached in the

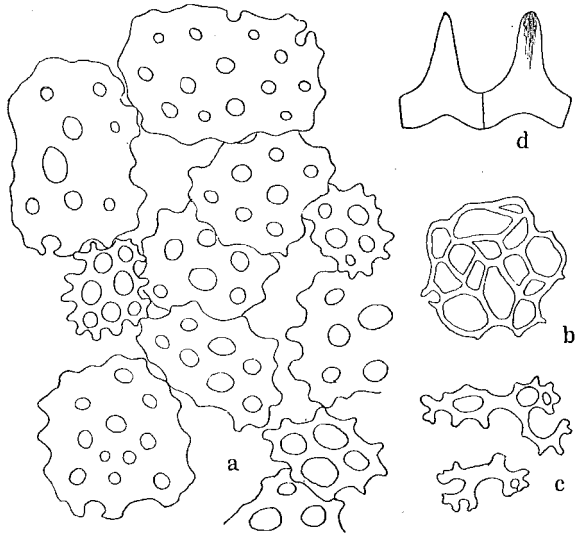


Fig. 43. Calcareous deposits and calcareous ring (d) of *Psolidiella nigra*. a. Deposits from the ventral sole, natural group; b. disk from dorsal tubefoot; c. spicules from tubefoot; d. radial and interradial of calcareous ring. a—c. $^{150}/_{1}$; d. $^{9}/_{1}$.

anterior part of the body. One Polian vesicle and one very short stone canal. Oesophagus without muscular thickening. Genital coeca numerous, very long, unbranched, filling up the body cavity. Respiratory trees well developed.

Calcareous deposits small, somewhat irregular, smooth plates, which lie in a close layer in the ventral sole, but hardly overlapping (Fig. 43.a.). Among these are found some finer, more regular, button-like plates, together with various developmental stages of the former sort. In the dorsal skin only the first sort of calcareous bodies occur, much more sparingly and accordingly not at all overlapping; they are slightly smaller than those of the ventral sole.

Ventral tubefeet with a large, regular end-plate, the dorsal tubefeet with a small, irregular one (Fig. 43.b); both sorts of tubefeet with a few, irregular spicules (Fig. 43.c) near the disk; similar spicules are found in the tentacles.

The black colour must make this species very difficult to observe on the dark rocks, where it lives, and thus afford it a most effective protection.

The nearest relative of this, both in regard to morphology and biology, highly interesting Holothurian would seem to be *Psolidium gaini* Vaney (Holothuries. II. Expéd. Antarct. Francaise. 1914. p. 18. Pl. I.7—9, IV.6—14), which may well be suggested to belong in reality to *Psolidiella*, not to *Psolidium* s. str.

The discovery of this species is due to the young Swedish zoologist, Dr. Sten Vallin, who paid a short visit to the Stewart Island in 1924, on a whaling trip to the Antarctic seas.

18. *Psolus neozelanicus* n. sp.

2 miles E. of North Cape, N. Z ; 55 fms; hard bottom. 2/I. 1915. 2 specimens.

The larger specimen is 10 mm long, with tentacles expanded; it has a short caudal appendage. The body of this specimen is rather high, but the somewhat inrolled edges of the sole show that this is not the normal shape. The second specimen, 7 mm long, with retracted tentacles, is very flattened (Fig. 44); no doubt this specimen shows the natural shape of the body. Colour white.

The scales of the dorsal side are fairly large, imbricating at least on the sides of the body; 4—5 scales between the introvert and the caudal appendage. The scales are set, not very closely, with small, sharp grains. The overlapping edge of the scales whitish. The introvert is surrounded by 5 large, interradial valves. Smaller scales are found at the base, the limit between the oral valves and the scales of the body being not very distinct. 3—4 circles of smaller scales round the anal opening.

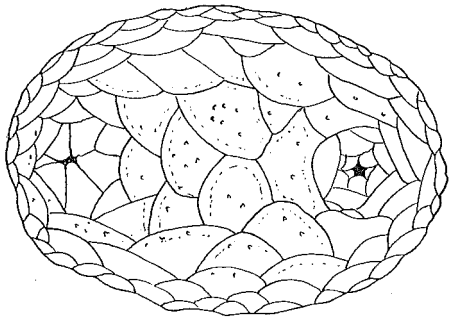


Fig. 44. *Psolus neozelanicus*. Dorsal side. 8/1.

The ventral sole with a close layer of fairly regular plates, in which, as a rule, four primary holes are recognizable, surrounded by an outer, more or less regular circle of smaller holes; rounded projections along the edge, and mostly a few knobs in the middle of the plate. (Fig. 45).

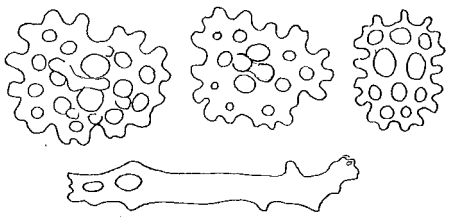


Fig. 45. Calcareous deposits of *Psolus neozelanicus*. The upper series plates from the ventral sole; lower figure rod from tentacle. $^{165}/_{1}$.

Tentacles 10, finely branched; the ventral pair conspicuosly smaller than the others, not branched, only bifid at the point. Tubefeet of the ventral sole arranged in a double series around the whole edge of the sole, those of the outer series being as large as those of the inner series. No tubefeet in the median radius. Spicules of tubefeet like the plates of the ventral sole, only bent so as to fit the wall of the feet; those of the tentacles irregular, more or less branched rods (Fig. 45, the lower figure).

Calcareous ring well developed, of the form usual in this genus. 1 stone canal and 1 Polian vesicle. 5 pairs of short, thick genital coeca, containing a fairly large number of rather small eggs, ca. 0.2 mm in diameter (which have the appearance of being, at least, very nearly ripe). This small size of the eggs, rather unusual for a Dendrochirote, would seem to indicate that this species may perhaps have true pelagic larvæ, though such are otherwise unknown among the Dendrochirotes. At least, we may feel sure that it does not protect its brood.

It appears that this species is not very closely related to any other species hitherto described; but it is evident that it belongs to the *squamatus*-group.

19. *Caudina coriacea* (Hutton).

Molpadia coriacea. Hutton. 1872. Catalogue Echinod. New Zealand; p. 17.

— — Hutton. 1878. Notes on New Zealand Echinod. Trans. N. Z. Inst. XI. p. 307.

Caudina meridionalis. F. Jeffr. Bell. 1883. Studies in Holoth II. P. Z. S. p. 58. Pl. XV.1.

Caudina coriacea. Théel. 1886. "Challenger" Holoth. II. p. 47, 54. Pl. III.4.

— — Dendy. 1897. Observ. Holoth. N. Z. Journ. Linn. Soc. Zool. XXVI. p. 28. Pl. 3.9—18.

— — Dendy. 1897. On some points in the anatomy of Caudina coriacea. Ibidem. p. 456. Pl. 29.

— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. Wales. p. 324.

— — Ludwig. 1898. Holoth. Hamburg. Magalh. Sammelreise; p. 63.

— *pulchella.* R. Perrier. 1905. Holoth. Antarct. Mus. Paris. Ann. Sci. Nat. Zool. 9. Sér. I. p. 117, Pl. V.14—17.

— *coriacea,* var. *brevicauda.* Perrier. 1905. Ibidem, p. 121.

— — Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. J. Linn. Soc. Zool. XXX. p. 108.

— *chilensis* (Müller). H. L. Clark. 1907. The Apodous Holothurians; p. 175.

— — Benham. 1909. Echinoderma. Sci. Rec. N. Z. G. Trawling Exped. Rec. Canterbury Mus. I.2. p. 28.

Non: *Molpadia chilensis.* Johs. Müller. 1850. Anat. Studien über Echinodermen. Müll. Arch. p. 139. 1854. Über den Bau d. Echinodermen. Tal. IX. 1,12.

— — *australis.* Semper. 1868. Holothurien; p. 233. Taf. 39.14.

— *Caudina chilensis.* Joshua & Creed, 1915. South Australian Holothurioidea. Trans. & Proc. R. Soc. S. Australia. XXXIX. p. 21. (= *C. australis* (Semper)).

— — — Joshua. 1914. Victorian Holothurioidea. Proc. R. Soc. Victoria. XXVII. p. 6.

Colville Channel, 35 fms; sandy mud. 21/XII 1914. 1 specimen (caudal appendage only).

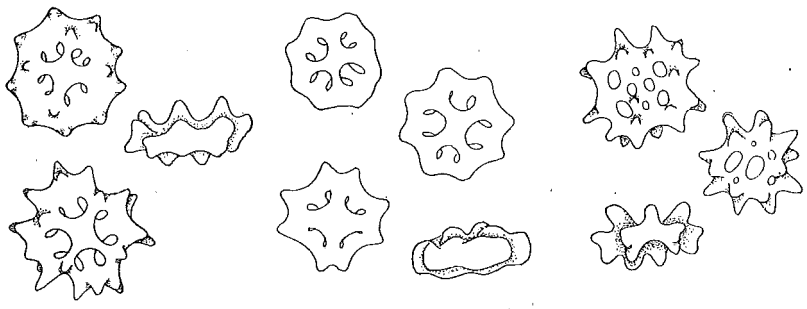
Tiri-Tiri, 15 fms; mud. 28/XII 1914. 2 specimens (caudal appendages only).

These new localities are of interest, the species having not hitherto been recorded from North of Cooks Strait.

H. L. Clark (Op. cit.) has declared both the New Zealand and the Australian form of *Caudina*, *C. coriacea* (Hutton) and *C. australis* (Semper) to be identical with the South American form, *C. chilensis* (Joh. Müller) and has been followed herein by Benham, Joshua & Creed. As I have had the opportunity of directly comparing specimens of both the New Zealand and the Australian form with the type-specimens of Joh. Müller, I am in a position to express a definite opinion about this matter. The result of the comparative

study of these forms is that they are beyond doubt separate species all of them, good distinguishing characters being afforded by the calcareous bodies of the skin as well as by the calcareous ring.

Figs. 46.a—c. represent the calcareous bodies of the three forms. *C. australis* is seen to differ from the two others in entirely lacking



a. b. c.

Fig. 46. Calcareous bodies, in front and side view, of *Caudina chilensis* (a), *C. coriacea* (b), and *C. australis* (c). 187/1.

the characteristic x-formed elevation in the middle of the plates; there are several irregular holes and both sides are rather spiny. *C. coriacea* is more like *chilensis* in regard to these calcareous plates, but they are decidedly more thorny in *chilensis* than in *coriacea*. No less marked differences are found in the calcareous ring (Figs. 47.a—c). *C. chilensis* has long and narrow interradials with a distinct median keel, and the radials have three prominences on the anterior margin, one median and two lateral ones.[1]) *C. coriacea* has short broad interradials, without a longitudinal keel; the radials have only two lateral prominences on the anterior margin, being concave in the middle; they are also characteristic through being distinctly narrowed off the posterior end of the interradials, while in the two other species there is no such distinct narrowing. In *C. australis* the interradials are intermediate in form between those of *chilensis* and *coriacea*, while the radials are

1) This also holds good of *C. rugosa* Perrier, be this Chilenian form identical with *C. chilensis* or a separate species, a question which need not concern us here, seeing that it is, at any rate, different from the New Zealand species.

peculiar in being unsymmetrical, having at the anterior margin one simple and one double prominence; no median prominence. These differences, to which must furthermore be added the existence in *chilensis* of those remarkable organs regarded by Joh. Müller as Cuvierian organs which are absent in the two other forms (so far as I have been able to see on the not very satisfactory material at my disposal), make it evident that it is perfectly unjustifiable to unite all these forms into one single species. Very probably also other differences will be found between the three species, when well preserved specimens are available; but the facts pointed out here are already sufficient to show how illfounded it was to make *coriacea* and *australis* synonyms only of *chilensis*. The same most probably applies to the species *caudata* (Sluiter) form the Java Sea and *Ransonnettii* v. Marenzeller from the Chinese Sea, which Clark makes likewise synonyms of *chilensis*. I have had no opportunity of examining specimens of these two forms, but the figures of the calcareous ring and the calcareous bodies given in the original descriptions seem to me to leave no doubt but that they are perfectly distinct species, as might also be expected from zoogeographical reasons. Thus the zoogeographical paradox of the species *Caudina chilensis* occurring at S. America, New Zealand, Australia, the Java Sea and China need not trouble us any more and worrying over the name *chilensis* as inappropriate for the New Zealand —Australian—Javanese—Chinese species is likewise quite superfluous. But we may well worry over the harm that this mixing up of all these various forms has already done.

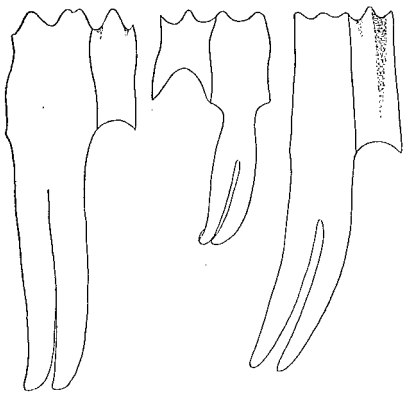


Fig. 47. Radial and interradial of calcareous ring of *Caudina australis* (a), *C. coriacea* (b), and *C. chilensis* (c). 4/1.

I beg to express my sincere thanks to Dr. W. Arndt, Zoological Museum, Berlin, for lending the type specimens of Joh. Müller's *Molpadia chilensis*, and to Dr. Edgar R. Waite, Di-

rector of the S. Australian Museum, Adelaide, for sending me a pair specimens of Joshua & Creed's "*Caudina chilensis*", which proved to belong to *Caudina australis* (Semper).

20. *Protankyra uncinata* (Hutton).

Synapta uncinata. Hutton. 1872. Catalogue Echinod. New Zealand; p. 16.
— *inæqualis.* Hutton. 1872. Ibidem, p. 17.
— *uncinata.* Théel. 1886. "Challenger" Holoth. II. p. 27.
— — Dendy. 1897. Observ. Holoth. N. Z. Journ. Linn. Soc. Zool. XXVI, p. 25.
— — Farquhar. 1898. Echinod. Fauna N. Z. Proc. Linn. Soc. N. S. W. p. 323.

Wellington Harbour, ca. 5 fms; mud. 16/II. 1915. 1 specimen.
Colville Channel, 35 fms; sandy mud. 21/XII. 1914. 1 specimen.
Tiri-Tiri, Auckland, 15 fms; mud. 5 specimens and some fragments.

Of this species was hitherto known only the single specimen, the type, upon which the description of Hutton as also the additional description given by Dendy was based. It is then a matter of satisfaction that material has been collected which enables me to supply information on some points which Dendy had to leave unsettled because of the unsatisfactory state of preservation of the type specimen.

The largest of the specimens in hand measures 8.5 cm in length, by 5—6 mm in diameter; the anterior half is, however, rather strongly contracted, so that the specimen may well have been some 12 cm long when fully extended, which corresponds fairly well to the size of the type specimen, as estimated by Dendy.

All the specimens in hand have 12 tentacles; thus, the type specimen evidently is exceptional in having 13 tentacles. Generally, but not always, the dorsal tentacles are distinctly longer than the ventral ones. There are two pairs

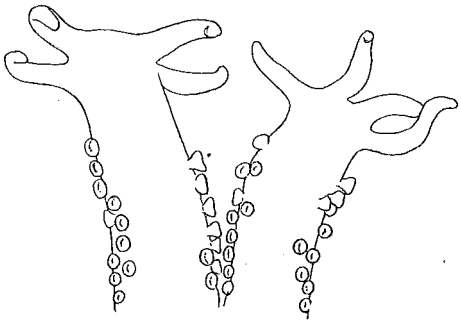


Fig. 48. Two tentacles of *Protankyra uncinata*, showing sensory cups. 15/1.

of slender digits, about equal in length; the terminal digit is quite short, knobshaped. Sensory cups arranged in two lateral series,

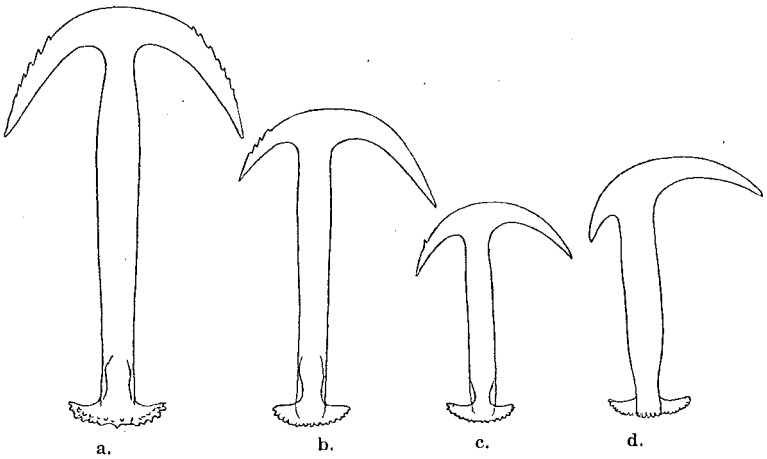


Fig. 49. Anchors of *Protankyra uncinata*. a. Symmetrical form; b—c. unsymmetrical forms; d. unsymmetrical form of "*Synapta inæqualis*". 120/1.

very prominent, recalling, indeed, as stated by Dendy, sucker-bearing tubefeet. (Fig. 48). A brownish-yellow spot at the base between each pair of tentacles. The anchors (Fig. 49.a—d) measure

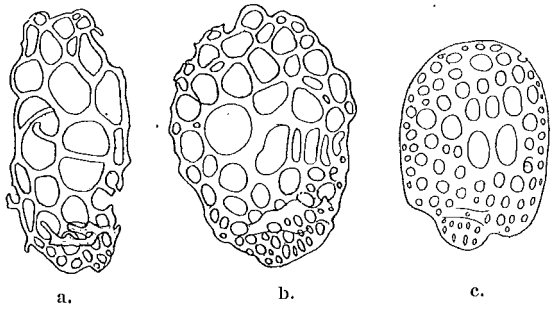


Fig. 50. Anchorplates of *Protankyra uncinata*. a. From the posterior part of body; b. from anterior part; c. exceptionally complete anchor plate. 120/1.

ca. 0.3—0.4 mm. They are symmetrical, the arms more or less serrate or smooth, and the stock finely toothed, unbranched. The plates are irregular, with smooth holes, and with an imperfect bow, or none, across the posterior end. They are very conspicuously

different in the posterior and anterior part of the body. In the posterior part they are small and narrow, irregular in shape, in the anterior part large and rounded (Figs. 50.a—c). This difference is so conspicuous that, if the two forms were not found in one and the same specimen, one would rather think them to belong to two different species. — In the anterior end some small, irregular, fenestrated plates (Fig. 51.a) occur, more or less sparsely. Numerous small lenticular bodies (Fig. 51.b) occur in the longitudinal muscle bands. In the tentacles numerous curved rods, slightly widened in the ends are found. (Fig. 51.c).

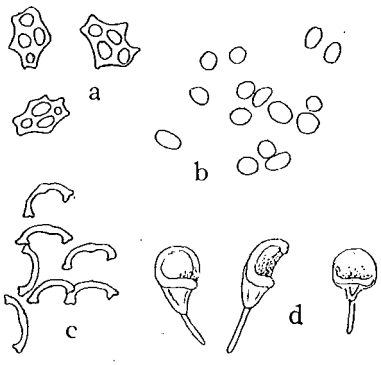


Fig. 51. Calcareous deposits (a—c) and ciliated funnels (d) of *Protankyra uncinata*. a. Small plates from anterior part of body; b. lenticular bodies from longitudinal muscles; c. rods from tentacles. a—c. $^{145}/_{1}$; d. $^{80}/_{1}$.

Regarding the inner anatomy I may add the following observations to those given by Dendy. Calcareous ring consisting of 12 pieces of a square shape (Fig. 52); each of the dorsolateral interradii with two interradial pieces; the radial pieces perforated. Oesophagus long and thin; no distinct stomach, a small swelling on the oesophagus in the specimens opened being due, evidently, to swallowed food particles. The loop of the intestine rather short. — Genital organs slightly branched; the genital duct opens in the middorsal line, just behind the tentacles. I have found only one, much convoluted stone canal. Polian vesicles 4—5 (in the type specimen Dendy found nine of them). Ciliated funnels very numerous, occurring in the middorsal and left dorsal interradii in the whole length of the body; they are very small, rather longstalked, slipper-shaped (Fig. 51.d), placed somewhat scattered.

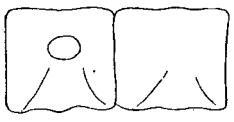


Fig. 52. Radial and interradial of calcareous ring of *Protankyra uncinata*. $^{20}/_{1}$.

The anterior end of the body with numerous reddish spots, especially on the dorsal side.

The small size of the eggs, ca. 0.1 mm, indicates that this species may probably have a typical Auricularia larva.

The locality of the type-specimen is unknown. From the localities given here it may well be

concluded that the species will be found distributed at least along the East Coast of the North Island, from Cook Strait to the Hauraki Gulf.

Not rarely asymmetrical anchors are found among the normal symmetrical ones; in one specimen (from Tiri-Tiri) even the majority of the anchors are asymmetrical, with smooth arms (Fig. 49.b—c), and finally in a specimen from off Kapiti Isl., Cook Strait, 12 fms (collected by Dr. G. M. Thomson in 1915) which was sent me by Professor Benham, all the anchors are asymmetrical, with smooth arms (Fig. 40.d). That we have here a specimen of Hutton's *Synapta inæqualis* seems beyond doubt. But as this specimen in all other features perfectly agrees with the typical *Protankyra uncinata,* this leads to the result that Hutton's *Synapta inæqualis* is the same species as his *Synapta uncinata.* As he had only a fragment of "*inæqualis*", without the tentacles and the anterior end, it was only natural that he regarded it as a separate species, in view of the very curious character of the anchors. But the finding of specimens with unsymmetrical anchors in varying numbers among the symmetrical form of anchors, while all other characters remain the same as in those without asymmetrical anchors, leaves no doubt but that it is all individual variations of one and the same species.

21. *Chiridota gigas* Dendy & Hindle.

Chiridota gigas. Dendy & Hindle. 1907. Add. knowl. N. Z. Holoth. Journ. Linn. Soc. Zool. XXX. p. 110. Pl. 12.9—11.
— — Joshua. 1914. Victorian Holothurioidea. Proc. R. Soc. Victoria. XXVII. p. 7.

1 specimen from Dusky Sound; sent by Professor Benham.

The specimen measures ca. 11 cm in length, but is very much contracted in its anterior part and must therefore have been at least some 2—3 cm longer in a living state. In its posterior end, which is fully distended, it measures ca. 12 mm in diameter.

The characters of this specimen agree very completely with those given in the original description by Dendy & Hindle, to which I have only to add that the ciliated funnels appear to occur

only in the left dorsolateral interradius, scattered over the whole breadth of the interradius. They are of a broad trumpet-shape, with a short stalk (Fig. 53).

The specimen contains apparently ripe eggs, which are very small, ca. 0.08 mm in diameter. This would appear to indicate that this species has a typical Auricularia-larva.

Fig. 53. Ciliated funnels of *Chiridota gigas*. 70/1.

The species having hitherto been recorded only from the Chatham Islands and the Victorian Coast, it is very satisfactory now to have a definite record of its occurrence also at New Zealand, where it was, of course, to be expected to occur.

22. *Chiridota nigra* n. sp.

Chiridota gigas. Benham. 1909. Echinoderma. Sci. Res. N. Z. G Trawling Exped. Rec. Canterbury Mus. I.2 1909. p 3.

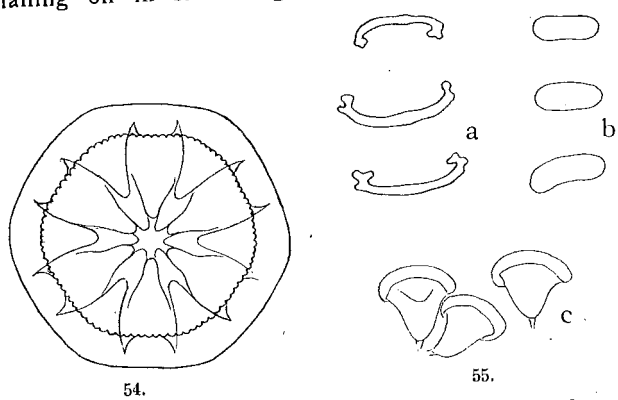
Non: *Chiridota gigas* Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. J. Linn Soc. Zool. XXX. p. 110. Pl. 12.9—11.

Paterson Inlet, Stewart Island, 12—15 fms; mud. 17/XI. 1914. 3 specimens. Carnley Harbour, Auckland Isl., ca 45 fms. 6/XII. 1914. 1 specimen.

The specimen from Carnley Harbour is a fragment in poor condition, without the anterior end. One of the specimens from Paterson Inlet is a fragment of the anterior end of a young specimen, in very poor condition. The others are large ones, in fairly good condition, though broken to pieces, so that it is impossible to give the exact length of the specimens. One of the fragments measures 14 cm in length; as it is partly strongly contracted and lacks the anterior end, we may safely conclude that this specimen was at least, 20 cm long; in the non-contracted part it measures ca. 1.5 cm in diameter. It is thus clear that this species reaches a large size, probably equalling that of *Chiridota gigas* which, according to Joshua[1]) is capable of extending itself to a length of about two feet.

1) E. C. Joshua. Victorian Holothurioidea, with descriptions of new species. Trans. R. Soc. Victoria. 27. 1914. p. 7.

The colour is very dark violet or black, with more or less numerous very small lighter spots, and more or less distinct, close-set, fine longitudinal and transversal lines of a lighter colour, which may give the skin a somewhat wrinkled appearance. These lines appear to be more developed on the ventral side. The skin is very brittle, falling off in small rags, disclosing the underlying white



54. 55.

Fig. 54—55. *Chiridota nigra*. 54. Wheel. $^{230}/_{1}$. 55. a. rods from tentacles; b. lenticular bodies from longitudinal muscles; c. ciliated funnels. a—b. $^{275}/_{1}$; c. $^{80}/_{1}$.

muscle coat; this may give the specimens a very conspicuously mottled appearance, which is, however, unnatural, the living specimens being uniformly dark coloured, the small light spots mentioned above being hardly discernible without a lens. In the preserved specimens the wheel-papillæ form very conspicuous white spots, but this is due to the skin covering being lost. In a few cases, however, the skin covering of the papillæ is preserved, and also these show off as white spots; it may therefore well be concluded that in the living specimens the wheel-papillæ are visible as white spots. Otherwise the skin is smooth, without papillæ.

The wheel-papillæ appear to be confined to the dorsal side, forming an irregular longitudinal series in each of the three dorsal interradii. They are generally very large, compact, somewhat oval in shape, and contain a very large number of wheels, lying very compactly. In one such papilla I counted 165 wheels. The shape of the wheels (Fig. 54) is the usual, the size varying from 100 to 140 μ. Along the radial muscles numerous small elongate-oval,

smooth calcareous bodies (Fig. 55.b) occur, lying mainly parallel to the muscle fibres. No other calcareous bodies in the skin. The tentacles contain numerous small arched spicules, slightly widened

a. b.

Fig. 56. Radial and Interradial of *Chiridota nigra* (a) and *Ch. carnleyensis* (b). a. 15/1, b. 18/1.

in the ends (Fig. 55.a); they are arranged in a close series along each side of the tentacle and its digits.

The tentacles are twelwe in number, with 5—6 pairs of digits, the distal ones being the longer, though not very conspicuously longer than the proximal ones. The calcareous ring is composed of twelwe pieces, there being two interradial pieces in the two dorso-lateral interradii. The radial pieces are perforated (Fig. 56.a). Oesophagus rather long, without any muscular thickening. The intestine very sinuate, with a large loop. Its course otherwise not to be made out exactly. 8 Polian vesicles and one stone canal. The gonads long, unbranched tubes. The type specimen, the only one with the genital organs preserved, being a male, it is evident that the species has separate sexes. Ciliated funnels (Fig. 55.c), all small (0.1 mm), with a wide opening, in the left dorso-lateral and the left ventro-lateral interradii.

In his report on the Echinoderms of the N. Z. G. Trawling Expedition Benham records *Ch. gigas* Dendy & Hindle also from Stewart Island. Having received a pair of these specimens (collected by Dr. G. M. Thomson) from Prof. Benham I must declare them to be identical with *Ch. nigra,* not with *Ch. gigas.* Benham himself also appears to be in doubt about the correctness of identifying these specimens with *Ch. gigas.* — Judging

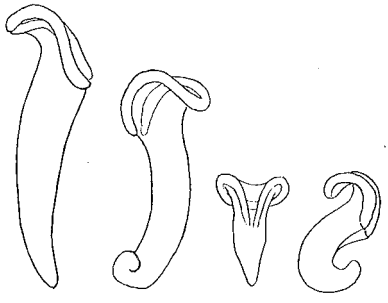


Fig. 57, Ciliated funnels of *Chiridota discolor.* 70/1.

from the description of the colour also the other specimens (Molyneux Bay) referred by Benham to *Ch. gigas* would appear to be *Ch. nigra*.

The present species is very well distinguished from *Chiridota gigas* Dendy & Hindle through several characters, especially the totally different arrangement of the wheel-papillæ and the presence in the latter species of thick, curved rods with spinous ends. Also the colour is quite different, *Ch. gigas* being, according to Joshua, bright scarlet with white papillæ. From the two other large, dark species of the Pacific region, the Hawaiian *Ch. uniserialis* W. K. Fisher and the Japanese *Ch. regalis* H. L. Clark, it is easily distinguished through the absence of curved calcareous rods in the skin and in the wheel papillæ in these two species being confined to the mid-dorsal interradius. The Arctic Pacific species *Ch. discolor* Esch. might appear to have some relation to *Ch. nigra*. From the description of this species given by H. L. Clark (The Apodous Holothurians, 1907; p. 27) it is not easy to gather exactly by which characters it is distinguished from the New Zealand species, and a pair of poorly preserved fragments received from the U. S. National Museum do not allow a closer comparison of the two species. Only one important distinguishing character is disclosed, viz. the entirely different shape of the ciliated funnels, which are long and slender in *Ch. discolor* (Fig. 57), very short and broad in *Ch. nigra*. That the two species are perfectly distinct is beyond doubt.

23. *Chiridota carnleyensis* n. sp.

Carnley Harbour, Auckland Islands; ca. 45 fms. 6/XII. 1914. Several specimens.

The species was found to be very hard to preserve; most of the specimens were only fragments, without the anterior end. The larger of them measure 13—14 cm, by a diameter of ca. 6—8 mm. It is thus a rather large form, though not quite so large as *Ch. nigra* and *gigas*.

The colour is white-transparent, the radial muscles being distinctly seen through the skin, which is perfectly smooth. The wheels do not form papillæ; they are collected into diffuse round

heaps which may be so much as 2—3 mm in diameter, but which hardly form any prominence, except where the skin has been strongly contracted. They are of very irregular occurrence, sometimes lying quite close, sometimes very sparse; as a rule it appears that they are confined to the dorsal interradii, but sometimes they are found, though much more sparsely, also in the ventral interradii; they

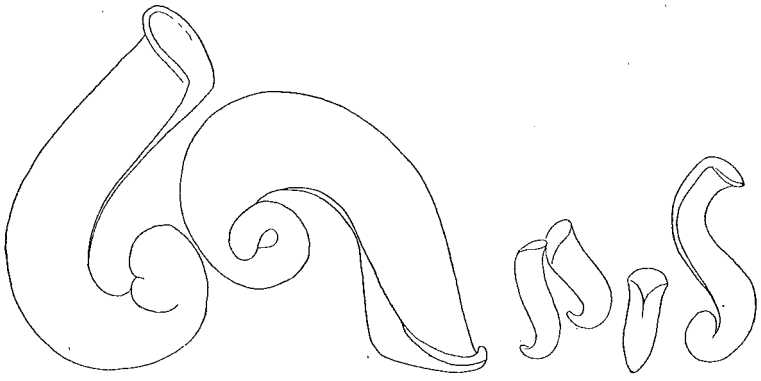


Fig. 58. Ciliated funels of *Chiridota carnleyensis*. 65/1.

may form an irregular series in each interradius, but mostly they lie quite irregularly. Small patches may be found among the larger ones, and in these especially various stages of development of the wheels are met with. The wheels lying not nearly so compact as in *Ch. nigra*, the number of wheels in each heap is not so large as in that species, in spite of the larger size of the heap. I have counted ca. 125 wheels in one of the larger heaps. The structure of the wheel is exactly like that of *Ch. nigra*, so that I may simply refer to the figure of the latter; in regard to size they are more varying than in *Ch. nigra*, from 90—200 μ. Also the spicules of the tentacles are of the same shape as in that species. No calcareous spicules are found along the radii or in the skin.

The tentacles are twelwe in number, with 6—8 pairs of digits, gradually increasing in length towards the end of the tentacle, the distal ones being about twice the length of the proximal ones. An oval, reddish spot is found at the base, between each two tentacles; possibly it is a sense organ. The calcareous ring is composed of twelwe pieces, the two dorso-lateral interradii having each two interradial pieces. The radial pieces are perforate (Fig. 55.b).

There are 8—9 Polian vesicles and one stone-canal. The oesophagus is long, without any muscular thickening. The intestine makes the usual loop.

The genital organs are long, unbranched tubes. The sexes are separate; the eggs are rather small, ca. 0.2 mm.

Ciliated funnels in middorsal, left dorsal and right ventral interradii; they are slender, with a narrow opening. Those in the right ventral interradius are very large, very elegantly shaped, like a french-horn (Fig. 58), They may be up to 1 mm long, while the usual size otherwise is only ca. 0.2 mm. Also in the left dorsal interradius some larger funnels may be found among the usual small ones, but it appears that they do not grow nearly so large there as those in the right ventral interradius.

This species is rather sharply distinguished from all other species of *Chiridota* known till now, and it is hardly possible to point out any nearer relation of it.

24. *Trochodota dunedinensis* (Parker).

Chirodota dunedinensis. T. Jeffr. Parker. 1881. On a new Holothurian. Trans. N. Z. Inst. XIII. p. 418.

— — Hj. Théel. 1885. "Challenger" Holothurioidea. II. p. 34.

— — A. Dendy. 1897. Observations on the Holothurians of New Zealand. Journ. Linn. Soc. London. Zool. XXVI. p. 26. Pl. 3. figs. 1—8.

— — H. Farquhar. 1898. Echinoderm Fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. p. 323.

Trochodota — H. Ludwig. 1898. Holothurien d. Hamburger magalhaensische Sammelreise; p. 87.

— — H. Lym. Clark. 1907. The Apodous Holothurians; p. 124.

— — R. Perrier. 1905. Holothuries antarctiques du Muséum d'hist. nat. Paris. Ann. Sci. nat. Zool. 9. Ser. I. p. 123.

Chiridota benhami. Dendy. 1909. On a small collection of Holothurians from the Auckland Islands. Subantarctic Isl. of New Zealand. I. p. 151. Pl. VI. figs. 3 a—l.

Trochodota dunedinensis. H. Lym. Clark. 1921. The Echinoderm Fauna of Torres Strait. Departm. Mar. Biol. Carnegie Inst. Washington, Vol. X. p. 166.

Trochodota benhami. H. Lym. Clark. Ibidem. p. 166.

? *Chiridota geminifera.* Dendy & Hindle. 1907. Additions to the knowledge of New Zealand Holothurians. Journ. Linn. Soc. Zool. XXX. p. 112. Pl. 14 80.

Non. *Trochodota dunedinensis.* M. J. Allan. 1911. Trochodota dunedinensis in Victoria. Trans. Amer. Microsc. Soc. III. 30. p. 325. (= *Trochodota allani* Joshua).

— — — H. Ohshima. 1914. The Synaptidae of Japan. Annot. Zool. Japan. VIII. p. 478. (*Tr. diasema* H. L. Clark).

— *Chiridota australiana* Stimps. Théel 1886. Challenger Holoth. II. p. 16.

Masked Island, Carnley Harbour, Auckland Isl. Under stones, at low water, and among *Melobesia* on the rocky shore. 30/XI. 1914. Numerous specimens.

Figure 8 Isl., Carnley Harbour, Auckland Isl., under stones, at low water 2/XII. 1914. Several specimens.

Perseverance Harbour, Campbell. Isl.; under stones, at low water 9/XII. 1914. 1 specimen.

A closer examination of these specimens, taken on the type-locality of Dendy's *Chiridota benhami*, has made it clear that the latter species cannot be distinguished from *Trochodota dunedinensis.*

The characters given by Dendy as distinguishing *benhami* from *dunedinensis* are these; The digits of the tentacles do not increase gradually in size from base to apex, the terminal pair being considerably larger than any of the others; the diameter of the wheels is only about half the size of those of *dunedinensis* (0.053—0.087 mm in diameter, against about 0.16 mm); the wheels are numerous in *dunedinensis*, few and scattered in *benhami*, and the inner margin of the rim of the wheels is much more finely toothed in *dunedinensis* than in *benhami*, there being about 100 teeth in the former, only 35—40 in the latter. These would certainly be very good distinguishing characters, if they did hold good; but the rich material in hand shows that they do not hold good.

The digits of the tentacles increase very gradually in size from base to apex; according to the state of contraction they may all be quite short and thick or long and slender, the terminal ones being, of course, the longest. The wheels are generally rather numerous, especially in the larger specimens; their size varies from 0.06 to 0.16 mm, 0.10 to 0.14 being the usual size. So small as 0.53 I have

not seen them, and the sizes of 0.06 and 0.16 I have found only very rarely. Also in *dunedinensis* (from type locality) they may be, at least, as small as 0.08 mm. Almost constantly the inner margin of the rim of the wheels was found to be very finely toothed, with ca. 100 teeth in the whole circumference; only once a wheel was observed with only ca. 70 teeth, the other wheels of the same specimen having the usual number, and in one young specimen, with very few wheels (6 in the whole animal), all very small (0.06 mm), there were only ca. 50 teeth. A coarse dentation as that figured by Dendy (Pl. VI.3.e) I never observed. The wheels are confined to the three dorsal interradii; only at the posterior end a few wheels may occur also in the two ventral interradii. The sigmata are very numerous, scattered, not arranged in papillæ. As pointed out by Perrier (Op. cit.) they lie mostly transversally directed.

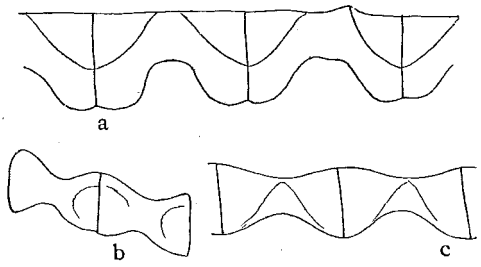


Fig. 59. Pieces of calcareous ring of *Trochodota Dendyi* (a), *Tr. dunedinensis* (b), and *Tr. dunedinensis*, var. *microurna*. (c). a. 25/1, b. 22/1, c. 16/1.

Some additional information about this species may be given. The size of the specimens in hand varies from ca. 1.5 to 4.5 cm (in a well preserved condition). The skin is smooth, not papillate, except when strongly contracted. The colour of the living specimens was reddish-brown, small spots of this colour being still observable in some of the preserved specimens. An oval brownish spot at the base between each pair of tentacles.

The anterior end is, in well preserved specimens, distinctly oblique in the dorso-ventral direction, the dorsal side being the more prominent. Also the dorsal tentacles are somewhat longer than the ventral ones. The mouth is a narrow slit, distinctly excentrical, adjoining the ventral side of the oral disk. Also the calcareous ring is distinctly oblique, parallel to the oral disk. The 10 pieces are, in accordance herewith, somewhat unsymmetrical; they are narrow, the radial pieces not perforated by the nerve (Fig. 59.b). The alimentary canal is stated by Dendy to exhibit three limbs, forming the usual S-shaped figure, being otherwise a good deal

sacculated, in *benhami,* while in *dunedinensis* it is stated to run straight from mouth to anus, only slightly convoluted (through the contraction of the body). This would appear to be a too important difference for specimens of one and the same species. I do not think so, however, because the loop which may be found in some specimens is not of the same morphological value as that found in other Holothurians, but merely accidental folds of the much convoluted alimentary canal. It is not found in all specimens; sometimes, on the other hand, there are two of them, one above the other, both in the posterior part, at the passage from the intestine into the rectum. The oesophagus is, in accordance with the character of the mouth, strongly compressed laterally; it is very short, without any muscular swelling. The dorsal mesentery continues directly unto the rectum, which latter is suspended by two strong mesenteries, attached to the ventro-lateral radial muscles; the dorsal mesentery is passing into the left of these rectal mesenteries. In one case the right rectal mesentery was found attached to the right dorso-lateral radial muscle.

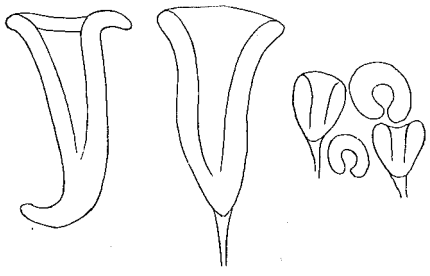


Fig. 60. Ciliated funnels of *Trochodota Dendyi* (a), *Tr. dunedinensis* (b) and *Tr. dunedinensis*, var. *microurna* (c); in the last figure two of the funnels are figured as seen from above. 100/1.

Regarding the radial muscles Dendy states that (*in dunedinensis*) "there are, of course, no retractor muscles" (1897; p. 27). However, the anterior end of the longitudinal muscles is so strongly compressed and marked off from the part lying in the plane of the body wall that it is very tempting to regard this part as a true retractor muscle; but this compressed part is not entirely separated off from the part of the muscle following the body wall, and thus it may be maintained to be not directly homologous to the retractor muscle of Dendrochirotes. The retractor-part of the radial muscle begins at about $^1/_3$ of the body length from the anterior end, gradually increasing in height forwards.

The ciliated funnels are stated by Dendy to be scattered singly in the neighbourhood of the dorsal mesentery. It appears that

normally they occur only along each side of the mesentery and in a series in the left dorso-lateral interradius; but then, further, they may occur along both sides of the left ventral interradius, along the radial muscles, and finally in some specimens there are 10 longitudinal series of ciliated funnels, one along each side of all the radial muscles. Their shape and size is given in fig. 60.b.

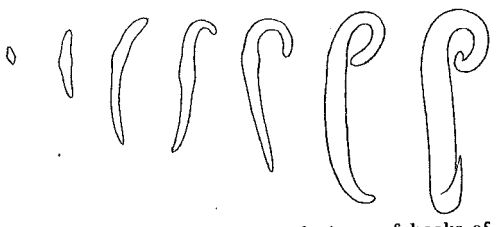


Fig. 61. Series of developmental stages of hooks of *Trochodota dunedinensis*. 220/1.

The gonads are rather short, generally bending forwards so as to lie wholly in the anterior end of the body. The eggs are small, ca. 0.2 mm in diameter, which might indicate that this species may have pelagic larvæ.

The development of the wheels has been described by Dendy (1897); it is, indeed, very easy to find all the different developmental stages scattered among the fully formed wheels. Also developmental stages of the sigmata occur in considerable numbers, so that it is very easy to trace them from the first simple, straight spicule with a slight median thickening, through the beginning curvature to the fully formed hook (Fig. 61).[1])

Regarding Dendy's *Chiridota geminifera* I agree with Clark (1921. p. 165) that the evidence available is altogether too insufficient for accepting this form as a separate species (or even belonging to another genus than *Trochodota,* as it would, evidently, if it should definitely prove to be provided only with sigmoid spicules, lacking completely the wheels). Until further material is at hand it is the safest course to regard it as, probably, only a synonym of *Tr. dunedinensis.*

Dendy (Op. cit. 1896) suggested that the *Chiridota australiana* Stimpson recorded by Théel ("Challenger". Holoth. II. p. 16) as doubtfully from New Zealand might probably be identical with *Tr. dunedinensis.* Ludwig, however, has shown definitely (1898. Holoth.

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1) A similar series of developmental stages was figured and described by Ludwig for *Tæniogyrus (Chiridota) contortus* and *Trochodota purpurea* (Holoth. Hamburger Magalh. Sammelreise, 1898; p. 79. Taf. III.$_{37}$; p. 85. Taf. III.$_{45}$).

Hamburg. Magalh. Sammelreise, p. 86) that it is identical with *Troch. purpurea* (Lesson), the locality being the Falkland Islands, not New Zealand.

From off Moko Hinau, 5 fms (30/XII. 1914) there are two specimens which differ from typical *dunedinensis* in having 12—14 digits on the tentacles (against 8—10 in the typical form), in the calcareous ring having a somewhat different form (Fig. 59.b; to compare with Fig. 59.c.) and in the ciliated funnels being distinctly smaller (Fig. 60.b to compare with Fig. 60.c). The genital organs are in a very imperfect stage of development; it is therefore probable that the two specimens which measure ca. 50 mm (well extended) are not yet fully grown, and thus would appear to reach a larger size than the typical *dunedinensis,* in which the genital organs are fully developed already at a length of ca. 25—30 mm.

Very probably these specimens represent another species; but since it is, in any case, very closely related to *dunedinensis*, and as only two specimens are at hand, I think it the better course, for the present, at least, to designate this form only as a variety of *dunedinensis*, naming it var. **microurna** n. var.

25. *Trochodota Dendyi* n. sp.

Plimmerton; sandy beach, at low water. 15/I. 1915. 3 specimens.
Waikeke, Auckland Harbour. 3 specimens (from Mr. W. R. B. Oliver).
Paterson Inlet, Stewart Island. VII—IX. 1899. 3 specimens (Dr. G. M. Thomson).

The specimens from Plimmerton (the type) are 7—8.5 cm long, by a diameter of ca. 3—4 mm in the anterior end, the posterior end being somewhat narrower. The specimens from Auckland Harbour are very much larger, the longest ca. 18 cm, although in a rather contracted state; diameter in the anterior end 5 mm; the posterior end is somewhat thicker on account of the rectum being full of coarse sand. Those from Stewart Island are in a very poor condition, strongly contracted. The specimens from Plimmerton are white, those from Auckland Harbour with a faint purplish tint.

Tentacles with 6 pairs of digits, increasing in length towards the end of the tentacle, the distal pair being distinctly the longest. Mouth not in the shape of a dorsoventral slit. No distinct yellow

spots between the tentacles. The skin is closely and distinctly papillate, the papillæ being supported each by a group of hooks, generally 3—6 in each papilla (Fig. 62). When the skin is very much distended, the papillæ are indistinct, but the arrangement of the sigmata in groups remains distinct enough. Sometimes, in the larger specimens, the hooks are very scarce in the anterior part of the body, the papillæ here having only one hook or none at all. Along the radii the hooks generally are more numerous and may form a close series, less distinctly arranged in groups, along each side of the radial muscle. Size of the hooks ca. 0.08—0.14 mm; their shape not especially characteristic. In the dorsal interradii numerous wheels are found scattered, in the Plimmerton specimens. In the larger specimens from Auckland Harbour and Stewart Island they are much more scarce; in one of them I have discovered only one single wheel, even abnormal in structure. The size of the wheels varies considerably, from 0.04 to 0.1 mm, samples of these various sizes being found especially among one another in the posterior end of the body in one of the Plimmerton specimens. The rim of the inner margin of the wheel with some 100 teeth, as in the wheels of *Chiridota nigra* and *carnleyensis* from which they do not differ noticeably. The spicules of the tentacles bifid in the ends (Fig. 63.a).

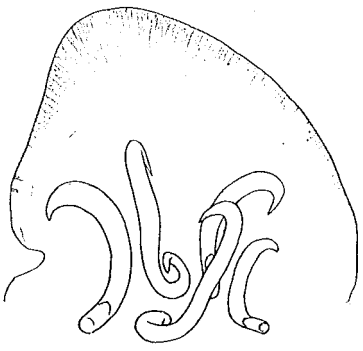
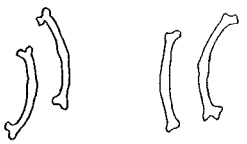


Fig. 62. Papilla with hooks of *Trochodota Dendyi*. 160/1.

The calcareous ring not very solid, the pieces being easily split in hypochlorite of sodium. A distinct notch in the hind edge of each piece; radials imperforate (Fig. 59.a). The radial muscles with a distinct retractor-part, connected with the body wall through a membrane of connecting tissue, looking, in well extended specimens, like a sort of mesentery. Oesophagus rather short, without a muscular swelling. The alimentary canal straight, without any loop; it is somewhat



a b.

Fig. 63. Spicules from tentacles of *Trochodota Dendyi* (a) and *Kolostoneura novæ-zealandiæ* (b). 275/1.

folded. There is 1 Polian vesicle and 1 stone canal. Ciliated funnels (Fig. 60.a) only in the right dorso-lateral interradius, where they are arranged in a close series along the ventro-lateral radial muscle. Gonads a few slightly branched, very long tubes, which fill up the body cavity nearly to the end of the intestine. The genital duct opens upon a small papilla between the bases of the dorsal tentacles. The eggs are very small (ca. 0.01 mm) and very numerous which indicates that this species may probably have a typical pelagic larva (Auricularia).

The three localities: Auckland Harbour, Plimmerton and Stewart Island, indicate rather certainly that the species is distributed along all the coasts of New Zealand.

Evidently this species is nearly related to *Trochodota japonica* (v. Marenz.), and since the latter species is recorded from Port Jackson, the suggestion lies at hand that they might be identical. This they are, however, not. Having myself collected some specimens of the species in question, I have been able to undertake a direct comparison between the New Zealand and the Port Jackson specimens; the result is that they can by no means be regarded as identical. The Port Jackson species differs from the New Zealand species in its colour, in the more numerous sigmata in the papillæ, in the digits of the tentacles being all nearly of the same, considerable length, in the spicules of the tentacles being very scarce and not divided at the ends. A closer study of its anatomy may disclose more points of difference, but what has been pointed out already will suffice to show definitely that the two forms are not identical. I also doubt very much whether the Port Jackson species is really identical with *Trochodota japonica*, but as I have no material for comparison of the Japanese form, I shall not try to decide this question, which does not concern us directly here.

I dedicate this new species, which represents a very interesting addition to the New Zealand fauna, to the late Professor Dendy, to whose studies we owe most of our knowledge of New Zealand Holothurians.

26. *Kolostoneura novæ-zealandiæ* (Dendy & Hindle).

Rhabdomolgus novæ-zealandiæ. Dendy & Hindle. 1907. Add. Knowl. N. Z. Holoth. J. Linn. Soc. Zool. XXX. p. 113. Pl. 11.1—4. Pl. 13.16—17. Pl. 14.22—29.

Kolostoneura novæ-zealandiæ. S. Becher. 1909. Die systematische Stellung des *Rhabdomolgus novæ-zealandiæ*. Arch. Zool. expér. & génér. (5) I. Notes & Revue. p. XXXIII—XLIII.

— — H. L. Clark. 1921. Echinoderms of the Torres Strait. Dep. Mar. Biology. Carnegie Inst. Washington. X. p. 164.

Akaroa Harbour; under stones, at low water. 14/XII. 1914. 4 specimens.
Plimmerton; — — 15/1. 1915. 18 specimens
Takapuna Beach, Auckland. — 23/XII. 1914. 1 specimen.
Stewart Island. 1908. 1 specimen (received from Professor Benham).

The largest of the specimens in hand measures 8 cm in length, corresponding thus very well to the estimate of the size of the living animal given by Dendy & Hindle. (The specimen is preserved in a very well extended state.)

To the very careful description given by Dendy & Hindle I have only little to add. An important fact is that the tentacles contain, almost constantly, calcareous spicules[1]) of the usual form Fig. 63.b; only in two specimens I was unable to find any; in some specimens they are fairly numerous. — In the preserved specimens the posterior end rather commonly is found to be somewhat swollen and the cloaca evaginated, which makes these specimens look rather peculiar, *Edwardsia*-like. The ciliated funnels may be very scarse or even wanting along the mesentery. Dendy & Hindle state them to occur also on the longitudinal muscle-bands, without stating more exactly on which of them. I have found them to occur along the right side of the mid-ventral and along the upper side of the left latero-ventral muscle. There is a distinct retractor part of the usual shape, the elevated part of the muscle beginning at about a centimeter's distance from the anterior end. — The eggs are small, ca. 0.1 mm, which may indicate that this species has a true pelagic larva. — Two of the specimens from Plimmerton are infested with an ectoparasitic snail.

The new localities given here, together with those given by

1) This fact has some practical importance, the existence of spicules in the tentacles giving definite proof that the absence of spicules in the body wall of such specimens is not due to the preserving fluid having been acid and thus caused their disappearance.

Dendy & Hindle, indicate that this species is distributed, like the preceding species, all round the coasts of New Zealand.

I fully agree with Becher that this species is no true *Rhabdomolgus*. H. L. Clark expresses the opinion that it is derived from *Trochodota* by loss of the wheels and the sigmata. I think it beyond doubt that Clark is right in this suggestion, and I can give some proof of its correctness. In the specimen from Takapuna Beach, which I am otherwise unable to distinguish from the Plimmerton specimens, I have found a few hooks in the skin. In one of the two specimens from Plimmerton, infested with parasitic snails, I even find both hooks and wheels. Now, this specimen is a very small one and in a very poor condition, perhaps because of the parasites, and the identification is not certain; but as it does not at all look like the specimens of *Trochodota Dendyi,* found at the same locality, I think it rather probable that it is really a specimen of *Kolostoneura* which has, through the influence of the parasites, developed the calcareous bodies of its ancestor.

If, then, we have a separate genus, *Anapta,* for the Synaptas without anchors, another genus, *Achiridota,* for the Chiridotas without wheels, we should, consequently, have a separate genus also for the Trochodotas without hooks or wheels, and we must there accept the name *Kolostoneura*, proposed for it by Becher, even if we may regret that he did not use the name analogous to *Anapta* and *Achiridota* which he had first planned to use, *Asigma*, but one which does not a priori convey any idea at all of its relationships. The name *Kolostoneura* refers to the statement of Dendy & Hindle that the radial nerve disappears even before reaching the level of the calcareous ring. But I cannot help expressing some doubt as to the general validity of this statement; at least, I find in some sections from the middle of the body of a specimen of *Kolostoneura* the radial nerve quite distinct in places, such sections recalling very much the fig. 18, Taf. II of Hamann's" Histologie d. Echinodermen", which shows a transverse section of the body wall, with the radial nerve, of *Synapta (Labidoplax) digitata*. It has very much the appearance that the nerve lies within the layer of circular muscles, with muscular substance both externally and internally to the nerve; this might well account for the fact, that the nerve is quite indistinct in places. I must content myself with these indications, this

being not the place for a detailed study of the finer structure of the nervous system, for which my material is also quite insufficient. But, evidently, here are some problems which might well deserve being taken up for a closer investigation.

V. Crinoidea.

No Crinoid was known from New Zealand seas, until in 1916 A. H. Clark[1]) made known a species found by Mr. Percy Seymour in Preservation Inlet, on the West Coast of the South Island, which was sent him for determination by Professor Benham. It was named *Comanthus trichoptera benhami,* being regarded by Dr. Clark as representing merely a variety of the Australian species *Comanthus trichoptera* (Joh. Müller).

During the author's investigations in New Zealand seas another Crinoid was obtained off Three Kings Island, and specimens of a third species were obtained from Captain Bollons, who had dredged them in the same region. Specimens of these two forms were also submitted to Dr. A. H. Clark, who described them as *Comanthus novæ-zealandiae* and *Argyrometra mortenseni.*[2])

For the present then only these three species (— *Comanthus benhami* being later on thought by Dr. Clark to be entitled specific rank —) are known to occur in New Zealand seas. That more species will ultimately be found there can hardly be doubted; especially the deeper parts of Cook Strait and the Sea off North Cape and Three Kings Islands may be expected to yield a rich harvest, also in Crinoids.

I shall give here some figures and a few supplementary remarks on two of these species, *Comanthus benhami* being available only in one specimen in a very poor condition, lent me by Prof. Benham.

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1) A. H. Clark. The first New Zealand Crinoid. Proc. Biol. Soc. Washington. XXIX. 1916. p. 48.

2) A. H. Clark. A new Crinoid from New Zealand, and another from Tasmania. Ibidem. XXXI. 1918; p. 41.
A. H. Clark. A revision of the Crinoid family Antedonidæ, with the diagnoses of nine new genera. Journ. Washington Acad. Sci. VII. 1917. p. 127.

1. *Comanthus novæ-zealandiæ* A. H. Clark.

(Figs. 64.a—b; 65.a—c).

Comanthus novæ-zealandiæ. A. H. Clark. 1918. A new Crinoid from New Zealand, and another from Tasmania. Proc. Biol. Soc. Washington. 31. p. 42.

Off Three Kings Islands, 65 fms; hard bottom. 5/I. 1915. 6 specimens.

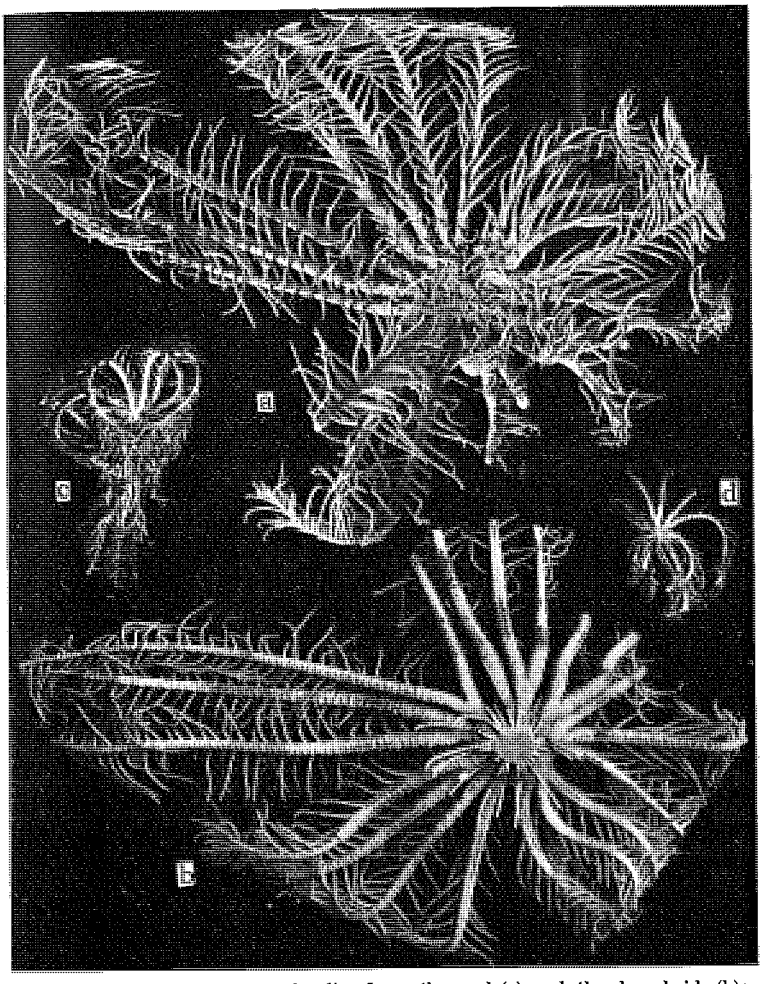

Fig. 64. *Comanthus novæ-zealandiæ*, from the oral (a) and the dorsal side (b); *Argyrometra mortenseni*, side view (c) and from the dorsal side (d). Nat. size.

While the number of arms is, evidently, normally 20, one of my specimens has only 18, two only 19 arms. The figures 65.a—c show the peculiar serration of the pinnules.

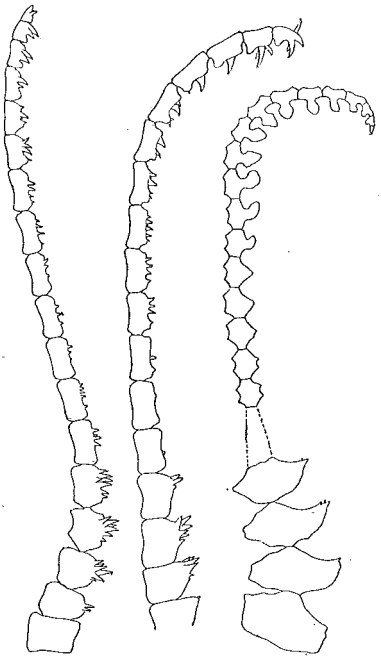

Fig.65. *Comanthus novæ-zealandiæ*; genital pinnules (a—b) and oral pinnule (c); the latter shows only the basal and outer joiuts, 16 joints having beeu omitted in the middle. $^{15}/_{1}$.

The number of the arms, 18—20, makes this species easily distinguishable from the otherwise very similar *Comanthus Benhami*, which has ca. 30 arms. (The type specimen had 28, the specimen lent me by Prof. Benham had probably 38 arms.

2. *Argyrometra mortenseni* A. H. Clark.

(Figs. 64.c—d ; 66)

Argyrometra mortenseni. A. H. Clark. 1917. A Revision of the Crinoid family Antedonidæ. Journ. Wash. Acad. Sc. VII. p. 129.

Off North Cape, 60 fms. 5 specimens (Captain Bollons).
Off Three Kings Isl., 95 fms. 2 specimens (Captain Bollons).

The figures give sufficient information about the general features of this species. It may be pointed out that the number of

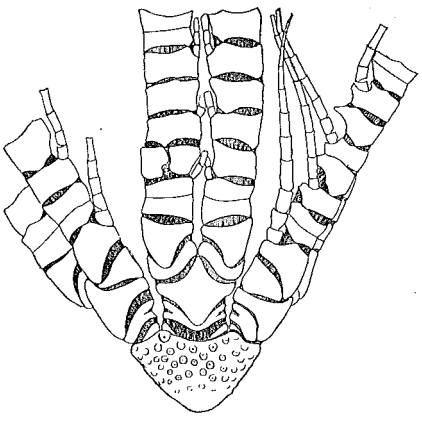

Fig. 66. *Argyrometra Mortenseni.* $^6/_1$.

joints in the first pinnules is not constantly 12, as given in the original description. One may find 8 joints in the first, 10 in the second pinnule; the number of joints in the cirri is generally 12—16, the number 17 given in the original diagnosis is more rarely met with.

On one of the specimens from 95 fms two Myzostomas were found.

Appendix.

Goniocidaris umbraculum (Hutton). In the "New Zealand Journ. of Sci. & Technology" Vol. VII.3. p. 189 (Sept. 1924) Maxwell Young has published a note on the "Occurrence of the Echinoderm Goniocidaris umbraculum Hutton" in which he records numerous specimens from E. N. E. off Otago Heads, 60 fathoms. His statement that "the species has previously been recorded from Foveaux Strait and Stewart Island" seems to show that he has not seen my report on the New Zealand Echinoidea, in which the species is recorded also from the Cook Strait (p. 146). Had he seen that report, he would probably also have avoided turning his specimens upside down, as he has evidently done, since he states that the spines "on top are of the usual shape, but the ones on the underside are dilated at the tip so as to form a concave terminal disc".

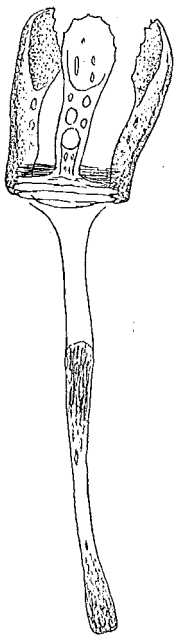

Fig.67. Tridentate pedicellaria of *Echinocyamus polyporus*. 200/1.

Echinocyamus polyporus Mrtsn. In my description of this species I was unable to give any information about the characters of the spines and pedicellariæ, all my specimens being naked tests. Professor Benham having since then sent me a pair of alcoholic specimens, I can here supply some of the information lacking.

The spines are not very characteristic. The primary spines are clubshaped, very nearly smooth, ca. 0.5 mm long. Those near the peristome and the periproct are elongated, c. 1.5 mm long, slender, slightly curved. The miliary spines have a smooth crown, or there may be a faint indication of serrations. — Of the pedicellariæ I have only succeeded in finding the tridentate form (Fig. 67); the valves are narrow, the blade closed in the lower half; the edge of the outer, open part faintly dentate.

Clypeaster virescens Döderlein. According to the kind information of my friend H. Lyman Clark there are in the British Museum

2 fine specimens of this species from off New Zealand, collected by the "Terra Nova" Expedition; they were forgotten in Bell's report. The species was recorded from the N. S. Wales Coast in H. L. Clark's report on the "Endeavour" Echinoderms (p. 119); its occurrence in New Zealand seas is thus not so very surprising.

Echinobrissus recens (M. Edw.)[1]) H. L. Hawkins has recently established a new genus *Apatopygus* for this species, in a very interesting and important paper[2]) which was not, and, on account of the rather exasperating state of scientific records of those years immediately after the great war, hardly could be known to me by the time my paper on the New Zealand Echinoids was published. While I fully agree with Hawkins that the New Zealand species cannot be referred to the genus *Oligopodia* to which it was referred by H. L. Clark, but must form a separate genus, I am not so very glad to adopt the name *Apatopygus* instead of *Echinobrissus*. It may be that according to the rules of nomenclature the name *Echinobrissus* does not rightly belong to the New Zealand species, *E. recens;* but this seems to me to be a case where exemption from the rules might be desirable. Accordingly, in order both to call attention to the name proposed by Hawkins and to keep in mind the old name I shall for the present designate the New Zealand species *Apatopygus (Echinobrissus) recens.*

Ophiomyxa brevirima H. L. Clark. The statement that this species is viviparous is given (Ophiuroidea, p. 97 and 113) as a new discovery. In fact, this was observed as long ago as 1898 by Farquhar (On the Echinoderm fauna of New Zealand. Proc. Linn. Soc. N. S. Wales. 1898. p. 303), which I had overlooked.

In the same place Farquhar also makes the statement about **Pectinura cylindrica** that it is viviparous. I must confirm this statement, and, furthermore, I find that also **Pectinura gracilis** is viviparous. In both species only a single young is found at a time in a bursa, and apparantly only in some of the bursae, not in all of them, at the same time. Both species likewise are

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1) In the paper on the Echinoidea (p. 184) the author-name has been misprinted as (Mr. Edw.)

2) H. L. Hawkins. Morphological Studies on the Echinoidea Holectypoida and their Allies. X. On Apatopygus gen. nov. and the affinities of some recent Nucleolitoida and Cassiduloida. Geol. Magaz. LVII. 1920. p. 393.

hermaphroditic. In *P. cylindrica* there is a single ovary at the distal end of the bursal slit, at the adradial side, and one or two testes at the proximal end of the slit, at the abradial side. In *P. gracilis* there are 1—3 genital organs at the adradial and a series of upto 6 along the abradial side of the slit; it appears that the ovaries and testes occur among one another, without definite order.

The eggs seem to be remarkably small for viviparous Ophiurids, only ca. 0.25 mm — but the eggs observed may possibly not be so nearly ripe, and thus may perhaps grow to a somewhat larger size, before they are ripe.

It is a highly interesting fact that thus no less than three new viviparous and hermaphroditic Ophiurans: *Amphiura annulifera* and the two *Pectinura*-species, have been discovered among the New Zealand Ophiurids, against only one, *Ophiomyxa brevirima*, with separate sexes. This fact greatly emphasizes the relation between viviparity and hermaphroditism that the author has previously shown to exist in Ophiurids ("On Hermaphroditism in viviparous Ophiuroids". Acta Zoologica. I. 1920).

Ophioplocus Huttoni Farquhar. In his report on the Ophiuroids of the Australasian Antarctic Expedition (Vol. VIII.2. 1922. p. 47) Koehler has established, for an antarctic species, *O. incipiens* Koehler, the genus *Ophioceres*, related to *Ophioplocus* but differing from the latter genus in the breaking up of the dorsal plates being not carried so far, and in the presence of only one tentacle papilla. To this genus he also refers the New Zealand species, evidently with full right. The name of the New Zealand species will then be *Ophioceres Huttoni* (Farquhar).

In February—April 1924 the Swedish Zoologist Sten Vallin, partaking in a Whaling-Expedition to the Antarctic Sea, had the opportunity of collecting some Echinoderms also at Campbell Island (Perseverance Harbour) and at Stewart Island (Paterson Inlet). These specimens were kindly placed at my disposal by my friend Professor O. Carlgren, Lund. Besides the very interesting new Holothurian, *Psolidiella nigra*, described above, the collection proved to contain nothing of special importance. The species collected were the following:

Campbell Island: *Calvasterias lævigata* (Hutton), *Henricia lukinsii* (Farquhar), *Amphioplus basilicus* (Koehler), *Cucumaria leoninoides* Mrtsn.

Stewart Island: *Asterina regularis* Verrill, *Calvasterias Suteri* (de Loriol), *Coscinasterias calamaria* (Gray), *Ophionereis fasciata* Hutton, *Amphipholis squamata* (D. Ch.), *Pectinura maculata* (Verrill), *Pect. gracilis* Mrtsn., *Psolidiella nigra* Mrtsn.

In the Narrative of his Fiji—New Zealand Expedition (Univ. of Iowa Studies. Studies in Natural History. X. Nr. 5. 1924, p. 206—8) Professor C. C. Nutting mentions some Echinoderms dredged in the Hauraki Gulf. It would appear that there is a new Comatulid, perhaps also a new Asteroid (apparently allied to *Pentagonaster pulchellus*) and an Ophiurid "with a leathery disk" allied to *Ophiocoma*. Although nothing definite can be said about these forms from the brief preliminary mention given in the narrative quoted, I have thought it proper to call attention here to these presumable additions to the New Zealand Echinoderm fauna.

Zoogeographical remarks on the Echinoderm fauna of New Zealand and the Auckland-Campbell Islands.

It may be practical to begin this chapter on the zoogeographical relations of the New Zealand Echinoderm fauna with a list of all the species known with certainty to occur in New Zealand seas, with a tabellaric view of their distribution.

As appears from this list no less than 98 of the total number of 119 species known from New Zealand seas, or 82.4 %, are not known to occur outside the New Zealand area, taken in a wider sense so as to include, besides the Chatham and Auckland-Campbell Islands, also the Macquarie and Kermadec Islands. This truly astonishing high percentage of endemic forms most probably will ultimately be somewhat reduced, partly, because it is to be expected that some of the species hitherto known only from the deeper water off the North of the

List of the Echinoderms of New Zealand and the Auckland-Campbell Islands.

Name	New Zealand				Auckland Isl.	Campbell Isl.	Chatham Isl.	Kermadec Isl.	Australia	Macquarie Isl.	Magellanic Region	Remarks
	North Isl.	Cook Str.	South Isl.	Stewart Isl.								
1. *Goniocidaris umbraculum* (Hutton)		+	+	+								
2. *Ogmocidaris Benhami* Mrtsn.	+								+			
3. *Arœosoma thetidis* (H. L. Clark)	+		+	+		+				+		
4. *Notechinus novæ-zelandiæ* Mrtsn.												
5. *Pseudechinus albocinctus* (Hutton)	+	+	+	+								
6. — *Huttoni* Benham			+	+								
7. — *variegatus* Mrtsn	+											
8. — *grossularia* (Studer)	+								+			
9. *Holopneustes inflatus* Ltk.	+											
10. *Evechinus chloroticus* (Val.)	+	+	+	+				+	+			
11. *Heliocidaris tuberculata* (Lamk.)	+							+				
12. *Echinocyamus polyporus* Mrtsn.		+							+			
13. *Clypeaster virescens* Döderlein	+											
14. *Arachnoides zelandiæ* Gray	+	+							+			Identification not beyond doubt.
15. *Laganum depressum* (Ag.)	+											
16. *Peronella hinemoæ* Mrtsn	+											
17. *Apatopygus (Echinobrissus) recens* (M. Edw.)		+		+								
18. *Echinocardium australe* Gray	+	+	+	+					+			
19. *Brissopsis zealandiæ* Mrtsn.	+											
20. *Ophiocreas constrictum* Farquh.			+						+			
21. — *longipes* Mrtsn.	+								+(?)			
22. *Astrotoma Waitei* Benham			+									
23. — *Benhami* Bell	+											
24. *Astroporpa Wilsoni* Bell	+											
25. *Astroceras elegans* (Bell)	+											Typical form in the magellanic region.
26. *Gorgonocephalus chilensis*, var. *novæ-zelandiæ* Mrtsn.		+										
27. *Ophiomyxa brevirima* H. L. Cl.	+	+	+	+	+							

28. *Ophiacantha vilis* Mrtsn.		+											
29. *Ophiothrix aristulata* Lym.	+									+			Also Malay Archipelago.
30. — *Oliveri* Benham	+												
31. *Ophiocormus notabilis* H. L. Cl.		+											
32. *Ophiocoma Bollonsi* Farquh.	+	+							+				
33. *Ophiopteris antipodum* E. A. Sm.	+	+											
34. *Ophiactis resiliens* Lym.	+	+								+			
35. — *hirta* Lym.		+								+			
36. — *profundi* var. *novæ-zealandiæ* Mrtsn.	+	+											Typical form probably all over the Pacific.
37. *Amphiura magellanica* Ljg.		+	+	+	+						+		
38. — *spinipes* Mrtsn.	+												
39. — *præfecta* Koehler					+	+							
40. — *aster* Farquh.	+	+	+										
41. — *noræ* Benham	+					+							
42. — *eugeniæ*, var. *latisquama* Mrtsn.	+												Typical form in the magellanic region.
43. — *rosea* Farquh.	+	+	+	+									
44. — *amokuræ* Mrtsn.	+		+			+							
45. — *alba* Mrtsn.	+												
46. — *hinemoæ* Mrtsn.	+												
47. — *annulifera* Mrtsn.	+												
48. — *pusilla* Farquh.		+	+										
49 *Amphiocnida pilosa* (Lym.)	+									+			
50. *Amphioplus basilicus* (Koehler)			+		+	+							
51. *Ophionephthys stewartensis* Mrtsn				+									
52. *Amphipholis squamata* (D. Ch.)	+	+	+	+	+				+	+			Cosmopolitan.
53. *Ophionereis fasciata* Hutton)	+	+	+	+			+[1]		+[1]				[1] Probably this species.
54. *Ophiozonoida picta* H. L. Clark	+	+											
55. *Ophioceres (Ophioplocus) Huttoni* (Farquh.)	+	+											
56. *Pectinura cylindrica* (Hutton)	+	+					+						
57. — *gracilis* Mrtsn.		+		+									
58. — *maculata* Verr.		+	+	+			+						

Name	New Zealand				Auckland Isl.	Campbell Isl.	Chatham Isl.	Kermadec Isl.	Australia	Macquarie Isl.	Magellanic Region	Remarks
	North Isl.	Cook Str.	South Isl.	Stewart Isl.								
59. *Astropecten polyacanthus* M. Tr.	+	+							+			All over the Indo-Pacific.
60. — *dubiosus* Mrtsn.	+											
61. — *primigenius* Mrtsn.	+											
62. *Psilaster acuminatus* Sladen	+	+	+						+			? South Africa.
63. *Luidia varia* Mrtsn.	+											
64. — *neozelanica* Mrtsn.	+											
65. *Pentagonaster pulchellus* Gray	+	+	+	+			+					
66. *Diplodontias dilatatus* E. Perr.	(?)		+									
67. *Asterodon miliaris* (Gray)	+	+	+	+								
68. *Mediaster Sladeni* Benh.			+									
69. *Peridontaster Benhami* Mrtsn.			+	+								
70. *Eurygonias hylacanthus* Farquh.		+										
71. *Nectria pedicelligera* Mrtsn.	+											
72. *Ophidiaster kermadecensis* Benh.	+							+				
73. *Asterina regularis* Verr.	+	+	+	+								
74. — *aucklandensis* Koehler					+							
75. *Stegnaster inflatus* (Hutton)	+	+	+									
76. *Echinaster Farquhari* Benh.			+									
77. *Henricia lukinsii* Farquh.					+	+						
78. — *compacta* (Sladen)	+	+			+		+					
79. — — var. *aucklandiæ* Mrtsn.					+	+						
80. *Calvasterias Suteri* (Loriol)			+	+	(+)					(?)		
81. — *lævigata* (Hutton)					+	+						
82. *Stichaster australis* (Verr.)	+		+									
83. *Allostichaster polyplax* (M. Tr.)	+	+	+	+			+		+			
84. — *insignis* (Farquh.)	(?)	+	+	+	+							
85. *Sclerasterias mollis* (Hutton)			+									
86. *Astrostole scabra* (Hutton)	+	+	+									
87. *Coscinasterias calamaria* (Gray)	+	+	+	+					+			*All over the Indo-Pacific.*

87. *Goschasterias calamaria* (Gray)	+	+	+	+						+				*All over the Indo-Pacific.*
88. *Stichopus mollis* (Hutton)	+	+	+	+						+				
89. *Holothuria neozelanica* Mrtsn.	+													
90. *Cucumaria brevidentis* (Hutton)	+		+	+	+	+		+						
91. — — var *carnleyensis* Dendy				+	+	+					(?)			
92. — *calcarea* Dendy	+	+		+								+[1]		[1] Juan Fernandez
93. — *leoninoides* Mrtsn.					+	+								
94. — *amokuræ* Mrtsn.				+	+									
95. — *Farquhari* Mrtsn.	+													
96. — *Bollonsi* Mrtsn.	+													
97. — *alba* (Hutton)	+	+	+	+										
98. — *ocnoides* Dendy		+	+											
99. — *Huttoni* Dendy			+											
100. *Phyllophorus longidentis* (Hutton)	+	+	+											
101. — *dearmatus* Dendy & Hindle		+	+							+				
102. *Pseudocucumis Thomsoni* (Hutton)				+										
103. — *bicolumnatus* Dendy & Hindle			+											
104. *Pseudopsolus macquariensis* (Dendy)				+[1]							+			[1] Locality perhaps not wholly reliable.
105. *Psolidiella nigra* Mrtsn.				+										
106. *Psolus neozelanicus* Mrtsn.	+													
107. *Caudina coriacea* (Hutton)	+	+												
108. *Molpadia Marenzelleri* Théel	+													
109. — *Dendyi* Benham			+											
110. *Protankyra uncinata* (Hutton)	+	+												
111. *Chiridota gigas* Dendy			+					+		+				
112. — *nigra* Mrtsn.				+	+									
113. — *carnleyensis* Mrtsn.					+									
114. *Trochodota dunedinensis* (Parker)			+	+	+									
115. — *Dendyi* Mrtsn.	+			+										
116. *Kolostoneura novæ-zelandiæ* (Dendy & Hindle)	+		+	+										
117. *Comanthus Benhami* A. H. Cl.			+											
118. — *novæ-zelandiæ* A. H. Cl.	+													
119. *Argyrometra Mortenseni* A. H. Cl.	+													

North Island (especially off Three Kings Island) will prove to have a wider distribution (Australia), partly, because several of the species described in these papers are small and inconspicuous forms which are easily overlooked by collectors (e. g. the small Amphiurids). On the other hand, such reduction in the number of endemic species will probably be counterbalanced to some degree by the finding of new endemic species, as we may well feel sure that the list of New Zealand Echinoderms is still rather far from complete; even among the littoral forms new species are to be expected, not to speak of those of the deeper waters off the North end of the North Island or of the Cook Strait. But even allowing for a not inconsiderable reduction in the percentage of endemic forms a large number of characteristic forms remain which are not likely ever to be found outside the New Zealand area. As such I would especially name the following:

Goniocidaris umbraculum
Pseudechinus albocinctus
Notechinus novæ-zealandiæ
Evechinus chloroticus
Arachnoides zelandiæ
Apatopygus (Echinobrissus) recens
Ophiomyxa brevirima
Ophiocoma bollonsi
Ophiopteris antipodum
Ophioceres Huttoni
Pectinura cylindrica
— maculata
Astropecten primigenius
Pentagonaster pulchellus
Diplodontias dilatatus
Asterodon miliaris
Eurygonias hylacanthus
Asterina regularis
— aucklandensis
Stegnaster inflatus
Calvasterias Suteri
— lævigata
Stichaster australis
Sclerasterias mollis
Astrostole scabra
Cucumaria brevidentis
— leoninoides
— alba
— ocnoides
Kolostoneura novae-zealandiæ

This long list of highly characteristic forms bears testimony of the immense time during which New Zealand has been isolated. Especially the Echinoid *Apatopygus (Echinobrissus) recens*, the direct descendant of a group that flourished and was of worldwide distribution in Jurassic and Cretaceous times, in recent time known alone from New Zealand seas[1]), is of the greatest interest, a not

1) The record of its occurrence at Madagascar must be regarded as perfectly unreliable, resting probably on wrong labelling in old collections.

unworthy parallel to the Tuatara *(Hatteria)* among the land animals of New Zealand. Also *Astropecten primigenius*, the most primitive of all Astropectens, is highly interesting as, evidently, representing a survival from very remote times.

Among the genera endemic in the New Zealand region I would point out as the more important, besides *Apatopygus: Pseudechinus* and *Evechinus*. Especially interesting is *Pseudechinus*, which has developed into a rather flourishing group of no less than four species. As stated in the report on the Echinoidea (p. 167) it is not improbable that a fifth species of the genus occurs in the Australian seas, which probably means that the group has spread from its original home, the New Zealand seas, into the Australian seas, not inversely.

In the "Subantarctic Islands of New Zealand" the number of Echinoderms recorded from the Auckland—Campbell Islands amounts to 8; through the author's researches the number is now raised to 19 species, given in the following list. (The letters A = Auckland Isl., and C = Campbell Isl., indicate from which of these islands each species is known).

Notechinus novæ-zealandiae (C.)
Ophiomyxa brevirima (A.)
Amphiura magellanica (A.)
— præfecta (A. C.)
— amokuræ (C.)
Amphioplus basilicus (A. C.)
Amphipholis squamata (A.)
Henricia lukinsii (A. C.)
— compacta, var. aucklandica (A.)
Asterina aucklandensis (A.)
Calvasterias lævigata (A. C.)
Allostichaster insignis (A.)
Cucumaria brevidentis (A.)
— — var. carnleyensis (A. C.)
— leoninoides (A. C.)
— amokuræ (A.)
Chiridota nigra (A.)
— carnleyensis (A.)
Trochodota dunedinensis (A.)

Of these 19 species 8, or 42 %, are endemic; of the rest of them 9 are otherwise known only from New Zealand, while one, *Amph. magellanica*, occurs also in the Magellanic region and another, *Amph. squamata,* is cosmopolitan. These facts show that, at least as far as the Echinoderms are concerned, the Auckland-Campbell Islands have no nearer relation to any other region than New Zealand, the sole species *Amphiura magellanica* not being of sufficient weight for proving a nearer relation to the Magellanic region, as this species may very easily have been transported on floating algæ.

Very probably several of the endemic species will ultimately be found to occur also at New Zealand (especially Stewart Island); but it would seem very likely that some of them, e. g. *Asterina aucklandensis, Calvasterias lævigata,* and probably also *Amphiura præfecta* and *Cucumaria leoninoides,* are truly endemic. Anyhow, the fact that this small area possesses endemic forms is most interesting, especially in view of the direct connection with New Zealand wich must have existed in the earlier Tertiary. That the very marked climatic conditions of these islands must have played an important role in the development of this endemic Echinoderm fauna can scarcely be doubted. Thus, we can well imagine that the two species of *Calvasterias,* the New Zealand *C. Suteri* and the Auckland-Campbell species *C. lævigata,* have developed from a form originally inhabiting the whole of the Southern part of the greater New Zealand continent. On the other hand species like *Asterina aucklandensis, Amphiura præfecta* and *Cucumaria leoninoides* have no close relation to any New Zealand species and may be supossed to have developed from forms inhabiting only the Southern coasts of the greater New Zealand continent.

The fact that only 8 species have been found at Campbell Island is probably due to this island being less accessible for investigations outside Perseverance Harbour. The difference in the number of species recorded from the two islands, therefore, has hardly any deeper zoogeographical meaning. The two species known alone from Campbell Island, *Notechinus novæ-zealandiæ* and *Amphiura amokuræ,* will, no doubt, prove to occur also at the Auckland Islands, since they are found also at New Zealand.

I may take the opportunity of mentioning in this connection that I found the New Zealand Enteropneust, *Dolichoglossus otagoensis* Benham — hitherto recorded only from the Otago coast, but occurring also at Island Bay, Wellington — in great numbers at the Auckland Islands, living among the leaves or crusts of *Melobesia antarctica* (Hook. & Harv.) on the steep rock wall of Masked Island, Carnley Harbour. This most interesting locality, upon the whole, is the home of a very rich animal community. The most conspicuous species is the beautiful red *Cucumaria brevidentis,* var. *carnleyensis,* which protrudes among the pale pink leaves of the alga, resembling strawberries. Very numerous,

but less conspicuous because of their dull colour, or because they live wholly concealed among the leaves of the alga, are *Cucumaria brevidentis* (the typical form), *Cuc. leoninoides*, *Amphiura magellanica*, *præfecta*, *Ophiomyxa brevirima*, *Henricia lukinsii*, *Trochodota dunedinensis*, various worms, e. g. *Steggoa brevicornis*, *Nereis australis*, *N. Mortenseni*, *Podarke angustifrons*, *Lumbriconereis magelhaensis*, *Polycirrus kerguelensis*, several Syllids.[1]) Also various small Crustaceans and some Actinians *(Edwardsia tricolor, Condylanthus aucklandicus).*[2]) Evidently, this luxurious growth of *Melobesia* thus offers a favourite place — perhaps no less a hiding place than a feeding ground — for a great variety of smaller animals. However, hardly any of these forms is exclusively bound to the Melobesia-locality, not being so specially adopted to life among the Melobesia-leaves as to be unable to thrive in other localities.

The Echinoderm fauna of Macquarie Island is still very insufficiently known; only as regards the Asteroids we have got some better information through the researches carried out there in 1913 by Mr. A. Hamilton as member of a research party left on the island by Sir Douglas Mawson, the leader of the Australasian Antarctic Expedition. In his Report on the Asteroidea of the said expedition R. Koehler records the following 6 species of sea-stars from Macquarie Island:

Sporasterias antarctica (Lütken)	Parastichaster sphærulatus Koehler
Parastichaster directus Koehler	Asterina Hamiltoni Koehler
— Mawsoni Koehler.	Cycethra macquariensis Koehler.

Benham ("Subantarctic Islands of New Zealand", p. 302) has recorded also *Calvasterias (Stichaster) Suteri* from Macquarie Island, likewise collected by Mr. Hamilton during a previous visit to the island. According to Koehler (Op. cit.) this is probably a mistaken identification of the species described by him as *Parastichaster Mawsoni*. — While it appears that no Ophiurids were collected at the Macquarie Island by Mr. Hamilton — at least none

[1]) H. Augener. Polychaeta von den Auckland-Campbell Inseln. "Papers from Dr. Th. Mortensen's Pacific Expedition". Nr. XIV.

[2]) O. Carlgren. Actiniaria from New Zealand and its Subantarctic Islands. "Papers from Dr. Th. Mortensen's Pacific Expedition". Nr. XXI.

are recorded in Koehler's work on the Ophiuroidea of the Australian Antarctic Expedition — I have been able to state the occurrence at the Macquarie Island of *Notechinus novæ-zealandiæ* (Echinoidea, p. 157). A Holothurian, *Pseudopsolus macquariensis*, was described from there by Dendy, and in the present paper is further recorded — though with some doubt as to the correctness of the locality — *Cucumaria brevidentis*, var. *carnleyensis*, while inversely *Pseudopsolus macquariensis* is recorded, likewise with some doubt as to the correctness of the locality, from Stewart Island.

Of these 8 species of Echinoderms thus far known from Macquarie Island at least five are endemic, three of them even belonging to an endemic genus. One, *Notechinus novæ-zealandiæ*, is widely distributed in the New Zealand region, another, *Sporasterias antarctica*, occurs in the Magellanic region, while a third species, *Cycethra macquariensis*, belongs to a genus characteristic of the Magellanic region, not represented in the New Zealand region proper. These facts bear testimony against any closer relation between the Macquarie Island and New Zealand, at least as far as their Echinoderm faunas are concerned. The occurrence of *Notechinus* also at Macquarie Island is very easily explained through the transport of the pelagic larvæ — its eggs are very numerous and small, only 0.08 mm, which proves beyond any doubt that it must have pelagic larvæ —, a transport which would hardly be impossible in recent times and still less so during the period of elevation of the great New Zealand Plateau in early Tertiary times, when the distance was considerably smaller. Also the — still somewhat problematic — existence of *Pseudopsolus macquariensis* at Stewart Island and *Cucumaria brevidentis*, var. *carnleyensis* at Macquarie Island is easily explained as being due to transport on floating algæ. Benham, it is true, has thrown doubt on the possibility of such transport. "Any one who has had experience of the size and tremendous power of the waves in these southern latitudes, and of the terrific windstorms that constantly rage over these seas, will be in a position to recognize the high degree of improbability that seaweed could be carried from island to island by the "West-wind trift" without being torn into fragments". (Report on the Oligochæta. Subantarct. Isl. of New Zealand. I. p. 294). I may object to this statement my own direct observations on various Echinoderms, a. o. Invertebrates,

being actually found, alive, among the roots of such algæ *(Macrocystis, Lessonia)* found floating in the sea or cast ashore *(Calvasterias Suteri, Ophiomyxa brevirima, Cucumaria leoninoides);* it is quite probable that the leaves of these large algæ, when drifting in these exceedingly rough seas, will not stand a very long transport but be torn to pieces by the waves, as Benham suggests; but it is not on the leaves that the animals are living, but among or within the roots, and these are so tough and consistent that they will certainly stand a very long transport. The remarkable thing is not that various species of marine Invertebrates, which live among the algæ in the littoral region, are transported in this way from one island to another, but much more the fact that only so few species bear witness of having been transported in this way.

After all we must say that the information about the Echinoderm fauna of Macquarie Island which has been gained till now is in very good accordance with the oceanographical researches carried out by Sir Douglas Mawson, which tend to show that Macquarie Island is separated from the New Zealand Plateau by a wide area of very deep water, and that the island has never, at least since Mesozoic times, formed part of the New Zealand continental area.

As regards the relation between Macquarie Island and the Magellanic region, as shown through the existence in both of *Sporasterias antarctica* and the genus *Cycethra,* a former direct connection is not necessarily proved thereby, as both forms may well have been transported on floating algæ, both being littoral and living among algæ.

The Echinoderm fauna of the Chatham Islands is very insufficiently known. So far as I have been able to gather from literature, only the following 8 species have been recorded form there:

Ophionereis fasciata[1])	Henricia compacta
Pectinura cylindrica	Allostichaster polyplax
— maculata	Cucumaria brevidentis
Goniaster pulchellus	Chiridota gigas

Excepting *Chiridota gigas,* of which only one specimen has as yet been recorded from the New Zealand coast, all are common

[1]) This species needs reexamination; it is recorded as *Ophionereis Schayeri,* but probably is *O. fasciata.*

New Zealand species. The Echinoderm fauna of the Chatham Islands thus appears to be identical with that of New Zealand, though perhaps not fully so rich. But a more careful investigation of the marine fauna of the Chatham islands would be very desirable.

The littoral fauna of the Kermadec Islands is fairly well known through the collections made by Mr. W. R. B. Oliver, treated by Benham.[1]) It appears very clearly from these reports that the Echinoderm fauna of this small group of islands is very different from that of New Zealand, its character being much more tropical. It seems evident that this climatic difference is too great for most species to stand it. The following 7 species are common to the Kermadecs and New Zealand:

Heliocidaris tuberculata	Ophionereis fasciata[2])
Echinocyamus polyporus	Astropecten polyacanthus
Ophiothrix Oliveri	Ophidiaster kermadecensis
Amphipholis squamata	

Three of these, *Echinocyamus polyporus*, *Ophiothrix oliveri* and *Ophidiaster kermadecensis*, are not known to occur outside the New Zealand region and therefore indicate that the Kermadecs belong really to the New Zealand region and that the different character of their Echinoderm fauna is due mainly to their different climatic conditions.

Geographically also Lord Howe Island and Norfolk Island may be reckoned to the New Zealand region, but, still more than with the Kermadecs, their climatic conditions forbid any nearer relation between their littoral faunas of Echinoderms. While Norfolk Island is almost totally unknown as regards its Echinoderm fauna, that of Lord Howe Island is fairly well known. A list of its Echinoderms is given by H. L. Clark.[3]) It has two species in common with New Zealand, viz. *Coscinasterias*

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1) W. B. Benham. Stellerids and Echinids from the Kermadec Islands; Report on Sundry Invertebrates from the Kermadec Islands. (Trans. N. Z. Inst. XLIII—XLIV. 1910—11).

2) Recorded as *Ophionereis Schayeri*, but may well be *O. fasciata*. Reexamination necessary.

3) H. L. Clark. Echinodermata. Trawling Expedition of the "Thetis". Mem. Austral Mus. IV. 1909. p. 520.

calamaria and *Heliocidaris tuberculatus*, both widely distributed species which are of very little zoogeographical importance.

Turning now to the relation between the Echinoderm fauna of the New Zealand region as a whole with that of other regions, Australia, as might be expected, stands foremost, 19 species — or 16 % — of the 119 species known from New Zealand being common to New Zealand and Australia. These species are the following:

Aræosoma thetidis	Amphiocnida pilosa
Holopneustes inflatus	Amphipholis squamata
Heliocidaris tuberculata	Astropecten polyacanthus
Clypeaster virescens	Psilaster acuminatus
Laganum depressum	Allostichaster polyplax
Echinocardium australe	Coscinasterias calamaria
Ophiocreas constrictum	Stichopus mollis
Ophiothrix aristulata	Phyllophorus dearmatus
Ophiactis resiliens	Chiridota gigas
— hirta	

Leaving out of consideration such widespread forms as *Clypeaster virescens*, *Laganum depressum*, *Ophiothrix aristulata*, *Amphipholis squamata*, *Astropecten polyacanthus* and *Coscinasterias calamaria*, we still have a fair number of species left which bear testimony of a fairly close relation between the Australian and New Zealand Echinoderm faunas. They may be divided in two groups, deep-water and shallow-water species. To the former belong *Arœosoma thetidis*, *Ophiocreas constrictum*, *Ophiactis hirta* and *Psilaster acuminatus*; even though they are as yet known only from relatively small depths, it is very probable that they will prove to occur also in greater depths and to belong to the fauna of the deep-sea between New Zealand and Australia, and their occurrence in both areas, therefore, does not offer any zoogeographical difficulty. Very probably also several more of the species recorded from the deeper water off the North end of New Zealand likewise will prove to belong to a common Australian—New Zealand deep-sea fauna.

Regarding the littoral species most of them have pelagic larvæ, and their occurrence in both regions can, therefore, easily be explained through the transport of the larvæ across the not so very broad deep-sea area that now separates the two areas, a distance

which was, moreover, very considerably smaller during the time before the great subsidence of the New Zealand Plateau. This will easily account for the occurrence at New Zealand of such species as *Heliocidaris tuberculata*, *Echinocardium australe*, *Ophiactis resiliens* and *Stichopus mollis*, probably also *Chiridota gigas*. On the other hand, *Holopneustes inflatus* has certainly not pelagic larvæ; even if it can be maintained as separate from *H. purpurascens*, it is sure to have a shortened development like the latter.[1]) The relatively large eggs of *Amphiocnida pilosa* indicate that this species has not pelagic larvæ either, and the same probably holds good for *Allostichaster polyplax* and *Phyllophorus dearmatus*. A passage of these forms across the deep-sea that now separates the two regions is hardly imaginable either in a pelagic stage or by means of transport on floating algæ, and even the raising of the northern extension of the great New Zealand Plateau would not make the direct transport across the separating sea very probable.

Holopneustes undoubtedly has its original home in Australia, but has extended its range to New Zealand; it forms an interesting parallel to *Pseudechinus*, which has, evidently, its home in the New Zealand region but has apparently extended its range to Australia, where it would appear to be represented by one species (cf. p. 399).[2]) *Heliocidaris tuberculata* is doubtless also of Australian origin. As regards the other littoral-sublittoral species common to both regions it is, for the present, at least, hardly possible to form a definite opinion, whether they belong originally to the Australian or the New Zealand region.

It is worth emphasizing that two species which were hitherto regarded as common to Australia and New Zealand, viz. *Ophionereis Schayeri* and *Ophiomyxa australis*, are not really so, the New Zealand forms representing two well defined species, *Ophionereis fasciata*

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1) Th. Mortensen. Preliminary note on the remarkable shortened development of an Australian sea-urchin, Toxocidaris erythrogrammus. Proc. Linn. Soc. N. S. Wales. XL. 1915. p. 206.

2) It is worth recalling in this connection that the species *Amblypneustes pachistus* H. L. Clark (Hawaiian a. o. Pacific Echini. The Pedinidæ etc. Mem. Mus. C. Z. XXXIV. 1912, p. 327) was founded partly on specimens labelled New Zealand. Clark himself regards this as incorrect labelling, the species being known with certainty only from Westernport, Australia.

and *Ophiomyxa brevirima*, known to occur only in the New Zealand region. The genera *Ophionereis* and *Ophiomyxa* being very widely distributed, these two species are of no importance for indicating zoogeographical relations between New Zealand and other regions (Australia, S. Africa, S. America). On the other hand there are some other genera represented by nearly related species in New Zealand and Australia, viz. *Ophiocoma bollonsi—canaliculata, Nectria ocelligera—pedicelligera, Comanthus trichoptera—benhami.* These again bear important testimony of a former closer relation between the two regions.

This former closer connection between Australia and New Zealand indicated by the Echinoderm fauna of the two regions is easily explained through the Continental drift theory of Wegener, according to which New Zealand was originally directly connected with Australia, forming the Eastern border of the great Australian continental block, from which it was then separated through Australia drifting away from it.[1]) It is of very great interest that this hypothesis, which solves so many zoogeographical riddles in the most surprisingly clear way, thus gets support also from the study of the New Zealand Echinoderm fauna. At least it seems hardly possible to give any other satisfactory explanation of the correspondence of the New Zealand and the Australian Echinoderm faunas, unless the comparative study of the fossil Echinoderms of the two countries should give another natural explanation.

Professor H. L. Hawkins is at present engaged on an investigation of the Tertiary Echinoidea of New Zealand. His work has not been carried far as yet, but he has almost completed the study of the Regular forms. He has very kindly allowed me to publish the following note, laying emphasis on its provisional character:

Note.

Up to the present time the published accounts of the Fossil Echinoidea of New Zealand are almost worthless. The only exception is the description of five species given by Zittel in 1864 (Novara Exped., Geol. Teil., Bd. i, Abt. ii, pp. 62—66). The diagnoses given by Hutton in his Catalogue are useless without the

[1]) Alfred Wegener. Die Entstehung der Continente und Ozeane. 3. Aufl. 1922. p. 46.

specimens, and a large proportion of the type specimens are useless anyway. Tate's attempted comparison between the New Zealand and Australian fossils seems to have been almost disastrous [1]).

Except for a series of Cidaroid radioles (including forms probably belonging to *Goniocidaris* and perhaps to *Phyllacanthus)* and the two living species *Notechinus novae-zealandiae* and *Pseudechinus albocinctus* (these are from raised beaches of probable Pleistocene age), practically all the known Tertiary forms seem to come from the older systems, chiefly the Miocene. This is probably the explanation of the extreme disproportion between the Regular and Irregular forms, the latter predominating enormously in numbers and variety. Such disproportion seems a normal feature of early Tertiary Echinoid faunas throughout the world.

Of the Cidaridae, Hutton's *"Cidaris" striata* has nothing to do with Duncan's *"Leiocidaris" australiae*, but seems to be more akin to *Goniocidaris* or to some Cretaceous group such as *Typocidaris*. It is probably of Miocene age, and can be compared closely only with the series of so-called *Goniocidaris* from the Miocene of Kutch described by Duncan & Sladen in 1883 (Pal. Indica, ser. xiv, vol. i, part iv). Another Cidarid, of proportions dwarfing those of *Phyllacanthus imperialis*, occurs in some abundance in deposits that are probably of Miocene date. Its generic position is doubtful, but I know of no species with which it can be compared at all closely.

The non-Cidarid Regular forms from the older Tertiary are mostly very small, and seem all to be akin to the troublesome *Paradoxechinus*-group well-known in Australia. Most of them have sculptured tests; and they show a remarkable uniformity of "mode" in spite of generic differences. *"Echinus" enysi* Hutton (which is utterly unlike *"Psammechinus" woodsi* from Australia) seems certainly to belong to *Grammechinus*, a monotypic genus from the Miocene of Northern India.

Among the Irregular genera, which I have not yet studied in detail, it is possible to record *Fibularia* and *Arachnoides*. There is

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1) R. Tate. Critical list of the Tertiary Mollusca and Echinodermata of New Zealand in the Collection of the Colonial Museum, in Reports of Geological Explorations during 1892—93. Colonial Museum and Geol. Surv. of New Zealand. Nr. 22. 1894.

Zittel's "*Nucleolites*" *papillosus* which may prove to be a forerunner of *Apatopygus*. I have not seen an undoubted example of "*Lovenia*" *forbesi* from New Zealand, but there are one or two closely allied forms. Of the Spatangidae, all I can say at present is that the genera indicated by Hutton need reconsideration, while most of his species are based on hopelessly imperfect material. There is, however, a large series of better specimens now available; and it is obvious that the two species of the family now living in the area are relics of a far more comprehensive fauna.

H. L. Hawkins.

It is, of course, too early to draw any conclusions as regards the former interrelation between the New Zealand and the Australian Echinoderm faunas from the preliminary informations given by Prof. Hawkins in the above note, the more so as also the Australian fossil Echinoderm fauna stands greatly in need of a complete revision.

I beg to thank Professor Hawkins most cordially for his kindness in allowing me to include the above most interesting note in my report.

A most interesting problem is the relation of the New Zealand Echinoderm fauna to that of the Antarctic and Subantarctic region, especially the Magellanic region. As seen from the list of the New Zealand Echinoderms given above only two species are known with certainty to be common to the New Zealand and the Magellanic region, viz. *Amphiura magellanica* and *Cucumaria calcarea;* very probably also *Gorgonocephalus chilensis* will ultimately be found to be common to both regions, the New Zealand form being only provisionally regarded as a separate variety. Several more species have been maintained to be common to the two regions, e. g. *Notechinus magellanicus*, *Echinus margaritaceus*, *Ophionereis Schayeri*, *Odontaster Grayi*, *Caudina chilensis*, *Cucumaria brevidentis*, *Cuc. leonina*; but these are all erroneous identifications, as has been shown in the present and the two previous reports on the New Zealand Echinoderms. The two (three) above named species have come instead of the old, erroneous cases to show that there is some slight relation between the New Zealand and the

Magellanic Echinoderm faunas. To these must also be added some few cases of nearly related species occurring in the two regions, viz. *Notechinus novæ-zealandiæ—magellanicus, Amphioplus basilicus —textilis, Allostichaster insignis—æqualis, Amphiura eugeniæ* — var. *latisquama.*

If we regard more closely into the matter, we find that, excepting *Gorgonocephalus chilensis,* all the identical or nearly related species occurring in the two regions live in the littoral region and are thus very liable to be carried along in the roots of large floating algæ. *Gorgonocephalus chilensis* is not known to occur in the littoral region and therefore a transport on floating algæ cannot explain its occurrence both in the Magellanic region and at New Zealand; but it may well be assumed to have free swimming larvæ, which would easily account for its occurrence in both regions, the more so at it is known also from Kerguelen.

Thus, we need not have recourse to any former land or shallow water connection between New Zealand and S. America (Patagonia) in order to explain the similarity in their Echinoderm faunas. It may rather be maintained, on the contrary, that the Echinoderm faunas of the two regions bear witness against such former connection in post-mesozoic times. If such had existed, it should be expected that the *Ophionotus*- and the *Abatus*-group, so highly characteristic of the Magellanic region, would be represented also in New Zealand, especially at the Auckland-Campbell Islands. But this they are, evidently, not; otherwise I could hardly have failed to discover them there in the several dredgings which I undertook, especially with the object of ascertaining their existence or non-existence there. Both these forms belong to the deeper littoral, and a transport over the open sea on floating algæ evidently is out of question; moreover they are viviparous (excepting *Ophionotus victoriæ).* They are, therefore, of the highest zoogeographical importance, their occurrence in distant localities (e. g. S. America and Kerguelen) giving strong evidence of former direct connection between such localities. As both types are widely distributed in the Antarctic and Subantarctic regions, the conclusion seems justified that, if there had been a former land-connection between the Auckland-Campbell Islands and the Magellanic region, or with Antarctica, one should expect to find both

these types there. Their absence at the Auckland-Campbell Islands shows that, if there has been a direct connection between the two regions — as is indicated by so very many facts in the distribution of both plants and animals of these regions, and as is also maintained by the Wegener-theory — such connection must have been discontinued, before the said forms came into existence, that is to say — for the *Abatus*-group — probably in the early Tertiary.[1])

It is of interest to note in this connection that P. Marshall in his paper on the Geology of Campbell Island and the Snares (Subantarct. Isl. of New Zealand II) mentions a *Micraster* and a *Brissopsis* as occurring in a limestone at Perseverance Harbour, Campbell Isl., of early Tertiary age. Unfortunatety, the uncertain identification, together with the fact that no figures are given of these fossils, does not allow to draw definite conclusions as to the relation of these fossil Echinoids from the Campbell Island to those of the Magellanic region. But if the identification of these forms as belonging to *Micraster* and *Brissopsis* is correct, this proves that also the fossils are quite different from those of Patagonia.

A comparison again of the New Zealand Echinoderm fauna with that of the Antarctic most decidedly shows that there is no relation whatever between these two faunas. Alone the genus *Ophioceres* is, so far as we know, restricted to these two regions, one species, *O. incipiens*, being known from the Antarctic, the other, *O. Huttoni*, from New Zealand. I cannot give any satisfactory explanation of this fact; but, in any case, we cannot see herein any proof whatever of a former nearer connection between the two regions — we might equally well maintain that the existence of the genus *Ophiopteris* alone in New Zealand and California proves a direct connection to have existed between those two countries

1) We do not know the exact time, when the *Abatus*-group came into existence. But I would suggest that the *Schizaster patagonensis* of Lambert (Note sur les Échinides recueillis par M. A. Tournouër en Patagonie. Bull. Soc. Géol. de France. 4. Sér. III. 1903. p. 481, Pl. XV) really belongs to this group. Lambert is of opinion that the strata from which the said collection of fossils came are of oligocene or miocene age. — Cf. also the author's report on the Echinoidea of the German S. Polar Expedition (Deutsche Süd-Polar Expedition XI. Zoologie III. 1909. p. 101). — As regards the time, when the *Ophionotus*-forms came into existence we have no means of forming any opinion thereof.

or that the genus *Stegnaster*, known only from New Zealand and the West Indies, proves a direct connection between these two regions to have existed in previous times. And here again the absence of the *Abatus*-group in New Zealand bears testimony against a former connection with Antarctica, where it is just as wide spread as in the Subantarctic region (Patagonia, Kerguelen).

The comparison of the Echinoderm fauna of the New Zealand region with that of the Magellanic and the Antarctic region thus gives the result that the few cases of identical or nearly related forms occurring in the two regions do not afford sufficient testimony for a former direct connection between the two areas, while the absence in the New Zealand region of the highly characteristc subantarctic and antarctic *Abatus*-group decidedly bears testimony against such connection in post-mesozoic times.

It is still to be pointed out that there is no relation either between the Echinoderm fauna of New Zealand and that of South Africa. A few species have been stated to be common to these two regions: *Echinus angulosus*, *Henricia ornata*, *Ophiomyxa australis;* but these are all erroneous identifications. Some other species which really occur in both areas, like *Astropecten polyacanthus* and *Coscinasterias calamaria*, are widely distributed forms which do not mean anything for proving a nearer relation between the two faunas.

It is thus evident from a study of the zoogeographical relations of the New Zealand Echinoderm fauna that the only other fauna to which it has really any nearer relaton is the Australian. To the Antarctic fauna or the Magellanic fauna it has no closer relation. Further it is evident that, as regards their Echinoderm fauna, the Auckland-Campbell Islands belong exclusively with New Zealand, this fauna being not at all subantarctic in its character, and the conclusion is obvious that the so-called "Subantarctic Islands of New Zealand" are not subantarctic at all.

The same result was reached already by Koehler in his fine study of the zoogeographical interrelations of the Echinoderm faunas of the various antarctic and subantarctic areas in his Report on the Echinoderms of the "Deuxième Expedition Antarctique Francaise (1908—1910)"; the more exact knowledge of the Echinoderm fauna of New Zealand and the Auckland-Campbell Islands now gained has fully borne out his result.

Second Appendix.

When, in the middle of September 1925, the last proofs of the above paper were in hand, notice was received from the Director of the Dominion Museum, Wellington, Dr. J. Allan Thomson, that recently a number of Echinoderms had been brought to the Museum by a local steam-trawler, the "Futurist", and that four species were being sent to me for examination. It was then thought preferable to have a note on this new material included in this paper, and the printing accordingly was stopped provisionally, until the said material could be at hand. On its arrival, in the middle of October, it turned out to represent an addition to the New Zealand Echinoderm Fauna of two new, very interesting species. It was thus well worth the little delay in the publication of the paper. The four species are:

Spatangus multispinus n. sp.
Persephonaster neozelanicus n. sp.
Psilaster acuminatus Sladen.
Astrotoma Waitei Benham.

The number of species of Echinoderms known from New Zealand is thus raised to 121, and the number of endemic forms to 100. The zoogeographical results arrived at above are not altered by the finding of the two new forms. The Spatangus has, so far as known hitherto, no relations nearer than the Hawaiian Islands or South Africa, while the new Asteroid has its nearest relations among forms known from the Philippine Sea.

No nearer information was included about locality and depth, where these specimens were found.

Spatangus multispinus n. sp.

Test 80 mm long, 76 mm wide, 40 mm high. General shape of the test broadly oval, scarcely asymmetrical; it is rather flattened, rising very gently to about midway between the apical system and the hind end. Frontal ambulacrum rather deep. — Petals narrow,

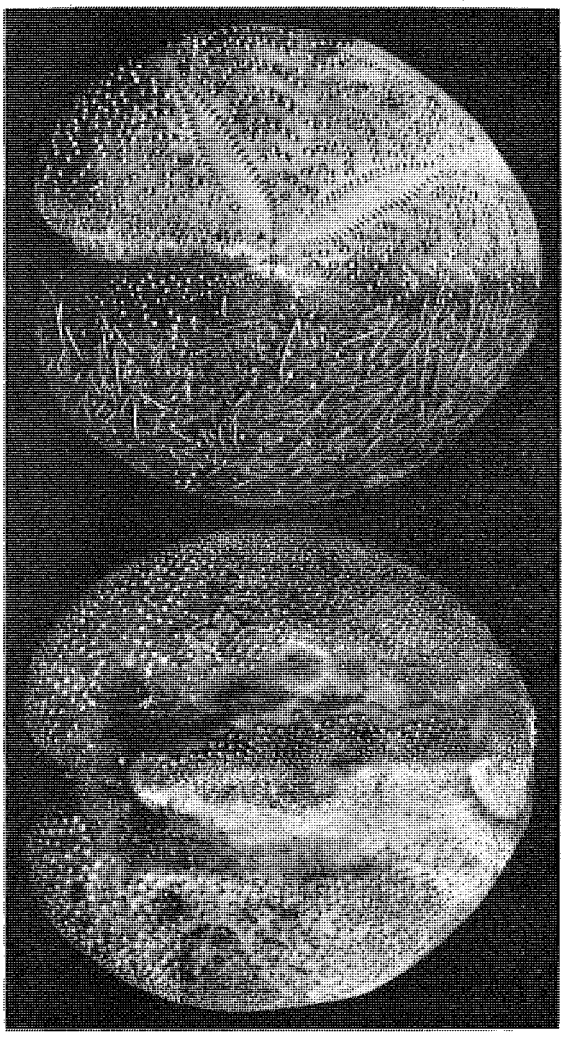
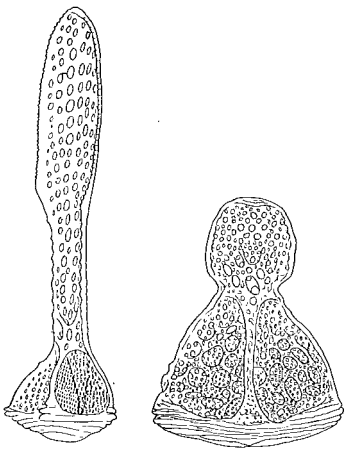


Fig. 68. *Spatangus multispinus* n. sp., from the oral and the dorsal side; slightly reduced.

distinctly tapering. Very numerous larger tubercles (and spines) in all the dorsal interambulacra, and also a few larger tubercles in the ambulacra outside the petals. Hind end of test vertical. Periproct transverse oval. Subanal plastron small, 20 mm wide, oval, mainly on the ventral side. 2 pairs of tubefeet enclosed by the fasciole. Plastron very narrow, the tubercles continuing without interruption on to the labrum, which is large and prominent. Pedicellariæ very scarce; only the two usual kinds of tridentate pedicellariæ have been found, viz. the slender and the short-valved, coarse form (Fig. 69. a, b). Colour purplish-violet.



a. b.

Fig. 69. Valves of tridentate pedicellariæ of *Spatangus multispinus*; a. slender; b. short-valved form. a. 115/1; b. 62/1.

This very distinct species appears to be the nearest related to the North Atlantic *Spatangus Raschi* Lovén, with which it agrees in the feature of larger tubercles occurring in the ambulacra, outside the petals. — As no species of the genus *Spatangus* is known to occur nearer than the Hawaiian Islands and the South African Seas, the finding of a species in New Zealand Seas is rather unexpected.

The type specimen in the Dominion Museum, Wellington.

Persephonaster neozelanicus n. sp.

Type-specimen measuring ca. 110 mm R, ca. 33 mm r, thus R = ca. 3.3 r. Arms ca. 35 mm broad at base, regularly tapering. In the second specimen the measurements are R ca. 103 mm, r ca. 27 mm, thus R = ca. 3.8 r. Arms ca. 29 mm broad at base. The second specimen thus has a rather smaller disk and more slender arms.

Paxillar area very broad; the paxillæ arranged in rather distinct transverse series, except along the midline, where no regular arrangement is seen; the size of the paxillæ very uniform, only slightly larger on the disk. The spinelets are slender, of equal length,

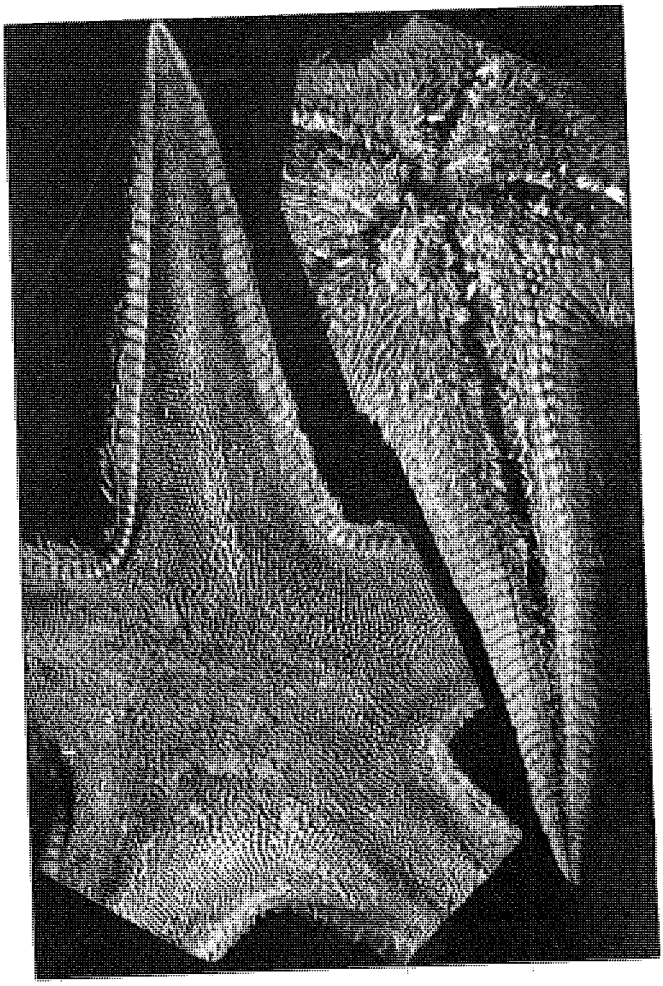


Fig. 70. *Persephonaster neozelanicus* n. sp. From the dorsal and oral side. Slightly reduced.

ca. 10—20 peripheral and ca. 6—8 central ones; apparently no pedicellariæ. The paxillar stalk rather slender; the plates are simple, elongate oval disks, not touching each other. — The madreporite fairly large, naked, nearer the edge than the centre of disk. No anal opening observable.

The marginal border not very high; the inferomarginals scarcely extend beyond the superomarginals, their aboral end scarcely at all tumid. Number of marginals 40 in both specimens. Superomarginals about twice as high as broad, not tumid, covered with a close coat of fine spinelets and besides bearing about in the middle a vertical series of 3—4, more rarely only two or as many as five large, slender, flattened spines, closely appressed and distalwards directed, reaching to the base of those of the following plate. In the second specimen these large superomarginal spines are fewer, only one to three, and are totally wanting on some of the proximal plates. In the outer part of the arms the superomarginals are somewhat oblique, the separating lines curving distinctly proximad. Inferomarginals in the type-specimen nearly four times as high as broad, in the second specimen somewhat less high; they are covered by short, flattened, rather scale-like spines, and bear along their distal edge a series of ca. 8 longer, flattened, appressed spines; the 3—4 upper ones are the longest, reaching somewhat beyond the base of those of the following plate. These longer upper spines form an oblique series towards the upper proximal corner of the plate, and they cover another series of 2—4 similar spines on the upper distal corner of the plate. The long spines on the upper end of the inferomarginals do not come into contact with those of the superomarginals.

Oral interradials at the base of arm in three series, the third series extending in the type along five, in the second specimen along three inferomarginals. The second series continues in the type specimen for ca. $^2/_3$ the length of the ray, in the second specimen scarcely to the middle. The first series in both continues almost to the end of the ray. — Adambulacrals with a comb of 6 rather large flattened spines, the middle ones turning edge to furrow. Subambulacral spines slender irregularly arranged in 3—4 longitudinal series. — The type specimen still shows a fairly pronounced reddish colour.

Type-specimen in the Dominion Museum, Wellington.

This species belongs to the *euryactis—luzonicus—anchistus* group of the genus *Persephonaster,* as comprised by Fisher. This group being otherwise known only from the Philippine Seas the discovery of a new species in New Zealand Seas is very interesting. — It seems to be the nearest related to *euryactis,* from which it is, however, well distinguished through the different form of the rays, the arrangement of the subambulacral spines etc. (cf. Fisher Starfishes of the Philippine Seas, p. 1.12).

It may perhaps be questionable, whether this group of species is justly referred to the genus *Persephonaster;* but this question cannot, of course, be discussed here.

Psilaster acuminatus Sladen.

The two specimens sent differ from those mentioned above (p. 274) in having somewhat slenderer arms and in the marginal plates being partly naked. There is some possibility that these specimens represent a second species, in which case there would be two species of the genus *Psilaster* in New Zealand Seas. This would account for the discrepancy pointed out above between the description and the figures of *Ps. acuminatus* given by Sladen. But it is equally well possible that the more or less naked condition of the marginal plates is a character subject to considerable variation in *Ps. acuminatus.* Only a rich material can give the proof whether the New Zealand Psilasters form one variable species or represent two distinct species.

The two specimens sent of *Astrotoma Waitei* Benham are perfectly typical and do not give rise to additional remarks.

Note ad p. 401. According to W. K. Fisher the genus *Parastichaster* of Koehler is not to be distinguished from the genus *Sporasterias* Perrier; he also suggests that *Parastichaster Mawsoni* Koehler is probably the same as *Sporasterias spirabilis* (Bell.), from the Falkland Islands. As both are littoral forms living among the roots of the large algæ, the identity of the two forms would not mean any closer relation between the Macquarie Island and the Magellanic region, a transport by means of the algæ being sufficient explanation.

25—X—1925.

Explanation of Plates.

Plate XII.

Figs. 1—2. *Astropecten primigenius* n. sp.; 1. dorsal; 2. oral side.
— 3—4. — *dubiosus* n. sp.; 3. oral; 4. dorsal side.
— 5. *Luidia neozelanica* n. sp.; dorsal side.
— 6—10. *Pentagonaster pulchellus* Gray, various sizes; 8. oral side, the others from the dorsal side. Showing the various development of the subterminal marginal plates.
— 11. *Diplodontias dilatatus* (Perrier); dorsal side.
— 12—13. *Peridontaster Benhami* n. sp.; 12. dorsal; 13. oral side.
— 14—15. *Asterina (Asterinopsis) aucklandensis* Koehler. 14. oral; 15. dorsal side.
— 16. — *(Patiriella) regularis* Verrill. Specimen of perfectly pentagonal outline; dorsal side.
— 17. *Asterina (Patiriella) regularis*, var. *a.*; dorsal side.
— 18. — — — var. *b.*; — —

All figures natural size.

Plate XIII.

Figs. 1—2. *Henricia lukinsii* Farquhar. 1. oral, 2. dorsal side.
— 3—4. — *compacta*, var. *aucklandiæ* n. var. 3. oral, 4. dorsal side.
— 5—6. *Nectria pedicelligera* n. sp. 5. dorsal, 6. oral side.
— 7—8. *Asterodon miliaris* Gray. 7. dorsal, 8 oral side.
— 9—10. *Ophidiaster kermadecensis* Benham. 9. dorsal, 10 oral side.
— 11. *Stegnaster inflatus* (Hutton). Side view.
— 12. *Calvasterias lævigata* (Hutton). Specimen carrying its young on the mouth.
— 13—14. *Luidia varia* n. sp. 13. the disk, 14. two rays, from the dorsal and half from the oral side.

All figures natural size.

Plate XIV.

Figs. 1—2. *Stichaster australis* (Verrill). 1. dorsal, 2. oral side.
— 3—10. *Calvasterias lævigata* (Hutton); various sizes. Showing various development of dorsal spines. 5. a four-rayed specimen; 8—9. a very large specimen, from the dorsal and oral side.
— 11—12. *Astrostole scabra* (Hutton). 11. oral, 12. dorsal side.
— 13—14. *Sclerasterias mollis* (Hutton). 13. dorsal side, 14. an arm from the oral side.

All figures natural size.