HOLOTHURIOIDEA[1]

The holothurians, often called sea cucumbers or by less elegant names, differ so much from the other classes of echinoderms, in their body form and texture, that the average person finds it hard to believe they are really closely related to sea stars or sea urchins. A few species are bright-colored or have some beauty of form, but the great majority are dull-colored and unattractive and some are undoubtedly repulsive. They are nevertheless an interesting group and amply repay observation and study. They are a common feature of marine life on the coasts of Australia, more particularly in the tropics, but owing to the absence of anything like a shell or firm skeleton, they are usually ignored by the average collector. For the same reason, they are ill adapted for preservation as fossils, and only one extinct species is yet known from Australia. In both Europe and America, micropaleontologists have discovered and figured a considerable number of calcareous spicules of varied form which can be referred with some accuracy to certain genera of holothurians, but only one observation of this sort has as yet been made in Australia (see *Chiridota ingens*, p. 458).

The holothurians are the least-known class of echinoderms, the difficulties in the way of preserving them well in museums, and the notable unattractiveness of the preserved specimens, being serious handicaps. As a result, it is probable that more undescribed species remain to be discovered than in any other class of the phylum. In Australia, the littoral forms are now pretty well known, so that the percentage of Australian holothurians to the whole number of known species is about as high as in the echini. But the total number of known species is undoubtedly nearer the number of existing species among echini than among holothurians.

The classification of holothurians is still unsatisfactory in all details. Though the 5 orders commonly recognized are fairly well defined and almost universally accepted, their subdivision is not yet agreed upon. The calcareous ring around the esophagus and the calcareous particles in the body wall afford characters of great importance for distinguishing species and even genera, but they are subject to growth changes and senescence, not to mention considerable individual diversity, probably associated with differences in the sea water or other environmental factors. The appendages, both tentacles and those of the body wall (pedicels and papillae), are subject to marked changes in form and often in number with increasing maturity and again with senescence. As all the appendages and the body wall itself are capable of extraordinary extension and

[1] In the preparation of this section of the present volume, I am under great obligations to Dr. Elisabeth Deichmann, whose exceptional knowledge of the class has been freely drawn upon to help solve the numerous problems presented. I extend to her herewith my sincerest thanks.

contraction, preserved specimens show a great deal of diversity in size and form, even though in life they may have been of very similar appearance.

The holothurians are the only echinoderms which have any direct economic value, barring a few echini whose gonads are used, when fresh, for food in several widely separated areas. The injury done by sea stars to oyster beds in the northern hemisphere is on the other side of the ledger. Long ago the Chinese, and possibly other Orientals, discovered that palatable and perhaps nourishing soups could be made from the body wall of many of the larger species of holothurians, when properly prepared. This preparation consists in eviscerating and briefly boiling the animals, then spreading them open and smoking them over a wood fire (mangrove preferred) for 24 hours or until they are thoroughly dry. They are then quite hard, the better grades being as hard as, and much like, dry glue. For an account of the Torres Strait industry and traffic in these smoked holothurians, known to the trade as "bêche-de-mer" or "trepang" (a Malay name), see H. L. Clark, 1921, pages 156–158. When we were in Torres Strait in 1913, the traffic with China in bêche-de-mer was flourishing, and many thousands of pounds were exported annually from Thursday Island, the best grades bringing as much as three shillings a pound. The first World War seriously hurt this traffic, but subsequently the Chinese demand exhausted the supply that was easily accessible in the Torres Strait region, and there is little doubt that the traffic can only be restored to its former importance by governmental action and careful supervision.

In their habits and habitats, holothurians show less diversity than the more active brittle stars and sea stars. They are more like the echini, which are equally sluggish. The largest holothurians, which may be nearly a meter long (and extensile beyond that), and (in less extensile forms) 100–125 mm. in transverse diameter, live more or less exposed on the sea bottom, particularly on open areas near or among rocks and coral heads. Smaller species also live in the open, especially on eelgrass areas or among rock fragments. Still smaller forms, and some species 150 mm. long, live under rock fragments or among dead coral, often burying themselves deep in the sand and withdrawing out of sight when disturbed. A few of the small species live on horny corals or in sponges, sometimes in great numbers, but most of the species under 50 mm. long live buried in the sand or mud, and some are extremely difficult to collect. Various small species, less than 35 mm. long, live closely appressed to the lower surface of rock fragments or large dead shells, and others live concealed in patches of coralline algae. Some of these latter may be quite gregarious. Elongated, slender forms with very thin body walls often live like worms in tubes in the mud or sand, and a number of larger but very thin-walled species live buried in soft mud. The colors are mostly brown or gray of some shade, or white, sometimes with bright red or bright yellow areas or markings. Some

species, however, are handsomely colored, usually with shades of red or yellow or both. Mottled, blotched, and variegated forms are common, but unicolored species are not rare. Some are so dark as to appear quite black; others are very dark green or purple. The tentacles are frequently in contrast with the body color, as black where the body is for the most part brown, or cream-colored when the animal itself is black.

The 4 orders of holothurians occurring in Australia are represented by 158 species, grouped in only 41 genera of 8 families. The classification is based on the character of the tentacles, the number and arrangement of the appendages, and the body form. There are also important internal structural differences which, though less convenient for a key, are of fundamental importance. Within the orders, the families are based on body form and characters of various internal organs. Genera are based for the most part on the tentacles, pedicels, papillae, and external details, but the calcareous ring and the spicules are also important. Species are distinguishable for the most part only by the microscopic calcareous particles in the body wall. As a consequence, identification is almost hopeless if the specimen has been killed or preserved in a fluid at all acid. Formalin not only damages the calcareous particles, but tends to swell and distort the tissues. It should never be used as a killing agent or preservative for holothurians.

Key to the Orders of Holothurioidea

A. Pedicels and papillae present:
  Tentacles dendritic; retractor muscles present ..... Dendrochirota
  Tentacles peltate or peltato-digitate; retractor muscles wanting ..... Aspidochirota
AA. Pedicels and papillae wanting:
  Body relatively short and plump, usually with an evident caudal part; respiratory trees present ..... Molpadonia
  Body slender, usually elongated, often vermiform; no respiratory trees ..... Apoda

Order DENDROCHIROTA

This order includes more Australian holothurians than any of the others, but the Aspidochirota are a close second. Indeed, in the Torres Strait region there are twice as many aspidochirotes as dendrochirotes, and at Lord Howe Island only one dendrochirote was found. But at Broome there were 28 dendrochirotes and only 10 aspidochirotes, and farther southwest there were 10 and 4 respectively. Obviously the dendrochirotes are strikingly predominant in Western Australia. The species of this order are easily grouped in 2 families, distinguished by the body form. No doubt a more extended knowledge will justify the recognition of additional families.

Body more or less cylindrical, not flattened ventrally into a creeping sole ..... Cucumariidae
Body broad, flattened, ventral surface a well defined, thin-walled creeping sole ..... Psolidae

Family CUCUMARIIDAE

Nearly all dendrochirotes are grouped in this family, but we are only beginning to understand their interrelationships, and it is quite possible that at least 2 families are confused here, perhaps more. The Australian species are now arranged in 17 genera, but the lines between them are not too clear, and young individuals are often hard to place. The number of tentacles seems to be the most obvious character and may well serve as the starting point for a key to the genera.

Key to the Genera of Cucumariidae

A. Tentacles 10:
- B. Pedicels (or papillae) confined to ambulacra, at least on ventral surface:
  - C. Dorsal appendages mostly developed as pedicels; at least ventrally, pedicels may be confined to ambulacra:
    - Body not elongated and more or less curved, not pentagonal, not encased in firm body wall ..... *Cucumaria*
    - Body elongated, curved, pentagonal, encased in firm body wall ..... *Leptopentacta*
  - CC. Dorsal appendages mostly developed as papillae or tubercles (sometimes wanting); pedicels on ventral ambulacra:
    - Body wall more or less rigid, with calcareous deposits ..... *Pentacta*
    - Body wall with little calcareous matter; body short and stout in adults ..... *Pseudocolochirus*
- BB. Pedicels or papillae not confined to ambulacra, at least on ventral surface:
  - D. Body wall firm with crowded deposits, without conspicuous papillae or tubercles save for a series of large, pointed tubercles along each side; pedicels very numerous all over body ..... *Apentacta*
- DD. Not as above:
  - E. Body wall hard with crowded deposits, covered all over with numerous rounded, hard, white calcareous tubercles, each perforated by a pedicel ..... *Acolochirus*
- EE. Not as above:
  - F. Body quadrangular; pedicels crowded ventrally; double series of tubercles and many pedicels dorsally; body wall not hard with crowded deposits, but with small tables having 2 rods in spire, and disk with few perforations ..... *Pentathyone*
- FF. Not as above:
  - G. Calcareous ring of 10 distinct loosely united pieces with no posterior prolongations; no calcareous particles in body wall ..... *Orbithyone*
- GG. Not as above:
  - Calcareous particles usually not abundant, consisting of stout cruciform plates and more or less numerous minute rosettes, with or without slender rods ..... *Staurothyone*
  - Not as above ..... *Thyone*

AA. Tentacles more than 10, usually 20:
- H. Pedicels confined to ambulacra in youth, but tending with growth to extend into interambulacra:
  - K. Papillae in dorsal interradii; 20 tentacles ..... *Actinocucumis*
- KK. No papillae in dorsal interradii; usually more than 20 tentacles in adults:
  - L. Chief calcareous particles big lenticular plates covered with low, sharp points ..... *Discucumaria*
- LL. No such plates:
  - Chief calcareous particles slender acicular rods, sharp at one end, wide and perforated at other ..... *Pseudocucumis*
  - Chief calcareous particles more or less developed tables ..... *Mensamaria*
- HH. Pedicels more or less distributed over whole body:
  - M. Calcareous particles more or less abundant in body wall:
    - Calcareous particles tables, more or less incomplete or reduced, though stout, with or without rosettes ..... *Phyllophorus*
    - Calcareous particles rods, more or less enlarged and either perforate or spinous at one end; tables may also be present ..... *Urodemas*
  - MM. Calcareous particles in body wall practically wanting ..... *Lipotrapeza*

CUCUMARIA

de Blainville, 1830. Dict. sci. nat., vol. 60, pp. 173, 176.

Genotype: *Holothuria pentactes* Gmelin, 1791, p. 3139.

Scores of species have been placed in this genus, and many suggestions have been made toward segregating them in smaller groups, but no really serious and careful study has yet been made of the heterogeneous assemblage. It is world-wide in its distribution, but is represented in Australia by only about half a dozen species, of which 4 are found on the southern coasts and 2 in the tropics. All but 1 are small, 50–60 mm. or less in length. All are dull-colored, but 1 or 2 show an interesting contrast between the ambulacra and the interambulacral spaces. The 6 species may be distinguished by characteristic calcareous deposits in the body wall. Ekman (1918, p. 42) gives figures (pl. 4, fig. 35) of calcareous particles from a small holothurian which he calls "Cucumaria sp. juv." This is quite as likely a young *Thyone*, as it is only 8 mm. long.

Key to the Species of Cucumaria

A. Chief spicules in form of tables:
- B. Tables with 10–12 holes in base and only 2 short rods for spire ..... *mirabilis*
- BB. Tables with long, narrow base with few holes, and high, tapering, 2-pointed spire:
  - Accessory spicules irregular plates with 8–10 holes of unequal size ..... *striata*
  - Accessory spicules regular, elliptical or more or less circular plates with about 4 holes of considerable size ..... *bicolor*

AA. Chief spicules not in form of tables:
- Spicules ellipsoidal frames of smooth curved rods ..... *semperi*
- Spicules delicate, spinous baskets overlying thick perforated plates ..... *squamatoides*
- Spicules flat, rather delicate perforated plates, of diverse sizes, few and scattered ..... *adela*

Cucumaria mirabilis

Théel, 1886. "Challenger" Hol., p. 61; pl. 9, figs. 5*a–f*.

This little holothurian was described from a single specimen, 12 mm. long, taken at Cebu, Philippine Islands, in 100 fms., and confirmed by a second specimen from Port Jackson, New South Wales, 6–15 fms., in which the length was only a trifle more. The "Thetis" took 2 specimens from off Cape Three Points, New South Wales, in 41–50 fms. No data were published in connection with the "Thetis" specimens, presumably because they threw no new light on the species. Deichmann thinks the species is invalid, based on young Thyones.

Cucumaria striata

Joshua and Creed, 1915. Trans. Roy. Soc. S. Australia, vol. 39, p. 18; pl. 3, figs. 2*a–d*.

The 2 specimens on which this species is based were collected in 1888 in the Great Australian Bight by W. J. Howard, and are in the South Australian Museum. They are about 25 mm. long and 12 mm. in diameter. The interradial areas are smoky black, and the ambulacra dirty white. No additional specimens have as yet been taken. The resemblance to the following species in color is notable, but the calcareous particles are obviously different. The improbability that the same species occurs in the Bight and in King Sound is so great, it would be unwise to treat *striata* as a synonym of *bicolor*. Deichmann thinks the former may be identical with *Pseudocucumis intercedens* Lampert. Though this is possible, it does not seem to me probable.

Cucumaria bicolor

Bell, 1887*a*. Proc. Zool. Soc. London, p. 532; pl. 45, fig. 2.

The 2 specimens on which this species is based are said to be from King Sound, Western Australia. They were 36×20 mm. and 25×12. The interambulacra were chocolate or black, the ambulacra quite white. The calcareous particles were relatively few, but if Bell's figures are to be trusted they were different from those of *striata*.

Cucumaria semperi

Bell, 1884. "Alert" rept., p. 147; pl. 9, fig. A.

This species was originally described from Port Denison, Queensland, and from Torres Strait. Vaney (1912) records it without comment from the Aru Islands. It is not a typical *Cucumaria*, but might well be made the type of a distinct genus. It proves to be common at Broome, where it grows to be 45–50 mm. long. In some individuals the body curves upward at each end, but this is not the rule. Most of our specimens were dredged in about 7 fms., but some were found in shallow water, and the largest was in a tide pool, above low-water mark. Small specimens are light brown or whitish with tentacles and pedicels purplish, but large specimens are dull flesh red or reddish white with long pedicels dusky or purplish black.

Cucumaria squamatoides, nom. nov.

Cucumaria squamata Joshua and Creed, 1915. Trans. Roy. Soc. S. Australia, vol. 39, p. 17 (NON Ludwig, 1898, p. 27).

Deichmann has given me the following notes on this species, to which I fully subscribe: "From what we know about the restricted distribution of the majority of the cucumariids, one can be almost positive that Joshua and Creed have erred in referring a single specimen from Encounter Bay, South Australia, to Ludwig's species from Kerguelen. We must assume that the specimen which Joshua and Creed examined agrees at least roughly with Ludwig's description and that such a holothurian does occur in South Australia, but critical study would undoubtedly reveal very definite differences from Ludwig's species. As the Australian writers give no hint as to the size, color, or general character of their specimen, it remains for some future investigator to point out the real differences between this type, which is presumably in the South Australian Museum, and the description and figures of *squamata*."

Cucumaria adela,[1] nom. nov.

Cucumaria japonica Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 39; pl. 4, figs. 32–34 (NON Semper, 1868, p. 236).

Deichmann has called my attention to the fact that this holothurian, 97 mm. long and exceptionally stout, collected by Mjöberg 45 miles southwest of Cape Jaubert, Western Australia, in 11 fms., cannot be properly referred to Semper's Japanese species, but almost surely represents an undescribed form. As Ekman has given a full description and several figures, no further account need be given here, but a new name is of course necessary, and is herewith suggested.

LEPTOPENTACTA

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 453.

Genotype: *Leptopentacta grisea* H. L. Clark, 1938, p. 453.

This is a small group of possibly half a dozen species occurring in the East Indian region, 1 of which is a member of the Australian fauna. They are easily distinguished by the slender, pentagonal, more or less curved form, with its firm body wall.

Leptopentacta grisea

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 453; fig. 37.

This is one of the most easily recognized of the holothurians occurring at Broome. It was not taken elsewhere, presumably because no other mud flat was so diligently searched as the one around the jetty in Roebuck Bay. Full-grown specimens are 75 mm. in length and 7 or 8 mm. in diameter. They are notably inert, and no movements were ever noted. The color is the same as that of the sandy mud in which they live: gray, with the ventral side of the middle of the body white or

[1] ἄδηλος = uncertain, since the status of this species is doubtful.

whitish. The animal is so rigidly curved that the mouth and anus are at the surface of the mud at the same time, and apparently are but very slightly contractile, save to close the openings.

PENTACTA

Goldfuss, 1820. Handbuch der Zool., pt. 1, p. 177.

Genotype: *Actinia doliolum* Pallas, 1766, p. 152.

This is a characteristic group of holothurians, widely distributed and ill defined, long recognized under the later name *Colochirus*. It is particularly characteristic of the tropical coasts of Australia, and more than a dozen species have been recorded from the continent. Ekman (1918) has given a careful account of the material brought back from northwestern Australia by Mjöberg in 1913, listing 8 species, all from shallow water, 45 miles southwest of Cape Jaubert, which is about 80 miles southwest of Broome. One of his 8 species (also taken at Broome) is now assigned to *Pseudocolochirus*, and 2 others are described as new. During my two visits to Broome, we collected scores of Pentactas and examined many more, but there did not seem to be more than 4 species living in the region. One of the most common is *tuberculosa*, which Erwe (1913) records from Port Hedland and Shark Bay, but Ekman does not include it among the species from Cape Jaubert. Evidently Ekman's and my identifications are not consistent, and this fact illustrates how imperfect our knowledge is of the specific characters and limits in the genus. After prolonged study, it seems best to remove 2 species from the Australian list, making each the type of a new genus, since they are very different and cannot be treated as Pentactas without making the definition of the genus too vague and unsatisfactory. There remain, however, 11 nominal Pentactas, and the making of an accurate, reliable key is a hopeless task. The following is offered merely as a starting point from which a satisfactory arrangement may ultimately be worked out. Meanwhile, reference to the descriptions and figures of Selenka, Semper, Théel, Ekman, and Erwe will be necessary.

Key to the Species of Pentacta

(Note: In this key, *australis* appears twice)

A. Conspicuous dorsal papillae, at least along angles of more or less quadrangular body:
  B. Dorsal papillae in more or less evident longitudinal series on ambulacra:
    C. Pedicels numerous (4–8 longitudinal series) in each ventral ambulacrum:
      Dorsolateral papillae long and tapering ..... *quadrangularis*
      Dorsolateral papillae short and blunt ..... *jagorii*
    CC. Pedicels in only 1–3 series in each ventral ambulacrum:
      Calcareous "baskets" in skin, of 1 kind, about 0.06 mm. across ..... *australis*
      Baskets of 2 sorts, smaller about 0.05 mm. across, larger about 0.09 mm. ..... *minuta*
  BB. Dorsal papillae irregularly scattered on both ambulacra and interambulacra:
    D. Very large, heavy, reticulate spheroids in dermis ..... *robustoides*

  DD. No such bodies present:
    E. Small baskets shallow or reduced to plates, but with knobs of more or less considerable size:
      Baskets stout, nearly as wide as long, with large knobs ..... *crassa*
      Baskets rather delicate, often much longer than wide, even reduced to plates, with small knobs ..... *robusta*
    EE. Small baskets deep and without knobs:
      Large flattened, reticulate, spheroidal or ellipsoidal bodies present ..... *cucumis*
      No such bodies present ..... *tuberculosa*
AA. No conspicuous dorsal papillae:
  Body elongated, smooth, tapering posteriorly ..... *dispar*
  Body quadrangular, sides and back uneven and lumpy ..... *trimorpha*
  Body quadrangular, not uneven and lumpy ..... *australis*

Pentacta quadrangularis

Colochirus quadrangularis Troschel, 1846. Arch. f. Naturgesch., vol. 12, no. 1, p. 64 (NON *Holothuria quadrangularis* Lesson, 1830, p. 90).
Colochirus coeruleus Semper, 1868. Holothurien, p. 59; pl. 11, fig. 1 (colored); pl. 13, fig. 18.
Pentacta coerulea H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 227.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 449; pl. 16, fig. 4 (colored).

Ekman (1918) pointed out that Lesson's *quadrangularis* is an aspidote holothurian and hence could not be a *Colochirus*, but he ignored or overlooked Troschel's (1846) recognition of that fact and his deliberate use of the same name for a *Colochirus*. Misled by Ekman, I (1932) adopted Semper's name, *coerulea*, for this common dendrochirote holothurian, which should of course bear the appropriate name Troschel gave it. A *Holothuria quadrangularis* does not invalidate a *Colochirus quadrangularis*.

This is one of the commonest holothurians of northwestern Australia, ranging south on the west coast to Albany. East of long. 125° E. it seems to be rare, but the Great Barrier Reef Expedition found it on the Queensland coast, and it is difficult to account for its apparent absence at the Murray Islands and in Torres Strait. It is well known from the East Indies. Large specimens exceed 100 mm. in length, the width and height of the more or less quadrangular body being one-fifth or even one-fourth as much. The diversity of color is great, and many individuals are very handsome; compare Semper's and my colored figures. An extreme case of bright red coloring was found at Broome, and as the brilliant shade was associated with certain peculiarities of form and tuberculation, it seemed desirable to regard it as a namable variety; accordingly it was designated in H. L. Clark, 1938 (p. 451; pl. 16, fig. 5, colored) as *Pentacta coerulea* var. *rubra*, which should be designated henceforth as *Pentacta quadrangularis* var. *rubra*.

Pentacta jagorii

Colochirus jagorii Semper, 1868. Holothurien, p. 60.
Pentacta jagorii H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 228.

The inclusion of this dubious species in the Australian fauna on the basis of a single small specimen collected by the Great Barrier Reef Expedition is necessary,

but until adequate material is obtained, it is very doubtful whether *jagorii* is a valid species, and whether the Barrier Reef specimen is *jagorii*. In my discussion of the Australian specimen, I assert that Théel's opinion that *jagorii* is identical with *quadrangularis* does not seem "probable," but I do not designate clearly a single feature by which the two may be distinguished. The character of the dorsolateral papillae is doubtless subject to much individual diversity.

Pentacta australis

Colochirus australis Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 88.
Colochirus doliolum Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 351; pl. 5, figs. 1*a–b*.
Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 29; pl. 2, figs. 2, 3; pl. 3, figs. 20–22.
Pentacta australis H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 229.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 445.

This is a very common holothurian on many parts of the Australian coast, and may apparently be expected anywhere, though it has not yet been taken at Lord Howe Island, the Murray Islands, or Darwin. Typical specimens are 50–65 mm. long when adult, and are usually gray of some shade. The dorsal papillae may be very inconspicuous, especially in small specimens; hence the occurrence of *australis* twice in the key (p. 390). For a detailed discussion, see H. L. Clark, 1938, pages 445–449.

Pentacta minuta

Colochirus minutus Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 89; pl. 6, fig. 16.
Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 356; pl. 5, figs. 4*a–d*.
Pentacta minuta H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 229.

This species, of which described specimens range from 20 to 70 mm., is very imperfectly known. The type locality is Bowen, Queensland, and the Great Barrier Reef Expedition took it at two of their dredging stations. Ekman (1918) does not list it, but Erwe (1913) reports it, surprisingly enough, from Albany, Western Australia. I have not met with it at any of my collecting stations. Its validity as a species and its relationships within the genus cannot be determined without critical study of much more and better material.

Pentacta robustoides

Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 18; pl. 1, figs. 5, 6; pl. 3, figs. 10–12.

Ekman reports 4 specimens, 37–72 mm. long, taken by Mjöberg, in 18 fms., 45 miles west-southwest of Cape Jaubert, Western Australia. His account and figures are detailed, but the validity of the species needs verification by additional material. None of the scores of Pentactas taken at Broome have as yet been identified as *robustoides*, but many specimens have not had the calcareous particles critically examined. They are apparently *quadrangularis*, *crassa*, or *tuberculosa*, when not the obviously different *australis*.

Pentacta crassa

Colochirus crassus Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 6; pl. 1, figs. 1–4; pl. 3, figs. 1–7.
Pentacta crassa H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 451; pl. 16, fig. 1 (colored).

This is the largest of the Pentactas found on the northwest coast, reaching a length of 145 mm. It is not very common; Mjöberg collected 4 specimens and we took only 8. The dull coloration, gray becoming more or less salmon red ventrally, makes the very inert animal inconspicuous. No specimens have yet been reported outside the Broome region.

Pentacta robusta

Colochirus robustus Östergren, 1898*a*. Zool. Anz., vol. 21, no. 552, p. 134.
Colochirus squamatus Sluiter, 1901. "Siboga" Hol., p. 101; pl. 8, fig. 3, no. 6.
Colochirus robustus Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 14; pl. 3, figs. 8, 9.

It is with no little hesitation that I include this *Pentacta* in the Australian fauna. Only my respect for Ekman's work induces me to accept his identification of a holothurian from southwest of Cape Jaubert with Östergren's species from Korea. His belief that Sluiter's East Indian species is the same as Östergren's is also hard for me to accept. The Cape Jaubert specimen, which is 51 mm. long, may be identical with Sluiter's from the East Indies, but even this needs verification.

Pentacta cucumis

Colochirus cucumis Semper, 1868. Holothurien, p. 58; pl. 13, fig. 17; pl. 14, fig. 16.
Pentacta cucumis H. L. Clark, 1921. Ech. Torres Strait, p. 171.

Sluiter (1894) identified one of the holothurians collected by Semon in Torres Strait as *cucumis*, and I (1932) have called a specimen collected by the Great Barrier Reef Expedition at their station 16 by the same name. On this very uncertain basis, the species is here included in the fauna of Australia.

Pentacta tuberculosa

Holothuria tuberculosa Quoy and Gaimard, 1833. Voy. "Astrolabe," vol. 4, p. 131.
Colochirus tuberculosus Semper, 1868. Holothurien, p. 239.
Colochirus anceps Semper, 1868. Holothurien, p. 57; pl. 12, fig. 1 (colored).
Pentacta tuberculosus H. L. Clark, 1921. Ech. Torres Strait, p. 171.
Pentacta tuberculosa H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 230.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 452; pl. 16, fig. 2 (colored).

This is one of the commonest species of the genus, ranging from southern Japan throughout the East Indian region to Port Jackson, New South Wales. On the tropical coasts of Australia, it is found from northern Queensland westward to Shark Bay. It is one of the common holothurians at Broome, occurring with *P. crassa* around the timbers of the jetty, but easily distinguished by its bright red and yellow colors. Full-grown specimens exceed 100 mm. in length. It is odd that Ekman (1918) did not find *tuberculosa* among the holothurians collected southwest of Cape Jaubert by Mjöberg, where 7 species of *Pentacta* were taken.

Pentacta dispar

Colochirus dispar Lampert, 1889. "Gazelle" Hol., p. 820.
Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 32; pl. 3, fig. 25; pl. 4, fig. 26.

Lampert's material consisted of 3 specimens, 42–50 mm. long, from Mermaid Strait on the northwestern coast of Australia. Ekman had a single specimen 45 mm. long from southwest of Cape Jaubert, some 300 miles east of Mermaid Strait. No further specimens have been reported. Possibly *dispar* is only a form of *australis*.

Pentacta trimorpha

H. L. Clark, 1921. Ech. Torres Strait, p. 171; pl. 37, figs. 1–8.

This species rests on a single small specimen, only 10 mm. long, taken at the Murray Islands in 1913. The color in life was purplish brown, the tentacles much darker. The calcareous particles seem to be distinctive, but of course a single specimen proves nothing.

PSEUDOCOLOCHIRUS

Pearson, 1910. Proc. Zool. Soc. London, p. 172.

Genotype: *Colochirus violaceus* Théel, 1886, p. 78.

So few holothurians referable to this genus have yet been taken, and their distribution is so scattered, it is by no means certain whether there are 4 species as now listed, or only 2. There is no doubt, however, that 1 occurs on the northwestern coast of Australia.

Pseudocolochirus axiologus

Colochirus axiologus H. L. Clark, 1914. Rec. W. Australian Mus., vol. 1, p. 171; pl. 25.
Pseudocolochirus axiologus H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 456.

The types of this extraordinary holothurian were taken at Port Hedland, Western Australia, and are in the Perth Museum, but additional material taken by Mjöberg at Cape Jaubert and Broome and carefully described by Ekman (1918, p. 26; pl. 2, fig. 1; pl. 3, figs. 16–19) contributed much to our knowledge. In 1932, 3 additional specimens, 1 of which was a huge adult, were taken at Pender Bay, northeast of Broome, and the following year Bardwell took 3 specimens still farther east, at Augustus Island. Owing to the peculiar shape of the animal, the length along the mid-ventral ambulacrum is 2.5–3 times the length of the mid-dorsal interambulacrum. In life the largest specimen was 125 mm. dorsally, but 325 mm. ventrally. Preservation in alcohol, however, caused a shrinkage to 75 and 150 mm. respectively. The coloring in life is surprisingly bright for a holothurian: yellow, blue (on interambulacra), and bright red (on ambulacra). The tentacles are white, brown, and orange. Preserved specimens are rose-purple, dull purplish gray, violet, reddish, or yellowish buff, giving little indication of the brilliant colors of the living animal.

APENTACTA, gen. nov.

Body form intermediate between *Pentacta* and *Thyone*, resembling the former in the 5 oral valves, but lacking the firm body wall with its 3 characteristic layers of calcareous deposits and its tendency to a quadrangular form. The resemblance to *Thyone* is in the pliable body wall, with numerous pedicels all over the body, not in longitudinal series. From both genera, *Apentacta* differs in the presence of a longitudinal series of 3–7 or more conical, more or less calcareous processes on each side of the body.

Genotype: *Holothuria spinosa* Quoy and Gaimard, 1833, p. 118.

In order that the line between *Pentacta* and *Thyone* may be definitely drawn, the curious, endemic holothurian discovered by the "Astrolabe" at Port Jackson must be placed in a genus by itself. Monotypic genera are often a nuisance, but certainly cannot always be avoided.

Apentacta spinosa

Holothuria spinosa Quoy and Gaimard, 1833. Voy. "Astrolabe," vol. 4, p. 118; Zoophytes, pl. 7, figs. 1–10.
Colochirus spinosus Selenka, 1868. Ztschr. f. wissensch. Zool., vol. 18, p. 117.
Théel, 1886. "Challenger" Hol., p. 76; pl. 6, fig. 12; pl. 14, figs. 3, 4.
Stereoderma validum Bell, 1884. "Alert" rept., p. 150; pl. 9, figs. E*a–f*.

This interesting holothurian is well known from Port Jackson and the neighboring coast to the north, but does not seem to have been taken elsewhere in Australia, save for Joshua's report (1914) of 5 specimens in the National Museum of Melbourne, supposed to be from "Victorian waters." In 1915, Joshua kindly presented to the Museum of Comparative Zoölogy a small holothurian taken at Point Cooke, Victoria, which he had labeled *Colochirus spinosus*. As it is only 12 mm. long, and strongly contracted, its identity is very doubtful. Bell reports his *Stereoderma validum* as from "China" and from "between Balls Head and Goat Island." It will be an interesting fact if the species is really confined to the vicinity of Port Jackson. It is a small form, 50–80 mm. long, and the color, as shown by Quoy and Gaimard, is dull gray (beneath?) and reddish.

ACOLOCHIRUS, gen. nov.

Body elongate, quadrangular, with 5 oral valves at anterior end. Body wall hard, leathery, almost inflexible (in preserved specimens), covered with numerous small, rounded, white, hard, calcareous protuberances, each penetrated by a minute retractile pedicel. Ventral pedicels not in defined series, except on mid-ventral radius.

Genotype: *Colochirus challengeri* Théel, 1886, p. 80.

As in the case of *Apentacta*, it has been necessary to establish a separate genus for this peculiar holothurian, in order to give definite limits to *Pentacta* and *Thyone*. It is endemic in tropical Australia and has no near allies.

Acolochirus challengeri

Colochirus challengeri Théel, 1886. "Challenger" Hol., p. 80; pl. 6, fig. 11; pl. 14, figs. 1, 2.

Although Théel considered this holothurian nearly related to the preceding (*spinosus*), the differences are so obvious and striking, they can hardly be denied. The "Challenger" took 3 specimens in 8 fms. in Torres Strait, and the "Siboga" took 1 large specimen in 31 fms. near the Aru Islands. Preserved specimens are dark brownish gray with lighter bands along the ambulacra. The size is notably large, 150 mm. from mouth to anus.

PENTATHYONE

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 458.

Genotype: *Thyone mirabilis* Ludwig, 1874, p. 93.

This is a monotypic genus also, but very different from either of the preceding, as the body wall contains relatively little calcareous matter.

Pentathyone mirabilis

Thyone mirabilis Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 93; pl. 6, fig. 18.
Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 362; pl. 5, fig. 8.
Cucumaria areolata Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 35.
Pentathyone mirabilis H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 459; pl. 16, fig. 3 (colored).

This well marked species is common on the tropical coast of Australia from Port Curtis, Queensland to Shark Bay, Western Australia. In life, large specimens exceed 100 mm. in length, but they are only 60–80 mm. when preserved. There is very great diversity of color, but adults are commonly brown of some shade, with the tips of the papillae bright red. For more details see H. L. Clark, 1938, pages 458–461.

ORBITHYONE

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 473.

Genotype: *Orbithyone megapodia* H. L. Clark, 1938, p. 473.

Still another monotypic genus is this, and based on a single specimen. But the characters are so well marked, it would be too bad to include the specimen in any known species or genus.

Orbithyone megapodia

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 473 (not figured).

The single specimen on which this species is based was collected at Broome, on a muddy bottom in 5–7 fms., in June 1932. It is only about 15 mm. long and 7 mm. in diameter. The pedicels are very large and numerous, with large end plates, but there are no supporting rods, nor are there calcareous particles in the body wall. On the other hand, the tentacles are richly supplied with rods both large and small.

STAUROTHYONE

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 474.

Genotype: *Staurothyone distincta* H. L. Clark, 1938, p. 475.

Five species are referred to this genus, of which 3 are from Australia. A fourth (*Thyone sargassi* Lampert) is known only from a single specimen, found floating in *Sargassum*, off northwestern Australia just outside the artificial limits of this work. As material in the genus is scanty and widely scattered, there is no certainty that more than 3 species exist. The Australian forms are distinguished by their calcareous particles, thus:

Key to the Species of Staurothyone

A. Cruciform particles longer than wide, terminal branches not rounded at tips:
  Cruciform particles with no vertical thorns rising from surface; associated with numerous slender rods and rosettes ..... *inconspicua*
  Cruciform particles with vertical thorns rising near corners; not associated with slender rods, but rosettes occur ..... *vercoi*
AA. Cruciform bodies large, as wide as long, terminal branches rounded at tips ..... *distincta*

Staurothyone inconspicua

Cucumaria inconspicua Bell, 1887. Proc. Zool. Soc. London, p. 532; pl. 45, fig. 3.
Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 3.
Staurothyone inconspicua H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 475.

Bell's specimens, averaging 17×6 mm., came from Port Phillip Heads, Victoria, but Joshua (1914) reports numerous specimens from Flinders. The following year he and Creed reported 3 specimens in the South Australian Museum taken by Verco, presumably in St. Vincent Gulf. Joshua thinks the species is very close to the Chilean species *Cucumaria parva* Ludwig, but the latter does not seem to be a *Staurothyone*. It is nevertheless interesting to note that both species have a brood-sheltering habit. Joshua refers to *inconspicua* as "little," but he gives no information as to size, color, or structure. Bell's account of the calcareous ring is vague and unsatisfactory; the word "fine" occurring in it is probably a misprint for "five." Apparently, however, it is the ring of a *Staurothyone*. Thanks to Joshua's generous kindness, there are specimens of *inconspicua* in the Museum of Comparative Zoölogy, and dissection of one shows that the calcareous ring is similar to that of *Staurothyone distincta*.

Staurothyone vercoi

Thyone vercoi Joshua and Creed, 1915. Trans. Roy. Soc. S. Australia, vol. 39, p. 19; pl. 2, figs. 2–4; pl. 3, figs. 1, 4.

Only a single specimen of this perplexing form is known. It was collected by Verco and hence probably came from St. Vincent Gulf. It is 36 mm. long, thickly covered with pedicels not arranged in rows, but perhaps less numerous dorsally. The calcareous ring is stout, the radial pieces prolonged posteriorly. The tentacles are

10 in number, the dorsal 2½ times as long as the ventral. The calcareous particles are minute cruciform bodies with small vertical spines, and a few rosettes. Numerous "digitiform bodies" crowded full of rosettes are dependent on the inner surface of the anterior part of the pharynx. These may be pathological. Thanks to the kindness of Joshua, beautifully prepared slides, one showing the cruciform bodies, and one, several of the pharyngeal appendages, are in the Museum of Comparative Zoölogy collection. They leave little room for doubt as to the validity of the species, but it is probably not a *Staurothyone*. Deichmann thinks it is identical with *Lipotrapeza vestiens*.

Staurothyone distincta

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 475; figs. 44*a–c*.

Although only 2 specimens of this holothurian were taken, its distinctiveness is outstanding. The smaller specimen was 25 mm. long, the larger 40. The latter had evident anal teeth; in the former they were not visibly developed. In the smaller specimen the tips of the pedicels are dark brown, in marked contrast with the gray-brown body wall, but in the larger the tips are yellowish brown, in very little contrast with the body color. Both specimens were taken at Broome in 1932.

THYONE

Oken, 1815. Lehrb. Naturgesch., pt. 3, p. 351.

Genotype: *Holothuria fusus* O. F. Müller, 1776, p. 232.

This is a large and heterogeneous group badly in need of a careful revision. Its representatives occur in all parts of the world, with rather more than a dozen in Australia. As a rule, they live on muddy or sandy bottoms, but some species are associated with rocks or corals. The species are for the most part small, in only a few cases exceeding 100 mm. in length. The color ranges from white to almost black but is never notable in any way. The Australian forms show considerable diversity, but the validity of some is still open to question. At present, they are distinguishable as follows:

Key to the Species of Thyone

A. Calcareous particles more or less abundant in body wall:
  B. Calcareous particles very numerous, skin crowded with very small plates, mostly smooth and flat with 2–30 perforations, but some thick, prickly, and without perforations ..... *perissa*
  BB. Calcareous particles not as above:
    C. Calcareous ring with more or less elongated and jointed posterior prolongations on radial pieces:
      D. Calcareous particles more or less well formed tables:
        E. Tables with 4 large, symmetrically placed perforations in disk, and spire of 2 vertical rods:
          Disk of tables about as wide as long, usually with 4 small holes alternating with the large ones ..... *papuensis*
          Disk about twice as long as wide, without supplementary perforations ..... *micra*

        EE. Tables usually with more than 4 perforations in oblong, elliptical, or roughly circular, more or less irregular disk:
          F. Tables with oblong or squarish disks with 6–10 small perforations, stout spire with spiny, oblong top, and conspicuous half-ring on lower surface ..... *axiologa*
          FF. Tables not as above:
            G. Tables with roughly circular disk, with 20–30 perforations ..... *perforata*
            GG. Tables stout, with more or less elongated oval or elliptical disks with 5–15 holes; radial pieces of calcareous ring with short, abruptly tapered posterior prolongations ..... *grisea*
            GGG. Tables with irregularly oval or triangular disks with 6–12 perforations; radial pieces of calcareous ring with long, slender posterior prolongations:
              White, with pedicels cream color ..... *alba*
              Deep purplish black, with white pedicels ..... *nigra*
      DD. Calcareous particles not tables, but knobbed buttons:
        Buttons very numerous, with many knobs on one side and often with vertical half-circle or arch on one side or both ..... *buccalis*
        Buttons not crowded, with fewer knobs and no arch ..... *minuta*
    CC. Calcareous ring stout, with relatively short projections on radial pieces:
      Calcareous particles stout tables or plates with spiny projections horizontally ..... *sluiteri*
      Calcareous particles knobbed buttons and delicate baskets ..... *gazellae*
AA. No calcareous particles in body wall, but terminal plates in pedicels ..... *okeni*

Thyone perissa

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 471; fig. 43.

The holotype is as yet the only recorded specimen of this remarkable *Thyone*. In life it was undoubtedly well over 100 mm. in length. The color was yellowish white with the numerous pedicels brown-black in sharp contrast. It was collected by a diver from "a hole in a rock," off Cape Villaret, Western Australia, in 5 fms. Deichmann thinks it is probably a *Phyllophorus*, and in that case identical with *P. magnus* Ludwig.

Thyone papuensis

Thyone fusus var. *papuensis* Théel, 1886. "Challenger" Hol., p. 92; pl. 7, fig. 1.
Thyone castanea Lampert, 1889. "Gazelle" Hol., p. 836.
Thyone papuensis H. L. Clark, 1921. Ech. Torres Strait, p. 167.

The "Challenger" took a single specimen in Torres Strait in 8 fms. The "Gazelle" took 3 specimens in Mermaid Strait, Western Australia, in 2–3 fms. The Great Barrier Reef Expedition took 3 specimens in the Low Isles region on the Queensland coast, 1 of which when extended was 100 mm. long. At Broome, we obtained 8 specimens, from 12 to 75 mm. in length. Apparently, this *Thyone* may be expected anywhere on the tropical coasts of Australia where local conditions are suitable, but

it is obviously not abundant, or possibly its chief habitats are such that it is not easily taken. The color ranges from yellowish brown to dull brown.

Thyone micra

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 468; fig. 41.

This little *Thyone* was collected in 5–7 fms. on sandy mud at Pearl Shoal near Broome, and farther southward near or in Lagrange Bay. Only 9 specimens were taken, all less than 20 mm. in length. They were pale brown, often with 5 darker longitudinal lines which may indicate the interambulacra. The larger tentacles are blackish brown, much darker than the yellowish-brown small pair. All tentacles have minute white spots on the inner surface, due to accumulations of calcareous rosettes.

Thyone axiologa

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 465; fig. 39.

A single specimen of this well marked species was taken at Broome in 1929. In 1932, we looked for it in vain. It was found clinging to the under side of a rock near low-water mark at Entrance Point. It is 35 mm. long, the spindle-shaped body 8 mm. in diameter near the middle. The color is light gray, with yellowish tentacles, and many pedicels faintly red or rust color at tip.

Thyone perforata

H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 222; figs. 1–3.

Like several other Thyones in the Australian list, this species is based on a single specimen. The calcareous tables are very distinctive, but as the unique holotype is less than 20 mm. long, it is probably immature, and the tables in the adult may be quite different. At station XII, in "Penguin Channel, 10–15½ fms., rock and shell gravel, mud on edges of pit," this little holothurian was taken by the Barrier Reef Expedition. The color is light gray with dark brown tentacles.

Thyone grisea

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 467; fig. 40.

This is a fairly common holothurian at Broome and southwestward along the coast. In habitat and habits it is much like *buccalis*, and the two are associated on the jetty flat at Broome. Full-grown specimens of *grisea* exceed 50 mm. in length. The color is gray-brown, ranging from light to dark; some individuals are a dull purplish, others more of a red-brown. The tentacles are commonly darker than the body wall.

Thyone alba

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 464; fig. 38.

This species rests on a single specimen, 21 mm. long, taken in sandy mud on the jetty flat at Broome, near normal low-water mark, in August 1929. Repeated efforts

during the following month and in 1932 failed to find another specimen. In life, it was "pure white, rather Cucumaria-like, long pedicels." It is now white, with pedicels cream color and posterior tip of the body grayish.

Thyone nigra

Joshua and Creed, 1915. Trans. Roy. Soc. S. Australia, vol. 39, p. 20; pl. 3, figs. 3, 4.

This species also rests on a single specimen, taken by Verco, presumably in St. Vincent Gulf, South Australia, and now in the South Australian Museum. The describers say nothing as to the size of the animal, but it must be very small, for they say that the Polian vessel, 3 mm. long, is "very large in proportion to the size of the animal." The calcareous ring is notable and probably a good species character.

Thyone buccalis

Stimpson, 1855. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 386.
Stolus sacellus Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 355; pl. 20, figs. 115, 116.
Thyone rigida Semper, 1868. Holothurien, p. 66; pl. 13, fig. 23.
Stereoderma murrayi Bell, 1883. Proc. Zool. Soc. London, p. 61; pl. 15, fig. 6.
Thyone sacellus Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 360.

With a distribution ranging from Delagoa Bay to Aden on the west and from Port Jackson to Japan on the east, this is one of the commonest holothurians of the Indian Ocean. It occurs on the tropical coasts of Australia from Shark Bay to Queensland and south even to Port Jackson. At Broome it is one of the holothurians most abundant on the jetty mud flat, especially in the soft mud around groups of partially buried rocks. Commonly 75–90 mm. long, it sometimes reaches 110 mm. The color ranges from bright yellow-brown, red-brown, or seal brown to purplish black, with the tentacles much darker, often nearly black.

One specimen, collected on the jetty flat at Broome, was so conspicuously different from all the others seen that it was supposed to be a different species, but critical study showed it to be different only in coloration. It was pure white with light brown tentacles. It is perhaps simply an albino, but for convenience of reference it seemed best to call it var. *pallida*, and it has been described and discussed under that name (H. L. Clark, 1938, p. 462). The preserved specimen is still a clear cream white.

Thyone minuta

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 470; fig. 42.

This curious little holothurian, usually less than 30 mm. long, is locally very common at Broome but seems to be wanting from many apparently just as suitable places. It occurs in great numbers on the inner side of Pearl Shoal, where there are many dead shells on a sandy-mud bottom; a habitat it shares with the much rarer *T. micra*. The color is white with more or less numerous minute blotches and spots of some shade of brown. When these are few, the color appears white; when they are abundant, the general effect is light brown.

Thyone sluiteri

Lampert, 1889. "Gazelle" Hol., p. 838; pl. 24, figs. 9*a–c*.

Lampert was unwilling to open the unique holotype in order to count and examine the tentacles, so he indicated the genus with a question mark, and until more material is available the status of this interesting holothurian must remain obscure. Deichmann thinks it is a *Phyllophorus* and probably identical with Bell's *P. proteus*. The holotype, taken in Mermaid Strait, northwestern Australia, was only 25 mm. long.

Thyone gazellae

Colochirus gazellae Lampert, 1889. "Gazelle" Hol., p. 823; pl. 24, figs. 5*a–c*.
Sluiter, 1901. "Siboga" Hol., p. 98; pl. 2, fig. 4 (colored).

The Museum of Comparative Zoölogy has 3 of the "Gazelle" specimens and 2 collected by the "Siboga," and I am obliged to disagree with my European colleagues as to the generic position of this holothurian. As is well shown by Sluiter's colored figure, the general appearance is surely that of a *Thyone* and not at all that of a true *Pentacta* (= *Colochirus*). Moreover, the calcareous particles in the relatively flaccid body wall are obviously not those of *Pentacta*. The 5 oral valves are an indication of a *Pentacta* relationship, but there are Thyones in which such valves are indicated if not fully formed.

Both the "Gazelle" and the "Siboga" took large numbers of specimens, but only at a single station each: the "Gazelle," in Mermaid Strait in 2.5–7.5 fms.; the "Siboga," on the east coast of Sumbawa in 20 fms. Obviously this holothurian is local and gregarious. It grows to a length of 80 mm., and its brilliant vermilion-red coloring is very striking.

Thyone okeni

Bell, 1884. "Alert" rept., p. 149; pl. 9, fig. II.

This is an endemic holothurian of obvious rarity, easily recognized by the absence of calcareous particles from the body wall, though end plates are present in the numerous pedicels. Bell's types are supposed to have been taken in Port Jackson, but no other report of the species has come from there. The only other known specimen of *okeni* is the one taken near Thursday Island, by the Carnegie Expedition to Torres Strait in 1913 (see H. L. Clark, 1921, p. 167). This individual was brownish in life, the pedicels with a reddish tint. Bell says his specimens were 62 and 85 mm. long and very dark brown.

ACTINOCUCUMIS

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 91.

Genotype: *Actinocucumis typica* Ludwig, 1874, p. 91.

This genus was monotypic when established; a second species was added by Bell in 1884 but not generally accepted as valid. Ludwig's material was from Bowen, Queensland, Bell's from Albany Island, Torres Strait. Pearson (1903) added a third species from Ceylon, but as it is based on a defective specimen only 15 mm. long, it cannot be accepted as an *Actinocucumis* at all. That the genus has been reported from several places along the southern and southeastern Asiatic coast is beyond question, nevertheless it is notable that the "Siboga" took but 2 small specimens in the East Indies, and the "Investigator" failed to obtain any in Indian seas. Even if it is not endemic in Australia, there is no doubt that the tropical coasts of that continent are the real home of *Actinocucumis*. Apparently 4 species occur there; particularly at Broome, *Actinocucumis* is common. A discussion of the occurrence, validity, and characteristics of 3 of the species will be found in H. L. Clark, 1938, pages 477–481. The fourth has been found as yet only on the Queensland coast. Material is so scanty, there is room for much difference of opinion as to the number of species that may wisely be recognized. Deichmann inclines to think there is but 1 or possibly 2 species, whereas I am disposed to recognize 4, and I offer the following tentative key to these:

KEY TO THE SPECIES OF ACTINOCUCUMIS

A. Large, 75–135 mm. long when adult; pedicels rather short and thick, especially dorsally, few and short around anus; supporting tables in pedicels stout; no delicate biperforate plates in skin:
  B. Color brown with reddish tinge, not darker on interambulacra; small, imperfect pedicels numerous dorsally, but relatively few around anus; acorn-shaped spicules abundant ..... *typicus*
  BB. Color white or whitish, or purplish gray, often darkest on interambulacra; small, imperfect pedicels not numerous dorsally:
    Color tending to purplish gray, darkest on interambulacra; pedicels numerous around anus; body wall firm but not rigid; acorn-shaped particles many ..... *difficilis*
    Color nearly or quite white; pedicels few around anus; body wall more or less rigid; no truly acorn-shaped particles ..... *quinquangularis*

AA. Small, 50–80 mm. long; pedicels long and slender, even dorsally and particularly so around anus; supporting rods in pedicels few and slender; delicate biperforate plates common, particularly in and near pedicels ..... *longipedes*

Actinocucumis typicus [1]

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 91; pl. 7, fig. 24.

The largest specimen taken of this species was 175 mm. long in life, but is only 135 mm. in its preserved condition (in alcohol). Unlike all the other specimens seen, it was dull purplish in color, not the normal walnut brown. Although the range of *typicus* is from Bowen, Queensland, to Shark Bay, Western Australia, it is not so common in the Broome district as the following species, and was never collected living near low-water mark. The records from Karachi, Amoy, and other Asiatic points need confirmation.

Actinocucumis difficilis

Bell, 1884. "Alert" rept., p. 148; pl. 9, fig. C.

Bell does not say how many specimens he had, but only that they came from Albany Island, which is at the southeastern entrance to Torres Strait. No later

[1] Ludwig used the feminine form, *typica*, but *cucumis* is a masculine noun.

writer has considered Bell's species valid, but at Broome it is apparently common and definitely different from *typicus*. It may reach a length of 100 mm. in life, but is usually smaller. Although it was occasionally taken at extreme low-water mark, most specimens were dredged in 5–7 fms.

Actinocucumis quinquangularis

Pseudocucumis quinquangularis Sluiter, 1901. "Siboga" Hol., p. 108; pl. 6, figs. 92–*f*.
Engel, 1933. Mém. Mus. roy. hist. nat. Belgique, hors sér., vol. 3, fasc. 13, p. 13; figs. 13, 14.

The status of this species is open to serious question. If Engel's identification and figures are correct, as seems probable, then "*quinquangularis*" is better placed in *Actinocucumis* than in *Pseudocucumis*, as the spicules indicate. Two large specimens from Lindeman Island, Queensland, collected by Melbourne Ward and presented by him to the Museum of Comparative Zoölogy, have very similar spicules and might be considered adults of Sluiter's species, but Deichmann thinks them an unnamed form. They are about 100 mm. in length, nearly pure white in color, and the pedicels are pretty uniformly scattered over the body as in *Phyllophorus*. But the spicules are like *Actinocucumis*, and for the present these specimens may be associated with that genus.

Actinocucumis longipedes

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 480; fig. 45.

This species, known as yet only from the Broome region, was taken when dredging in 5–7 fms., off Roebuck Bay or along the neighboring coast. It is smaller than either of the preceding, usually 50–70 mm. in length. The color is commonly deep purplish brown or brownish purple, with the tentacles very dark, sometimes almost black. The long pedicels are the distinguishing character.

DISCUCUMARIA, gen. nov.

Genotype: *Cucumaria africana* Semper, 1868, p. 53.

No other holothurian having been found with the big, rough, lenticular plates so characteristic of *africana*, it is necessary to recognize a monotypic genus for that species.

Discucumaria africana

Cucumaria africana Semper, 1868. Holothurien, p. 53.
Pseudocucumis théeli Ludwig, 1887. Sitzungsber. K. preuss. Akad. Wissensch., vol. 54, p. 1236; pl. 15, figs. 12–16.
Pseudocucumis africana Ludwig, 1888. Zool. Jahrb., Abt. syst., vol. 3, p. 815.

This is a widely distributed little holothurian, dull purplish or nearly black in life, becoming brown or even yellowish brown in alcohol. It rarely exceeds 50 mm. in length, and alcoholic specimens are much less. The large, rough plates in the skin (well figured by Ludwig) are very distinctive and can easily be seen with a hand lens. The species has a wide range, from the east coast of Africa to southern Japan and the East Indies. On the tropical coasts of Australia it is found from

Queensland to northwestern Australia. It is common at Low Isles, at the Murray Islands, and at Broome. The little animals live in the crevices and crannies of rocks and coral fragments, whence it is sometimes difficult to dislodge them.

PSEUDOCUCUMIS

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 90.

Genotype: *Cucumaria acicula* Semper, 1868, p. 54.

It is an interesting fact that although 15 species or more have been assigned to this genus, not one of them has calcareous spicules in any degree like those of the genotype. It seems best, therefore, to consider *Pseudocucumis* monotypic, containing only Semper's species. Deichmann considers the relationship to *Urodemas* of Selenka so close she would unite the two genera under the latter (earlier) name, but I am quite unable to agree to this.

Pseudocucumis aciculus

Cucumaria acicula Semper, 1868. Holothurien, p. 54; pl. 15, fig. 11.
Pseudocucumis acicula Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 90.
H. L. Clark, 1921. Ech. Torres Strait, p. 169; pl. 19, fig. 2 (colored).

Although its range extends from Mauritius to Fiji, this handsome holothurian does not seem to be common anywhere, but a number of specimens were taken at the Murray Islands by the Carnegie Expedition in 1913. Nowhere else in Australia has it yet been found, nor was it met with by the "Siboga" in the East Indies, although it certainly occurs in the Philippines. Semon took a specimen at Amboina in 1893. Large individuals when extended are 80–100 mm. in length, but contract to about half that size. They are normally brown-orange or orange-brown; when the brown pigment is excessively developed they may be nearly black, whereas if it is little developed they are bright orange. The tentacles are brown, more or less variegated with whitish.

MENSAMARIA,[1] gen. nov.

Tentacles 20 or usually more, often of diverse sizes. Pedicels more or less confined to ambulacra. Calcareous particles more or less abundant, including tables of some sort, though these may have either the disk or the spire or both more or less asymmetrical or irregular.

Genotype: *Pseudocucumis intercedens* Lampert, 1885, p. 254.

There is room for difference of opinion as to how many of the species supposed to be *Pseudocucumis* are congeneric with *intercedens*, but for the present, it seems best to let the 2 New Zealand species remain in this association. Probably, however, they will ultimately be removed, as the differences are obvious. Engel's careful work (1933) is an excellent start in analyzing the group as at present known, but far more material is essential.

[1] *Mensa* = a table, in reference to the characteristic deposits.

KEY TO THE SPECIES OF MENSAMARIA

A. Tables numerous, for the most part with symmetrical circular or elliptical bases perforated by 4 large and 4 small (alternating) holes ..... *bicolumnata*
AA. Tables with irregular, asymmetrical disks, often with 10 or more holes:
Spire of tables high, equal to long diameter of disk ..... *intercedens*
Spire of tables low and often imperfect, equal to about one-half disk length ..... *thomsoni*

Mensamaria bicolumnata

Pseudocucumis bicolumnatus Dendy and Hindle, 1907. Jour. Linn. Soc. (Zool.), vol. 30, p. 106; pl. 11, fig. 6; pl. 12, figs. 13, 14.

The admission of this New Zealand species to the Australian fauna is due to the statement of Joshua and Creed (1915) that "there is an excellently preserved and very typical specimen" in the South Australian Museum, collected by Verco. Dendy and Hindle had but a single specimen, only 35 mm. long and fully contracted; the Australian authors did not give even the size and color of their specimen. As Mortensen did not meet with the species in New Zealand, it is obvious that it is a rare form and still very imperfectly known.

Mensamaria intercedens

Pseudocucumis intercedens Lampert, 1885. Seewalzen, p. 254.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 482; pl. 16, fig. 6 (colored).
Pseudocucumis eurystichus H. L. Clark, 1921. Ech. Torres Strait, p. 169; pl. 37, figs. 9–19.

There is no doubt that the holothurian which I collected at Friday Island in Torres Strait in 1913 and called *eurystichus* is identical with Lampert's species, based on a specimen from an unknown locality. The matter is amply discussed in H. L. Clark, 1938, pages 482–484. In life, this is a very handsome holothurian with its red and dark blue-violet coloration. Nearly all known specimens are less than 75 mm. long, but an adult from Broome is 115 mm. The range of the species is from King Sound, Western Australia, northward to Amoy, China, eastward to Torres Strait, and along the tropical coast of Australia to Penguin Channel and Direction Island, northern Queensland.

Mensamaria thomsoni

Cucumaria thomsoni Hutton, 1879. Trans. Proc. New Zealand Inst. (1878), vol. 11, p. 307.
Cucumaria mutans Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 4; pl. 1, figs. 1*a–d*.
Pseudocucumis thomsoni Mortensen, 1925. Vidensk. Medd., vol. 79, p. 355; figs. 38–40.

The right of this New Zealand species to a place in the Australian fauna is based on 3 relatively young specimens collected in 5 fms. in Tasmania by T. T. Flynn, and in 90 fms. in Western Australia, at the western end of the Great Australian Bight, by D. L. Serventy. But there can be little question that the material on which Joshua based his supposedly new *Cucumaria mutans* is really made up of young and adult specimens of a *Mensamaria*. This might seem incredible, but Joshua kindly sent 4 specimens of his proposed species to the Museum of Comparative Zoölogy, and Deichmann, noting that Joshua's figure of the calcareous ring indicated a polychirote form, discovered that the specimens have 20 (±) tentacles. Further investigation has convinced us that the specimens are "*Pseudocucumis thomsoni* Mortensen," which also was first described (by Hutton) as a *Cucumaria*. Joshua has given interesting information regarding size and color of both young and adult specimens. He says the color is at first "deep blue-black" "during life (and generally in alcohol)," but with increasing size this color disappears, and mature specimens are "nearly white." He gives the size as "length 60 mm., greatest width, 20 mm." The specimens sent the M.C.Z. were scarcely half so big. Joshua says it "is perhaps one of our commonest holothurians—the young forms being met with between tide-marks in all the localities in which I have collected." It has not yet been reported from east of Western Port, except in Tasmania and New Zealand, but it occurs at Bunkers Bay, southwestern Australia, and even northward to Cottesloe Beach, Western Australia (see H. L. Clark, 1938, p. 444). Further study of this holothurian in New Zealand, Victoria, and Western Australia may show that at least 2 and possibly 3 species are at present confused under one name.

PHYLLOPHORUS

Grube, 1840. Act. Ech. und Würm. des Adriatischen, etc., p. 38.

Genotype: *Phyllophorus urna* Grube, 1840, p. 39.

This widely distributed group includes more than 30 species of varying degrees of validity. That it is a heterogeneous assemblage is beyond question, but Ludwig (1887) considered it better to include them all under one name than to attempt to distinguish two or more groups on the lines that had been suggested. Deichmann (1930) intimated that a distinction between *Phyllophorus* and *Thyonidium* might be made, but added that our knowledge is still too imperfect to permit such a division. The situation is no better today in the Indo-Pacific area, although a number of new species have been added. Deichmann's (1938, 1941) important revisions of American species will no doubt be of assistance when adequate Oriental and Australian material is available.

Seven Australian holothurians are referred to *Phyllophorus*, but not one is known from adequate material; of only 1 have a dozen specimens been taken; of 2, 6 or 7 were available; of the others, 5 or fewer. None is based on a single specimen, but much of the material studied is youthful or in very poor condition. The species here recognized are distinguishable by their calcareous rings, and particles in the skin, and these suggest that at least 2 genera are represented.

KEY TO THE SPECIES OF PHYLLOPHORUS

A. Disk of calcareous tables in skin irregular or elongate, not approximately circular:
B. Disk cruciform or reduced to a bar forked at each end or quite irregular, usually with 4 large perforations, or so reduced only 2 or no perforations are enclosed; stout, sharp projections on disk margin and sometimes on surface:
Tables with spire ..... *holothurioides*
Tables with central spike or very imperfect spire ..... *brocki*

BB. Disk of tables not so stout, elongate, with 4 symmetrical perforations and 2 blunt points in different planes on margin, outside each one ..... *proteus*

AA. Disk of tables approximately circular, though margin may have projecting angles and points:

C. Disk symmetrical, more or less circular, with 8 marginal perforations and no projecting points ..... *cebuensis*

CC. Disk more irregular, usually with marginal projections:

D. Calcareous ring very broad; radial pieces 10 mm. high, with posterior prolongations only 5 mm. ..... *thyonoides*

DD. Calcareous ring not nearly so broad and stout:

Radial pieces of ring with posterior prolongations more than twice height of ring (as 8 to 3) ..... *parvipedes*

Radial pieces not so much prolonged (as 8 to 5) ..... *trapezus*

Phyllophorus holothurioides

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 96; pl. 6, fig. 23.
Ekman, 1918. K. svenska Vetensk.-Akad. Handl., vol. 58, no. 6, p. 50; pl. 2, fig. 12; pl. 5, figs. 47–51.

The unique holotype of this species is from an unknown locality. Three specimens have been reported from the East Indies, at wide intervals. Mjöberg took 1 small specimen southwest of Cape Jaubert, Western Australia, and the Great Barrier Reef Expedition took 2 very small specimens off the coast of northern Queensland. In view of the small size and contracted condition of most of this material, it is open to serious question whether a single species is represented, or 2 or more. Obviously a series of adults and young from a single locality is a *sine qua non* in determining the growth changes and the reliable specific characters. Ludwig's holotype, 75 mm. long, was white speckled with brown and with small irregular black blotches. Apparently Mjöberg's specimen, 33 mm. long, was similar, but the Barrier Reef specimens, only 25 mm. long, were unicolor, one dark gray, the other light brown. Deichmann is satisfied that Mjöberg's specimen is *proteus* Bell, and the Barrier Reef material also.

Phyllophorus brocki

Ludwig, 1888. Zool. Jahrb., Abt. syst., vol. 3, p. 813; pl. 30, figs. 21–25.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 485; fig. 46.

Only 4 specimens of *brocki* are known from Australia, all from Augustus Island, Western Australia. A full account of these in comparison with Ludwig's and Sluiter's specimens is given in H. L. Clark, 1938. This is perhaps the largest of the Australian species, with a length much in excess of 100 mm. The color of preserved specimens is brown, and the pedicels have the tips noticeably darker and the walls white-dotted with little heaps of calcareous rosettes.

Phyllophorus proteus

Bell, 1884. "Alert" rept., p. 150; pl. 9, figs. F, F′.
H. L. Clark, 1921. Ech. Torres Strait, p. 168.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 488.

This is apparently an endemic species ranging from Port Molle, Queensland, northward to Torres Strait and thence westward to Darwin, Augustus Island, and Broome. Bell gives no hint as to the number of specimens in the "Alert" collection, but one of them is now in the Museum of Comparative Zoölogy, so it has been possible to compare it with the material from Darwin and Western Australia. The largest was one of those from Darwin, 100 mm. long in life, about 60 mm. in alcohol. The brown-red color in life was "masked by dusky blotches and fine sprinkling." It is now dirty white masked by very fine, irregular transverse lines of brown; the pale brown pedicels are whitish at base but blackish at tip. Other specimens are brown, dark gray, or dull purplish.

Phyllophorus cebuensis

Thyonidium cebuense Semper, 1868. Holothurien, p. 67; pl. 12, fig. 5 (colored); pl. 13, fig. 25; pl. 15, fig. 8.
Phyllophorus cebuensis Ludwig, 1892. Bronn's Klass. Ord. Thierreichs, vol. 2, pt. 3, bk. 1, p. 347.

To Semper's 3 specimens may be added 1 taken by the "Siboga" and 1 by the "Gier," in the East Indies, and 1 from Dongarra, Western Australia, in the Museum of Comparative Zoölogy. In view of this scanty and apparently youthful material, the status of the species is very uncertain. There is nothing distinctive about Semper's figures, but the specimen from Dongarra resembles them in all essentials. Nevertheless the identity is open to question.

Phyllophorus thyonoides

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 492; fig. 48.

The material on which this species is based was washed up on the beach at Cottesloe, Western Australia, in 1926, in company with large numbers of *Lipotrapeza vestiens*. There were only 5 *Phyllophorus*, the largest 42 mm. long. Their color was brown, with fragments of a much darker epidermis here and there. Naturally the condition of the specimens is poor, but it is reasonable to believe that in life this holothurian is 75–80 mm. long and nearly black.

Phyllophorus parvipedes

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 489; fig. 47.

Only in the vicinity of Broome has this species been taken. The 4 known specimens range from 16 to 90 mm. in length. The small ones are light gray; the smaller was "translucent white" in life. The larger ones are darker, the holotype being gray, tinted with yellowish brown, with numerous irregular blotches of red-brown or blackish brown; the paratype has the blotches dusky purplish. The smallest specimen was taken at Beagle Bay, north of Broome, in 5 fms.

Phyllophorus trapezus

H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 224; figs. 4–9.

This species has been taken as yet only by the Barrier Reef Expedition, at the Low Isles, and south of Cape Kimberley, in 4 fms. The calcareous tables are very

characteristic, the tall, well developed spire being especially noticeable. The known specimens are all small, less than 50 mm. long, and it is possible that all are young. In that case, it might be that the adult would have the tables less regular and with a more or less resorbed spire. The color is a light yellowish brown in the holotype, darker in the other specimens.

URODEMAS

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 352.

Genotype: *Urodemas perspicillum* Selenka, 1867, p. 352.

Although established so many years ago, this genus was not recognized by Ludwig or Théel, and only in the past few years has its validity been appreciated. It is a group of East Indian and Australian species, related closely to *Phyllophorus* but easily distinguished by the remarkable rods in the body wall. Of the 4 species now known, 3 have been taken in Australia, the fourth only at Hong Kong. Deichmann thinks that *Urodemas* and *Pseudocucumis* are identical and that the former name, which is some years older, should replace the latter. This seems to me unlikely, since the type species of the two genera are so different in general characters.

Key to the Species of Urodemas

Calcareous rods minute, smooth, perforate at one end or both; in adults no other particles present, but in young, small tables and very irregular perforated plates also present ..... *perspicillum*

Calcareous rods long, perforated at inner end but terminating distally in spinous knob ..... *schmeltzii*

Calcareous rods more table-like, inner end like disk with 4 perforations, outer end showing much diversity but often like spiked club ..... *hamatum*

Urodemas perspicillum

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 352; pl. 20, figs. 110, 111.

For the complete synonymy and discussion of this big holothurian, characteristic of Port Jackson and not certainly known from elsewhere, see H. L. Clark, 1938, page 499. Adult specimens are 150–200 mm. long, and owing to the habit of contracting the oral end and swelling the body greatly, they are known to the dredgers as "footballs." Bell's (1884) bare reference of holothurians from the Queensland coast to "*Orcula perspicillum*" requires confirmation. The only information we have as to color is Théel's statement: "Color in alcohol, brown, lighter round the pedicels; ends of pedicels, black."

Urodemas schmeltzii

Thyonidium schmeltzii Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 94; pl. 6, fig. 20.
Urodemas schmeltzii H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 501.

Few holothurians are so easily recognized from their spicules as is this tropical Australian species, which ranges from Port Curtis, Queensland, to "45 miles, west

southwest of Cape Jaubert," Western Australia. This westernmost record is based on a specimen taken by Mjöberg, misidentified by Ekman (1918) as "*Phyllophorus hamatus* Sluiter." Ekman seems to have overlooked *schmeltzii*. At Broome, this holothurian is common, the series we obtained ranging in length from 8 to 85 mm. In life, they were of course considerably larger. The color was an unreliable factor, as it ranged from yellow or flesh red, through brown or olive to blackish. Alcoholic specimens range from light brown to deep purplish brown, sometimes almost black. Young specimens were found under rocks and among corals near low-water mark, but adults were more commonly dredged in 5–7 fms.

Urodemas hamatum

Phyllophorus hamatus Sluiter, 1914. Contr. Fauna Indes Néerl., vol. 1, p. 17; pl. 1.
Urodemas hamatum H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 502.

This species is very imperfectly known, and its right to a place in the Australian fauna rests on a single specimen, only 15 mm. long, taken at Broome in 1932. There are notable differences between this specimen and those of Sluiter, but it is much smaller than Sluiter's and the differences may be due only to the difference in age.

LIPOTRAPEZA

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 494.

Genotype: *Phyllophorus vestiens* Joshua, 1914, p. 5.

For species of *Phyllophorus* which lack calcareous particles in the body wall (not including the caudal end) this genus was instituted, and 3 Australian species are included therein. All 3 occur on the southern coast between Bass Strait and Cottesloe Beach, Western Australia. Probably the New Zealand species will ultimately be relegated to a genus of its own, but for the present it may remain here. Deichmann considers *dearmatus* to be a true *Phyllophorus*, and *ventripes* to be identical with *vestiens*, for which she would retain the generic name *Lipotrapeza*. The 3 nominal species here recognized are distinguishable thus:

Key to the Species of Lipotrapeza

A. Calcareous ring very high, polyplacous, with long posterior prolongations on radial pieces ..... *dearmatus*

AA. Calcareous ring not so high, stout, made up of relatively few pieces and with short prolongations on radial pieces:

Pedicels abundant on middle of lower surface, much less abundant anteriorly and posteriorly, and nearly or quite wanting on middle of back ..... *ventripes*

Pedicels very numerous all over body, with little distinction between dorsal and ventral surface ..... *vestiens*

Lipotrapeza dearmatus

Phyllophorus dearmatus Dendy and Hindle, 1907. Jour. Linn. Soc. (Zool.), vol. 30, p. 103; pl. 11, figs. 7, 8; pl. 12, fig. 15; pl. 13, fig. 20.
Mortensen, 1925. Vidensk. Medd., vol. 79, p. 353; figs. 36, 37.

This New Zealand holothurian has been reported from several places on the coast of Victoria, but has not yet been found farther west. Although Joshua (1914) lists the localities of the Victorian specimens, he gives no information about them. The holotype was 60 mm. long and there were "red-brown" spots on the tentacles, but no further hint as to color is given. Mortensen studied 2 New Zealand specimens but gives no hint as to size or color. Obviously more information is needed before the best generic position of this interesting holothurian can be determined. After examination of the specimens received by the Museum of Comparative Zoölogy from Joshua, Deichmann thinks that these are not identical with the New Zealand species, but should be referred to *Thyone*.

Lipotrapeza ventripes

Phyllophorus ventripes Joshua and Creed, 1915. Trans. Roy. Soc. S. Australia, vol. 39, p. 19; pl. 2, fig. 1; pl. 3, fig. 5.
Lipotrapeza ventripes H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 495.

During his extensive collecting on the South Australian coast, Verco took "several" specimens of this notable holothurian, probably in St. Vincent Gulf. They are 50–60 mm. long, with numerous pedicels, especially crowded on the mid-ventral surface. The color is light brown with the pedicels whitish. The original description requires some modification, but there is little doubt as to the validity of the species. It has not yet been met with elsewhere.

Lipotrapeza vestiens

Phyllophorus vestiens Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 5; pl. 1, figs. 2*a–f*.
Lipotrapeza vestiens H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 496.

With a known range from Wynyard, Tasmania, to Cottesloe Beach, Western Australia, this species is the commonest member of the genus. It is also much the largest, some of the individuals from Western Australia being 200–240 mm. long, even in their present contracted condition. It is likely that in life such individuals would be nearly or quite a foot long. Apparently the color in life is some shade of brown, but it is possibly reddish or reddish brown. Preserved material, if not bleached, is some shade of light brown. Nothing is known as to habits or habitat, but since specimens are washed up on beaches in considerable numbers after a storm, it is probable that the animals live more or less gregariously, just below the surface, on muddy bottoms in relatively shallow water, 2–5 fms. In heavy storms, wave action would wash them out and up onto the beach.

Family PSOLIDAE

This is a small group of only 5 or 6 genera, of which but 3 occur in Australia. The Australian forms are all inconspicuous animals, mostly small (less than 25 mm. in length), living on the under side of rock or coral fragments, or on the inner surface of the valves of dead bivalve mollusks, or even on the outer side of pearl shell. The genera are distinguished by the number of tentacles and the presence or absence of pedicels on the dorsal side; but the latter character is, on account of the very small size of the contracted pedicels, difficult to make out. The Australian species, however, are sufficiently different in general appearance or in the calcareous particles in the skin so that they will not be confused with one another, in life or when well preserved.

KEY TO THE GENERA OF PSOLIDAE

A. Tentacles 15 ..... *Stolinus*
AA. Tentacles 10:
  Dorsal surface without pedicels ..... *Psolus*
  Dorsal surface with at least a few pedicels ..... *Psolidium*

STOLINUS

Selenka, 1868. Ztschr. f. wissensch. Zool., vol. 18, p. 110.

Genotype: *Stolinus cataphractus* Selenka, 1868, p. 110.

This genus is still very imperfectly known, and few specimens have been available for study during the past half-century. The figures published leave no room for doubt that the genus is warranted and easily recognized, but whether there is more than one species and just where they occur are still to be determined. The types and occasionally some other specimens are said to be from "Australia." Erwe (1913) describes the largest reported individual and figures calcareous particles, but there was no definite locality label (only "West Australia") with the specimen.

Stolinus cataphractus

Selenka, 1868. Ztschr. f. wissensch. Zool., vol. 18, p. 110; pl. 8, figs. 1, 2.
Psolus (*Hypopsolus*) *ambulator* Bell, 1882. Proc. Zool. Soc. London, p. 648; pl. 48, figs. 2*a–b*.
Théelia ambulatrix Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 358; pl. 5, figs. 6*a–b*.

The occurrence of a specimen, supposedly from Western Australia, in the Perth Museum warrants including the species here. The specimen is 85 mm. long, 35 mm. wide, 40 mm. high anteriorly, and only 20 mm. high at the posterior end. The type of Bell's species is nearly as large. It was said to be from Australia, as is supposed to be the case with the specimens studied by Selenka. Studer (1877) described a supposedly similar holothurian from Kerguelen, but it is very doubtful whether it is even congeneric with the Australian species.

PSOLUS

Oken, 1815. Lehrb. Naturgesch., pt. 3, p. 352.

Genotype: *Holothuria phantapus* O. F. Müller, 1776, p. 231.

Oken listed 3 species in his proposed genus, but Jaeger (1833) ignored one of these and put *squamatus* in a genus *Cuvieria*. Hence we must accept *phantapus* as the type of *Psolus*, although most of the species now included in the genus are much more like *squamatus*. Ultimately they will probably be called *Cuvieria*. It is to this group that the 2 Australian species belong. They are easily distinguished by the spicules in the sole:

Spicules of sole, baskets and plates with projecting teeth or knobs on margin ..... *minutus*
Spicules of sole, flat plates somewhat cruciform or more often with 4 symmetrical perforations, and knobs distal to them on plate surface near margin ..... *spinuliferus*

Psolus minutus

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 507; figs. 51, 52.

This tiny species, less than 10 mm. long in life, is not rare at Lord Howe Island, where it occurs on the under side of rock fragments near low-water mark. The color is pure white both in life and in alcohol, though the tentacles tend to be yellowish. It is probable that this little *Psolus* will ultimately be found on the coast of New South Wales or Queensland.

Psolus spinuliferus

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 509; fig. 53.

This species, about twice the size of the preceding, is known from a single specimen, 20 mm. long in life, found on the outer surface of a pearl shell off Eighty-Mile Beach near Broome, in 10–12 fms., June 9, 1932. The color was pure, translucent white in life; now it has more of a yellowish tinge, especially at the ends. It is entirely different from the Lord Howe *Psolus*, and surprisingly like the European species, *squamatus*.

PSOLIDIUM

Ludwig, 1886. Zool. Jahrb., Abt. syst., vol. 2, p. 9.

Genotype: *Psolidium dorsipes* Ludwig, 1886, p. 9.

When Ludwig established this genus, it was monotypic, but a number of species have been transferred to it from *Psolus* and in the past few years half a dozen new species have been described. Among the latter are 2 from Australia. A third Australian species is listed by Joshua (1914), who considered it identical with one known otherwise only from the Magellanic region of South America. These 3 species may be distinguished thus:

Key to the Species of Psolidium

A. Relatively large, 30 mm.; color very dark gray, almost black; triradiate cuplike spicules in epidermis ..... *nigrescens*
AA. Small, under 20 mm.; color light; no triradiate cuplike spicules:
Dorsal scales numerous, conspicuous, each bearing up to 6–8 coarse granules; sole sharply defined ..... *granuliferum*
Not as above ..... sp.?

Psolidium nigrescens

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 505; fig. 50.

This very well marked species rests on a single specimen, 32 mm. long, very dark-colored, taken in November 1929 at Gunnamatta Bay, Port Hacking, New South Wales. It was very *Psolus*-like in appearance and clung closely to its rock fragment as *Psolus* does. It was not until it was critically studied in the museum that the numerous dorsal pedicels were noted.

Psolidium granuliferum

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 503; fig. 49.

Like the preceding, this species is known from a single specimen. It was taken in Koombana Bay, Bunbury, Western Australia, in 5–8 fms., October 26, 1929. It is only 15 mm. long and is light gray above, with the sole distinctly white. The dorsal pedicels are few and apparently rudimentary, but seem to warrant putting the species in *Psolidium*. It may, however, prove to be a young *Psolus*, with adults lacking dorsal pedicels altogether.

Psolidium sp.?

Cucumaria convergens Joshua, 1914, p. 6 (non Hérouard, 1901, p. xliii).
Psolidium convergens R. Perrier, 1904. Bull. Mus. hist. nat. Paris, vol. 10, p. 15.
—— 1905. Ann. sci. nat., Zool., ser. 9, vol. 1, p. 38; figs. D, E, F; pl. 2, figs. 2–4.
Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 6.

Through the kindness of Joshua, one of the 3 psolids which he took at Flinders, Victoria, is now in the Museum of Comparative Zoölogy. It is mounted whole, in balsam, on a microscope slide, and measures 9 mm. long by 5 mm. wide. There is no reason that I can see for considering it identical with Hérouard's species. Joshua seems not to have realized that the supposed discovery of so remarkable a Magellanic holothurian on the coast of Victoria demanded full data on the 3 specimens he collected. It is impossible from the mounted specimen at hand to determine anything distinctive about it, save that the pedicels are obvious and apparently occur dorsally as well as ventrally, thus justifying its being placed in *Psolidium*. But I am sure it is not *convergens*. The condition does not admit of any description justifying a new name. I agree with Deichmann (1941, p. 142) that *convergens* Hérouard is not a *Psolidium*.

Order ASPIDOCHIROTA

This order of holothurians is well marked by its peltate tentacles, well developed respiratory trees, and conspicuous pedicels (or papillae). It includes the largest holothurians and many of the most strikingly colored. All the forms that are of commercial importance belong here. Deichmann (1930) recognizes 3 families, which she distinguishes as follows:

Key to the Families of Aspidochirota

A. Tentacle ampullae absent; "rete mirabile" usually absent and respiratory trees free ..... Synallactidae
AA. Tentacle ampullae present; left respiratory tree entangled in a "rete mirabile":
Genital tubules in 2 tufts, 1 on each side of dorsal mesentery ..... Stichopodidae
Genital tubules in tuft on left side only of mesentery ..... Holothuriidae

Family SYNALLACTIDAE

Nearly all the members of this family are deep-sea forms, many occurring only at depths of 2000 fathoms (or more) and very few in water less than 300 fathoms deep. One of the latter group has been taken off eastern Australia, and no doubt others will be found when more dredging is done on the continental slope.

MESOTHURIA

Ludwig, 1894. Mem. Mus. Comp. Zoöl., vol. 17, no. 3, p. 31.

Genotype: *Mesothuria multipes* Ludwig, 1894, p. 31.

Although this genus was monotypic when established, about a dozen species are now included in it, and one of these was met with by the Great Barrier Reef Expedition.

Mesothuria parva

Mesothuria murrayi var. *parva* Théel, 1886. "Challenger" Hol., p. 186; pl. 9, fig. 2; pl. 16, figs. 4, 5.
Mesothuria parva Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 686; pl. 71, figs. 2A–C.

The Great Barrier Reef Expedition took 3 specimens of this holothurian at its station XV, ½ mile outside Cook's Passage in 210 fms., on a bottom of clean sand and coral debris. They measure 55–150 mm., as alcoholic specimens, and are pale gray, with the tentacles darker. The species was previously known from the Hawaiian Islands in 192–429 fms. and from near the Admiralty Islands in 150 fms.

Family STICHOPODIDAE

This group consists of 4 genera, of which 1, *Parastichopus,* occurring on the coasts of Scandinavia, Japan, and California, is perhaps better placed in the preceding family. A second is known only from the West Indian region, but the remaining 2 occur in Australia. They may be distinguished thus:

Calcareous particles in skin in form of tables or at least perforated plates ..... *Stichopus*
Calcareous particles only innumerable, minute granules ..... *Thelenota*

STICHOPUS

Brandt, 1835. Prodr. descr. anim., p. 50.

Genotype: *Stichopus* (*Perideris*) *chloronotos* Brandt, 1835, p. 50.

Although 50 species have been named in this genus, careful revision (H. L. Clark, 1922) reduces the number of valid forms to about 20. Of these, 7 occur in Australia and make up a conspicuous feature of the holothurian fauna. They are found along shore and in shallow water on all the coasts of the continent and Tasmania also. Three of them occur in the Torres Strait region, but elsewhere it is unusual to find more than one. In spite of their large size, they seem to be of practically no value for bêche-de-mer, although some individuals of the common *variegatus* are apparently included occasionally in the making of "curry fish," one of the least valuable forms marketed.

Key to the Species of Stichopus

A. No buttons among calcareous deposits:
  B. Few rosettes or none among calcareous deposits, but tables present:
    C. Tables with regular spires and smooth disk margins:
      D. Spire of table more or less expanded and open at top:
        C-shaped bodies present, about 40 microns long ..... *chloronotus*
        No C-shaped bodies ..... *mollis*
      DD. Spire of table not expanded, but more or less conical; no C-shaped bodies ..... *ellipes*
    CC. Tables asymmetrical, with more or less deformed spires and often spiny margins ..... *ludwigi*
  BB. Rosettes present:
    E. Large tables with heavy, smooth, conical spires in dorsal papillae ..... *horrens*
    EE. No large tables with conical spires:
      Color fundamentally brown, light (with or without pink or red tinge) or dark or mottled ..... *variegatus*
      Color whitish gray, wisteria mauve, and pale ochre yellow ..... *variegatus* var. *pallidus*
AA. Buttons among calcareous deposits ..... *paradoxus*

Stichopus chloronotus [1]

Stichopus (*Perideris*) *chloronotos* Brandt, 1835. Prodr. descr. anim., p. 50.
Stichopus chloronotus Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 315; pl. 17, figs. 20–24; pl. 18, fig. 25.
Kent, 1893. Great Barrier Reef, chromo pl. 12, fig. 3.
H. L. Clark, 1921. Ech. Torres Strait, p. 186; pl. 18, fig. 2 (colored).

Although this is a common holothurian on the Barrier Reef and is widespread in the Indo-Pacific region, it does not seem to occur in Australian seas either west of Torres Strait or south of Queensland. In life its dark green color is very constant and distinctive. It is not a large species, seldom exceeding 300 mm.

Stichopus mollis

Holothuria mollis Hutton, 1872. Cat. Ech. New Zealand, p. 15.
Stichopus mollis Dendy, 1897. Jour. Linn. Soc. (Zool.), vol. 26, p. 46.
Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 387.
Mortensen, 1925. Vidensk. Medd., vol. 79, p. 327; fig. 22.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 511.
Stichopus simulans Dendy and Hindle, 1907. Jour. Linn. Soc. (Zool.), vol. 30, p. 97.
Stichopus simultans Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 388.

Mortensen (1925) has I think shown satisfactorily that *simulans* cannot be wisely distinguished from *mollis,* but must be recognized only as a form of that species, if at all. He says nothing as to the size of the New Zealand specimens, but in Tasmania, *mollis* reaches a length of 250 mm. For a discussion of its diversified coloring see H. L. Clark, 1938, page 311. Joshua (1914) says *mollis* is common in

[1] Whether this name ends in *-us* or *-os* seems to be a matter of opinion. Except Ludwig (1892), modern writers beginning with Selenka and Semper have used *-us*. Brandt used the name but once, and the *-os* in that case may be a slip of the pen or a typographical error. There is no obvious reason for it.

Port Phillip, Victoria, and Erwe (1913) records specimens from near Albany and from Rottnest Island, Western Australia. It is common at Hobart, Tasmania. It would seem, therefore, to occur from southern New Zealand (south of 44° S.) to Tasmania, Victoria, and southern Western Australia (south of 31°).

Stichopus ellipes

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 514; fig. 54.

A single perplexing holothurian taken at Broome in 1929 is the basis for this species, and no more specimens are yet known. It was probably less than 200 mm. long and 35 mm. in diameter in life. The color is brownish gray, with faint blotches of a darker gray on back and sides. Hundreds of minute dark (almost black) dots are scattered irregularly over the animal, chiefly on the dorsal side. The absence of C-shaped bodies and rosettes is notable, and the large tables with many (20 or more) perforations in the disk are very characteristic. Deichmann considers them juvenile tables retained.

Stichopus ludwigi

Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 388; pl. 8, figs. 24*a–f*.

Based on 3 specimens from an unknown locality in southwestern Australia, this species seems to be well characterized by its calcareous particles, especially the tables, as shown in Erwe's admirable figures. The types were 100–110 mm. long and the ground color was reddish gray, more or less spotted, blotched, and marked with brown or blackish. Joshua and Creed (1915) record a specimen from Verco's collections in South Australian waters. It is 120 mm. long, and the color is "fawn, darker dorsally," with the papillae dark brown.

Stichopus horrens

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 316; pl. 18, figs. 27–29.
H. L. Clark, 1921. Ech. Torres Strait, p. 187; pl. 18, fig. 4 (colored).

This appears to be definitely a species of the western Pacific Islands from Hawaii to the Philippines and south to the Tonga Islands, Torres Strait, and Queensland as far south as Low Isles at least. It is fairly common at Mer and Erub under rocks on the reef flats. Adult specimens may be 300 mm. long, and the big tubercles and irregular body form give an "irregular, soft and almost repulsive" appearance. The coloration is usually variegated with white, gray, brown, and blackish, but in some cases it is more uniformly dark and then tends to be dull green of two or more shades.

Stichopus variegatus

Semper, 1868. Holothurien, p. 73; pl. 16 (colored); pl. 17 (colored); pl. 30, figs. 1, 2, 6.

This is the largest species in the genus, with a reported length of 900 mm. and a diameter of 200. It is usually 300–700 mm. long and correspondingly stout. It shows great diversity of color, and Semper's fine colored plates perpetuate two types, but neither represents an Australian form. In my reports (1921, 1938), I have

discussed the great diversity of color and form shown by Australian specimens. The range of *variegatus* is from Zanzibar and the Red Sea to the Caroline and Samoan islands, north to southern Japan and south to Lord Howe Island and southwestern Australia. It is not definitely known on the eastern coast of Australia, south of the Capricorn Islets, Queensland, nor has it yet been taken between Torres Strait and Augustus Island, but it occurs at the latter point and at Broome, at Shark Bay, and even in southwestern Australia (Erwe).

The *Stichopus* of Western Australia need a careful resurvey, for it is probable that several distinct forms occur there. One of these has been named *Stichopus variegatus* var. *pallidus* (H. L. Clark, 1938, p. 514). The unique specimen on which this name rests was dredged in 1929 about 20 miles south of Cape Jaubert, in 5–8 fms., and is now 135 mm. long and 30 mm. in diameter. Color notes made at the time of capture say that "almost equal sized patches of whitish-gray, wisteria-mauve and pale ochre yellow" made up the coloration of the upper surface and sides, and the ventral side was "semi-transparent grayish-white." Probably more material will warrant separating one or more species from the northwestern and western forms of *Stichopus* here included under the broad term *variegatus*.

Stichopus paradoxus

Lampert, 1885. Seewalzen, p. 247; figs. 14, 17, 27.

This species is based on a single specimen, 140 mm. long, in the Stuttgart Museum. The color is uniformly brown. Lampert's description is apparently careful and detailed and indicates a very distinct species. The locality is said to be New Holland, but no information as to time of collection is given. No similar specimen has since been reported, and the specific status must necessarily be considered dubious. Deichmann inclines to the opinion that Lampert's supposedly new *Stichopus* is based on a specimen of *Holothuria leucospilota*. Only a re-examination of the type in Stuttgart can settle the matter.

THELENOTA

Brandt, 1835. Prodr. descr. anim., p. 53.

Genotype: *Trepang ananas* Jaeger, 1833, p. 24.

This genus (see H. L. Clark, 1921, pp. 183–186) was monotypic for eighty-five years or more, but a second species was found at the Murray Islands in 1913, though not named or described until 1921. These rank as the largest known holothurians, although *Stichopus variegatus* is of nearly the same size when fully grown. Unlike that holothurian, these are of great value for bêche-de-mer and hence are of commercial importance. The two species are utterly unlike in external characters and color, but agree in their internal anatomy and spicules. They are easily distinguished thus:

Dorsal side with numerous big pointed or blunt papillae; general coloration orange-brown or brownish orange-red ..... *ananas*
Dorsal side without big papillae; not brownish orange; lower surface white with crowded pedicels ..... *anax*

Thelenota ananas

Trepang ananas Jaeger, 1833. De Hol., p. 24; pl. 3, fig. 1.
Holothuria (*Thelenota*) *ananas* Brandt, 1835. Prodr. descr. anim., p. 53.
Stichopus ananas Semper, 1868. Holothurien, p. 75.
Sluiter, 1901. "Siboga" Hol., p. 30; pl. 2, fig. 1 (colored).
Mitsukuri, 1912. Actin. Hol., p. 150; fig. 25; pl. 1, figs. 6–8.
Thelenota ananas H. L. Clark, 1921. Ech. Torres Strait, p. 184; pl. 18, fig. 2 (colored).

Okinawa, Japan, is the farthest north for this huge East Indian holothurian, and the northern end of the Great Barrier Reef is the farthest south. It has not yet been found west of Java and Torres Strait, but it reaches the Marshall and Society islands on the east and southeast. It grows to a large size, possibly a meter in length; the largest recorded measurements are 750 mm. long, 115 mm. wide, and 85 mm. high. When prepared for market, where they are called "prickly redfish," these huge individuals lose about 60 per cent or more of their bulk and are nearly black. The big dorsal papillae persist as hard, sharp projections; hence the qualifying adjective in the market name. The color in life has been well likened, by Mitsukuri, to that of a ripe tomato. Owing to the great demand, the supply of *Thelenota* in northern Australia has seriously diminished, but possibly the recent war will give a new lease on life to the fishery, as present conditions have probably completely stopped bêche-de-mer collecting.

Thelenota anax

H. L. Clark, 1921. Ech. Torres Strait, p. 185; pl. 18, fig. 3 (colored).

This remarkable holothurian has not been met with, so far as published records show, since its original discovery at the Murray Islands, and all that is known about it is recorded with the original description. Though it is superficially very different from the preceding species, the calcareous particles in the body wall require its being placed in *Thelenota*.

Family HOLOTHURIIDAE

The natural classification of this family has yet to be discovered. It is a large group with scores of species, but the attempts to break it up into genera have as yet proved unsatisfactory. The genus *Actinopyga* is apparently a natural group, and its species are easily recognized. *Labidodemas* is much less satisfactory, and the number of component species is doubtful. The rest of the family are best retained in the old genus *Holothuria*. Pearson (1913–1914) started out on the task of breaking up the genus, but he made little progress and his work has never been continued. Panning (1929–1935) attacked the problem *de novo* and gave promise of reaching some helpful conclusions, but he was diverted into a different line of work and his results were incomplete. Neither Pearson nor Panning had access to sufficient material to enable him fully to meet the problems, and it seems best to continue using the name *Holothuria* in the old wide sense until someone with access to at least half the named species can concentrate on the problem.

The Australian members of this family represent all 3 genera, and these may be distinguished thus:

KEY TO THE GENERA OF HOLOTHURIIDAE

A. No large, conspicuous calcified anal teeth (though anal papillae may be calcified, and in *Holothuria difficilis* seem like such teeth):
  Pedicels in a double series mid-ventrally, less clearly so in lateral ambulacra; calcareous tables with spires terminating in 5 (or 4) long, nearly horizontal points ..... *Labidodemas*
  Pedicels not in longitudinal series, but more or less generally scattered, often transformed into papillae; calcareous tables not as above ..... *Holothuria*
AA. Five large, conspicuous calcified teeth surrounding anus ..... *Actinopyga*

LABIDODEMAS

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 309.

Genotype: *Labidodemas semperianum* Selenka, 1867, p. 309.

Monotypic when established, this genus still contains 1 well validated species.[1] Semper, Ludwig, and Sluiter have each proposed another, but not one of these is well defined and properly validated. The type species is still very imperfectly known, but it has been reported twice from Australia and hence is included here.

Labidodemas semperianum

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 309; pl. 17, figs. 1–3.

Ranging from the Andaman Islands to Tahiti, this holothurian has been found at the Murray Islands, east of Torres Strait, and at Norwest Islet, Capricorn group, Queensland. The Murray Island specimens were found buried in the sand under rock fragments. They were 200–250 mm. long and about one-tenth of that in diameter. The color was a delicate, transparent pink, and the papillae and pedicels were notably long. The preserved specimens are of course much contracted and quite opaque. The Norwest Islet specimen is about 85 mm. long, with diameter ranging from 12 to 28 mm., dull gray becoming almost black anteriorly. Neither the form of the calcareous tables nor the distribution of the pedicels is as distinctive as could be desired, but both characters warrant recognition. There is little doubt that the species is valid, but the status of the genus is rather dubious, and much more material is needed before we can be sure what its real characters are and what its true relationship to *Holothuria* is.

HOLOTHURIA

Linné, 1791. Syst. Nat., ed. 13, vol. 1, pt. 6, p. 3138.

Genotype: *Holothuria tubulosa* Linné, 1791, p. 3138.

In the opinion of the International Commission on Zoological Nomenclature (see Opinion 80, Smithsonian Misc. Coll., vol. 73, no. 2, p. 17), it is best, in order to avoid most disturbing changes in the use of several well known generic names, to

[1] Deichmann's *Labidodemas americanum* (1938) from the west coast of Costa Rica lacks the very characteristic tables of *semperianum*, and I am skeptical as to the two being congeneric.

ignore Linné's use of *Holothuria* in 1758 and date the name from 1791. This official opinion has been unanimously agreed to. But, although the name is no longer debatable, the limits and contents of the genus are vague in the extreme, for there is no doubt that in the broad sense, used here, several genera are confused under *Holothuria*. Since the Australian species, although numerous, make up only about one-third of those already named, this is not the place to undertake a revision of the genus. The following key therefore ignores the great majority of known Holothurias and will serve only for identification of the Australian forms. Nevertheless it is possible that some of the main divisions here recognized may ultimately serve as nuclei for useful genera.

Key to the Species of Holothuria

A. Tentacles 20:
- B. No tables among calcareous deposits, except possibly in juveniles:
  - C. Calcareous particles more or less incomplete rosettes:
    - Dorsal side with large brown elliptical or circular spots encircled with white ..... *argus*
    - No conspicuous spots, though irregular dark blotches may occur ..... *marmorata*
  - CC. Calcareous particles not rosette-like:
    - D. Calcareous particles in form of rods, usually branched or enlarged at ends:
      - Rods short and wide, with irregular projections, more or less flattened and smooth ..... *erinaceus*
      - Rods long, narrow, with irregular branched ends and granulated surface ..... *moebii*
    - DD. Calcareous particles in form of minute irregular plates, with or without a few perforations and knobs ..... *michaelseni*
- BB. Tables among calcareous deposits:
  - E. Tables only ..... *modesta*
  - EE. Tables accompanied by accessory particles:
    - F. Accessory particles small plates or rods; tables reduced, with simple annular disk:
      - G. Accessory particles small irregular plates, usually perforated:
        - Pedicels and papillae well developed, numerous both dorsally and ventrally; unicolor; disk of tables fairly well developed; accessory particles, small plates with about 4 perforations or slits, many reduced ..... *atra*
        - Pedicels and papillae small, not very numerous; upper surface brown, lower rose red in life, dirty whitish in alcohol; disk of tables reduced to ring; accessory particles also reduced, often only X-shaped granules ..... *edulis*
      - GG. Accessory particles rods:
        - Rods slightly curved and finely granulated ..... *cinerascens*
        - Rods irregular, not granulated, often flattened, with loops or perforations along side ..... *pervicax*

- FF. Accessory particles perforated plates or buttons or more complicated bodies:
  - H. Accessory particles fenestrated ellipsoids; commonly without plates:
    - Color black, with white or yellowish tentacles; fenestrated bodies short and thick, not twice as long as wide ..... *coluber*
    - Color yellowish brown, lighter ventrally; fenestrated ellipsoids 3 times as long as wide ..... *axiologa*
  - HH. Accessory particles buttons or flat perforated plates:
    - I. Buttons, at least in large part, with knobs or rough surface:
      - J. No smooth buttons:
        - K. No true pedicels, body covered above and below with papillae of some sort:
          - L. Papillae of back more or less white or light-colored, encircled at base by dark brown ring, often surrounded by outer white ring or area:
            - Tables with capitate thorny tops; no large tables with spire drawn out into long, simple point; elongated narrow buttons with 5 or more pairs of holes present ..... *ocellata*
            - Tables with low, squarish tops having few coarse teeth; large tables, with spire drawn out into long, simple point, present in papillae; no very elongated narrow buttons ..... *spinifera*
          - LL. Papillae not thus encircled:
            - M. Tables not peculiar, spire low, made up of 4 rods and only 1 or 2 crossbars ..... *scabra*
            - MM. Tables markedly peculiar:
              - Tables with high, somewhat tapering spire of 4 rods and 4–7 crossbars ..... *martensii*
              - Tables with 6–10 vertical rods capped with large, hemispherical spiny top ..... *albiventer*
        - KK. Pedicels present but sometimes few and very small:
          - N. Tables greatly reduced, spire seldom complete, but indicated only by 4 vertical rods ..... *notabilis*
          - NN. Tables not reduced, but often hypertrophied:
            - O. Tables of 2 kinds, the larger with spire fused into a simple, blunt, conical point ..... *fusco-olivacea*
            - OO. Tables of only one kind:
              - P. Spire of table more or less conical, with 3–6 crosspieces ..... *conica*
              - PP. Spire of table low, with more or less expanded tip and only 1 crosspiece; disk more or less convex:

Spire of table with 4–8 vertical rods, tending to become spiny hemispheres; buttons very knobby, often with 5–8 pairs of holes ..... *rigida*

Spire of table with 4 rods, and tending to become reduced; buttons not so knobby, with commonly 3 pairs of holes ..... *inhabilis*

JJ. Some smooth buttons without knobs, with 3–7 pairs of holes ..... *bowensis*

II. Buttons smooth, often reduced, with only 2–4 holes:

Q. Papillae all over body ..... *impatiens*

QQ. Papillae present only dorsally or wanting:

R. Papillae on dorsal side:

S. Tables of 2 kinds: ordinary, with smooth, flat disk having 8 marginal perforations; larger and rarer, with cruciform disk, tip of each branch expanded and perforated; buttons stout but smooth and regular ..... *altimensis*

SS. Tables all of one kind, but diverse in size and details:

T. Spire of 4–6 rods; disk with dentate margin; buttons short and wide, with 3–6 pairs of holes ..... *rugosa*

TT. Spire of 4 rods only; disk margin smooth:

U. Spire more or less incomplete; often vertical rods are not united and number may be reduced to 3 or 2; buttons thin and flat and usually with only 1 pair of slitlike perforations ..... *fuscocinerea*

UU. Spire normal; buttons with 3 or more pairs of perforations:

V. Buttons long and narrow, with 3–6 pairs of slitlike perforations ..... *macroperona*

VV. Buttons shorter and wider, with 1–3 pairs of perforations:

Color uniformly brown; ventral pedicels more or less crowded, not in 3 longitudinal series; top of table-spire with many (20–30) teeth; anal papillae calcified, appearing like anal teeth ..... *difficilis*

Color not uniformly brown; ventral pedicels more or less evidently in 3 longitudinal series; spire of table with fewer (12–16) teeth; no indication of anal teeth ..... *monocaria*

RR. No papillae; pedicels all over body:

W. Tables of 2 kinds: mostly of usual type, spire of 4 rods and 1 crossbar, terminating in about 12 thorns; larger ones with elongated spires having 3 or 4 transverse bars and terminating in 4 thorns ..... *remollescens*

WW. Tables all of one kind, though there may be much diversity in size and details:

X. Buttons in little circles or heaps:

Disk of tables with marginal teeth ..... *pardalis*

Disk of tables without marginal teeth ..... *cumulus*

XX. Buttons not in heaps:

Y. General form very *Stichopus*-like, ventral surface well set off from dorsal; color gray, more or less variegated or marked with brown, or uniformly brown; supporting rods of ventral pedicels, elaborated buttons with 10 or more holes ..... *hartmeyeri*

YY. Not as above:

Z. Dorsal pedicels with spinous rods tapering toward ends ..... *leucospilota*

ZZ. Dorsal pedicels without spinous rods:

Buttons small, flat, with 1 or 2 pairs of slitlike holes, or with pair of long slits, at each end of which is small circular hole ..... *homoea*

Buttons regular, with 3 pairs of holes ..... *arenicola*

AA. Tentacles 25–30 ..... *verrucosa*

Holothuria argus

Bohadschia argus Jaeger, 1833. De Hol., p. 19; pl. 2, fig. 1.
Holothuria argus Semper, 1868. Holothurien, p. 80; pl. 30, fig. 11.
Kent, 1893. Great Barrier Reef, chromo pl. 12, fig. 7.

Although this very strikingly colored holothurian has a range in the Indo-Pacific region from the Seychelles to Tahiti and northward to the Ryukyus, it enters the Australian region only at the northern end of the Barrier Reef. It is not uncommon at the Murray Islands, and has been reported from Cooktown, but it has not been taken in Torres Strait, nor did the Barrier Reef Expedition meet with it in the Low Isles region. It grows to a length of a foot or more and is quite plump. It would seem admirably adapted for bêche-de-mer, but is not greatly esteemed for that purpose. The market names are "leopard fish," "spotted fish," and "tiger fish." In life the ground color is brown, dull gray, or purplish of some shade, with the conspicuous white-encircled spots of a different and contrasting shade of brown. This striking coloration is fairly well retained in alcoholic material, and may even be detected in some bêche-de-mer of the market.

Holothuria marmorata

Bohadschia marmorata Jaeger, 1833. De Hol., p. 18; pl. 3, fig. 9.
Holothuria marmorata Semper, 1868. Holothurien, p. 79; pl. 30, fig. 10.

This is one of the largest species of *Holothuria* found in the Australian region, where it occurs on both the northeastern (Low Isles, Murray Islands) and the northwestern coasts (Broome). Its known range is from Mauritius to Fiji and north to the Ryukyus. It grows to a length of 400 mm. or more, with a diameter about one-fourth as much. It is collected largely for bêche-de-mer, but is graded and sold under two different names, "sand fish" and "chalky fish." The color in life is pale or yellow-brown above, lighter (sometimes white) beneath, usually with 2 or 3 large, irregular brown blotches on the upper side; the pedicels are darker than the body wall, and the tentacles are gray-brown, darker than the body.

Holothuria erinaceus

Semper, 1868. Holothurien, p. 91; pl. 30, fig. 24.

Originally described from the Philippines, Fiji, and Port Mackay, Queensland, this holothurian has not been reported since save by the Great Barrier Reef Expedition, which took a small specimen in 1929 at the Low Isles. Semper gives the length as 18–20 cm. and the color as gray-brown. It is rather remarkable that, although the "Siboga" took 38 species of *Holothuria* in the East Indian region, *erinaceus* was not among them.

Holothuria moebii

Ludwig, 1883. Ber. Oberhess. Gesellsch. Nat.- u. Heilk., p. 171.
Mitsukuri, 1912. Actin. Hol., p. 92; fig. 19.

In 1938 (p. 526, footnote), I expressed my disagreement with Mitsukuri's opinion that *moebii* is a variety of Selenka's Panamic species *lubrica*. The Indian species was described from Hong Kong and has since been reported from Mauritius, the Philippines, southern Japan, the New Hebrides, and Lord Howe Island. Semon did not find it at Amboina, nor did the "Siboga" take it in the East Indies. The color in life is brown with the feet yellowish, and preservation in alcohol alters it little. The ventral surface, with crowded pedicels, is markedly set off from the dorsal. The Lord Howe specimen is 110 mm. long by 30 in diameter. Deichmann reports scattered tables in young *moebii* (see *H. cinerascens*).

Holothuria michaelseni

Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 384; pl. 7, figs. 20*a–c*.

The remarkable black and white coloration makes this endemic holothurian of Western Australia easy to recognize, and the calcareous particles are equally characteristic. Only 5 specimens are as yet known, all from northwestern Australia between Shark Bay and Pender Bay (inclusive). Adult individuals are 100–125 mm. long in life. Deichmann thinks juveniles would have tables, but such juveniles are not yet known.

Holothuria modesta

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 106; pl. 7, fig. 26.

Described from Cape York and subsequently reported from Port Curtis and islands in Torres Strait, this holothurian is now known to be common in the Broome region. It also occurs in the East Indies, but records from the Red Sea and from the vicinity of Fremantle are based on poor material and need verification. Adult specimens are 100–125 mm. long. The color is dull gray or more or less variegated with shades of brown, purple, and gray, or even whitish. The tentacles are notably short, yellow or cream color. The animal is inert and clings closely to the under side of rock fragments in shallow water. The flatter ventral side is supplied with rather numerous pedicels in 3 more or less ill-defined series, and usually contrasts with the convex dorsal side, which has fewer and more irregularly distributed pedicels. Deichmann has found scattered rosettes as well as tables in some cases.

Holothuria atra

Jaeger, 1833. De Hol., p. 22.
Semper, 1868. Holothurien, p. 88; pl. 26 (colored).
Théel, 1886. "Challenger" Hol., p. 181; pl. 7, fig. 4.

From Mozambique to Tahiti and northward to tropical Japan is the range of this common and very widespread species. The calcareous particles are relatively simple, not very variable, and quite characteristic. The color is dark brown or black; in life the tips of the papillae and pedicels and occasionally the margin of the periproct may be light, even white, but this is not evident in alcoholic material. The usual size for an adult is 200–300 mm., but large individuals are sometimes 600. In Australia, *atra* ranges from Lord Howe Island on the southeast, northward to the Murray Islands and westward to Augustus Island in the northwest, but we did not find it at Darwin. Records from "Adelaide" and other points on the southern coast are almost certainly mistakes. See H. L. Clark, 1921, page 174, and 1938, page 517, for observations on appearance and habits in life and its use as bêche-de-mer, under the name "lolly fish."

Holothuria edulis

Lesson, 1830. Cent. zool., p. 125; pl. 46, fig. 2.
H. L. Clark, 1921. Ech. Torres Strait, p. 177; pl. 19, fig. 4 (colored).

This species ranges from Aden and Mozambique to the Philippines and the Ryukyus on the north and to the Caroline and Fiji islands on the east. In Australia, it is known only from the eastern coast between the Murray Islands and the Capricorn group. It is not large, usually less than 300 mm. in length, though occasionally one reaches 400. Its coloration is handsome and distinctive, brown above and rose red ventrally. The rose color is fugacious, and the lower surface is dirty whitish in alcoholic specimens. The calcareous particles have not been well figured, but Selenka's figures of the particles which he refers to *fuscocinerea* (1867, pl. 19, fig. 86) are considered by Semper and Théel to be those of *edulis*.

Holothuria cinerascens

Stichopus (Gymnochirota) cinerascens Brandt, 1835. Prodr. descr. anim., p. 51.
Holothuria pulchella Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 329; pl. 18, figs. 61, 62.
Holothuria cinerascens Lampert, 1885. Seewalzen, p. 82.
Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 654; pl. 68, figs. 1*a–f*.
Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 377; pl. 6, figs. 15*a, b*.

Only the respect due to Erwe's excellent work leads to the inclusion of this widely distributed Indo-Pacific holothurian in the Australian fauna. He records 1 specimen from an unknown station in southwestern Australia. Though it is very probable that there is some mistake about the locality label of this specimen, the species is so widely distributed throughout the islands of the Indian and Pacific oceans, its occurrence in tropical Australia is quite likely. It is, according to Fisher, reddish purple to brownish purple when living; the alcoholic specimens are purplish brown, lighter below. It grows to a length of about 160 mm. Deichmann thinks *cinerascens* and *moebii* have been confused, for when the tables are scarce, specimens of *cinerascens* are very hard to distinguish from *moebii*.

Holothuria pervicax

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 327; pl. 18, fig. 54.
H. L. Clark, 1921. Ech. Torres Strait, p. 181; pl. 19, fig. 1 (colored).
Holothuria fuscocinerea Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 379; pl. 6, figs. 16*a–d*.

As was stated in 1938 (p. 529), Erwe's action in uniting Selenka's well marked species with Jaeger's more dubious one is ill advised, as the 2 species seem to be quite readily separable. There is little doubt that Erwe's specimen from Shark Bay is a typical *pervicax*, but its occurrence in Shark Bay is unexpected, since the species has not yet been found elsewhere west of Torres Strait. It is common at Erub and the Murray Islands, but is as yet unknown between that region and Lord Howe Island, far to the south (where it is fairly common), except for the single specimen dredged southeast of Lizard Island, in 19 fms., by the Barrier Reef Expedition in 1928. Apparently it is local in occurrence, and possibly it prefers the tantalizing area along the outer side of reefs and shores between 10 and 100 fms., where collecting is well-nigh impossible. It is a rather handsome species in life, with a variegated brown back and a white ventral surface and translucent white tentacles. Full-grown specimens are 300 mm. long. The species is widely distributed from the Red Sea and Zanzibar to Hawaii and Tahiti.

Holothuria coluber

Semper, 1868. Holothurien, p. 90; pl. 28 (colored); pl. 30, figs. 28*a, b*.

This is one of the most noticeable of the holothurians found in the Torres Strait region, the contrast between the white (or yellowish) tentacles and the black body being very striking. Semper's colored figure is admirable. Adult specimens are 500–600 mm. long and the body wall is firm and rather thick, yet it is rejected as a source of béche-de-mer. The distribution of *coluber* is peculiar, for though it was originally

found in the Philippines, and occurs in Torres Strait, the "Siboga" failed to find it in the East Indies (save for 1 specimen at Lumu-Lumu in the Strait of Macassar), nor did Semon find it at Amboina. The "Challenger" failed to collect it, nor is it known from Japan. We failed to obtain a specimen anywhere in Australia in 1929 or 1932, but in 1913 it was very common at Mer, and we also found it at Thursday Island and Erub. Kent (1893) found it "common on inshore reefs" of tropical Queensland, but we do not know how far south. The Great Barrier Reef Expedition took a single specimen at the Low Isles, but there are no other definite records from the Queensland coast.

Holothuria axiologa

H. L. Clark, 1921. Ech. Torres Strait, p. 175; pl. 38, figs. 1–13.

No further specimens of this big holothurian have been taken since the unique holotype (600 mm. long, 100 mm. wide, 75 mm. high) was found at Mer, Murray Islands, in 1913. In life, the color was yellowish brown dorsally with dark brown pedicels, whitish with yellow pedicels ventrally and on the sides. The color in alcohol shows a loss of yellow tints. Deichmann thinks Jaeger's *fuscopunctata* may have been based on a specimen of *axiologa*, but as his name was previously used by Quoy and Gaimard for another species (probably *monocuria* Lesson), the name *axiologa* must be used.

Holothuria ocellata

Bohadschia ocellata Jaeger, 1833. De Hol., p. 19.
Holothuria ocellata Semper, 1868. Holothurien, p. 80.
Théel, 1886. "Challenger" Hol., p. 178; pl. 7, fig. 11; pl. 16, fig. 1.

This strikingly marked holothurian seems to be quite a rarity. Jaeger's type was from the Celebes, the "Challenger" took 1 specimen at the western end of Torres Strait in 28 fms., and the Barrier Reef Expedition took 1 large specimen in 10 fms. off Howick Island, Queensland. The last was referred to *ocellata* by me (1932), but a more critical examination may show it should be referred to *spinifera*. Erwe (1919) reports *ocellata* from the Red Sea, and Pearson (1910*a*) from the Mergui Archipelago, but these identifications need to be verified in the light of our present knowledge of *ocellata*.

The "Gier" took "zahlreiche Exemplare" of a holothurian, at various stations in the Java Sea, which Sluiter (1914) referred to *Holothuria squamifera* Semper. Special reference is made to specimens from 6° 28′ S. by 112° 39′ E., at 60 m., in which the tubercles and papillae were extraordinarily large and the coloration was unusually striking. One of these specimens is now in the Museum of Comparative Zoölogy and has been critically studied by Deichmann, who believes it is Jaeger's *ocellata*, a conclusion resting on the belief that Théel's description and figures in the "Challenger" report represent Jaeger's species. The matter is complicated by Théel's description and figures of a species, *spinifera*, based on a single specimen taken by the "Challenger" at her station 208, in the Philippine Islands, in 18 fms. The striking feature of this species is the big tables in the papillae, which terminate in a long-drawn-out simple point. On examining the holothurians from Broome and Augustus Island which I called *ocellata* (1938, p. 527), Deichmann found some of

these characteristic big tables and concluded that these specimens are *spinifera*. After a very careful comparison of the external characters and calcareous particles, I think Deichmann is correct. The tables that Théel figures are not the tables of the *ocellata* which the "Gier" took north of Java. It is therefore doubtful whether *ocellata* really occurs in Australia, but it is included here on the strength of the "Challenger" specimen from Torres Strait (station 188, 28 fms.) and the Great Barrier Reef specimen (off Howick Island, 10 fms.). Both these specimens are in the British Museum and should be re-examined, with particular reference to the tables. There is no published figure of the typical tables of *ocellata*, but they are unmistakable—assuming, of course, that the "Gier" specimens are *ocellata*.

To sum up, then, we have the following situation: The "Gier" took, north of Java, certain holothurians which Sluiter called *squamifera* Semper. One of these in the M.C.Z. collection has numerous capitate tables with thorny tops. (There is no published figure of just such a table.) Deichmann considers this to be *ocellata* Jaeger as figured by Théel, though he neither figures nor mentions the characteristic tables. Specimens from northwestern Australia reported by me (1938) as *ocellata* are undoubtedly *spinifera* Théel. Further study of the "Gier" specimens in Amsterdam and of "Challenger" and Barrier Reef material in the British Museum is absolutely necessary.

Holothuria spinifera

Théel, 1886. "Challenger" Hol., p. 175; pl. 8, fig. 1.
Holothuria ocellata H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 527 (NON Jaeger, 1833, p. 19, or Théel, 1886, p. 178).

The only representatives of this species hitherto known were the unique holotype from the Philippines, a rather large holothurian 240 mm. long, and a specimen, not half so large, recorded by Ludwig (1887) from Ceylon. The specimens from northwestern Australia, referred to above (H. L. Clark, 1938), are also only about half as large as the holotype. They show considerable diversity of coloration, the one from Augustus Island being conspicuously lighter than those from Broome. The actual distribution of *spinifera* cannot be determined until the line between it and *ocellata* is clearly recognized.

Holothuria scabra

Jaeger, 1833. De Hol., p. 23.
Semper, 1868. Holothurien, p. 79; pl. 19.
Mitsukuri, 1912. Actin. Hol., p. 135; fig. 24.

This big holothurian is a typical Indo-Pacific species, ranging from Port Natal to the Red Sea on the East African coast and thence eastward to the Caroline and Fiji islands. It does not seem to have reached Hawaii or Tahiti, but it does occur at the Ryukyu Islands in the north, and on the south it reaches Lord Howe Island. It seems to be not uncommon throughout the Barrier Reef region, but we did not find it at Mer, and Kent (1893) does not mention it. Yet it is present in Torres Strait, as we found it on the sand flat southwest of Friday Island. The Barrier Reef Expedition found it common at the Low Isles. It has not yet been reported from west of Darwin. It is extensively used for bêche-de-mer and is marketed at

Thursday Island as either "sand fish" or "curry fish." It grows to a large size (400 mm. long by about one-fourth as much in diameter), but shrinks about one-third in alcohol. The color seems to be unusually varied; the upper surface ranges from light gray or dull cream color to olive brown, or on the other hand to almost black; the lower surface is lighter, often white. The papillae and pedicels commonly have dark tips, but the tentacles are reddish yellow, yellowish, or white. The back may be finely speckled with blackish or it may have a few large blotches of some shade darker than the ground color.

Holothuria martensii

Semper, 1868. Holothurien, p. 86; pl. 30, fig. 16.
Théel, 1886. "Challenger" Hol., p. 177; pl. 7, fig. 12; pl. 16, fig. 2.
H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 233.
Holothuria subverta H. L. Clark, 1921. Ech. Torres Strait, p. 182; pl. 38, figs. 25–32.

This is an obscure and rarely collected little holothurian, 150 mm. or less in length, the width one-fourth to more than one-third as much, and the height usually much less than the width. It lives on the lower side of rock or coral fragments, more or less buried in mud. The dull color corresponds to the habitat. The type was from Amboina, and 2 less typical specimens were from Mariveles, Philippine Islands. The "Challenger" took the largest known specimen at her station 188, near the western end of Torres Strait in 28 fms., and a smaller individual in the Philippines. Pearson (1910) records 2 small specimens from the coral reef south of Pekawi, Kerimba Archipelago, Portuguese East Africa. We took a single specimen at Mer on the under side of a rock on the reef flat. It was dull gray, brownish dorsally. The papillae show no little diversity of form, and many of those on the ventral surface are much like pedicels. The resemblance between the dorsal and ventral sides of the animal is striking. Théel's figure represents the largest known specimen, and the papillae appear to be much less numerous than in the specimen we took at Mer, which was only two-thirds as large. The Barrier Reef Expedition took 2 half-grown specimens near Lizard Island, in 8–13½ fms., in 1 of which the ventral papillae are very white.

Holothuria albiventer

Semper, 1868. Holothurien, p. 83; pl. 30, fig. 14.
Erwe, 1919. Mitt. Zool. Mus. Berlin, vol. 9, p. 185; fig. 4.

Although this species has been met with frequently, few specimens are known. They range from 40 to 130 mm. in length, with the diameter from one-fourth to one-half as much according to the degree of contraction. The color in life is not known, but the best-preserved specimens are, according to Erwe, brown above with a few large dark brown spots, and lighter beneath with each papilla surrounded by a white patch. All the papillae are white. As yet, *albiventer* has been found only twice in Australia. The Barrier Reef Expedition took 3 specimens in Penguin Channel and off Direction Island in 10–19 fms. The Perth Museum has a single specimen taken at Carnarvon, Western Australia. It must be rare or local, as we did not find it at Mer, Darwin, or Broome. The known range is from the Kerimba Archipelago to the Red Sea and eastward to the Philippine Islands and Queensland.

As yet it is not known from farther east save for Théel's specimen in the Stockholm Museum, labeled as from "the Pacific Ocean."

Holothuria notabilis

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 102; pl. 7, fig. 43.

The unique holotype of this species came from Bowen, Queensland, and no other specimens have been referred to it since, except the 2 taken by the Great Barrier Reef Expedition in 1929 (see H. L. Clark, 1932). Lampert (1885) described a *Holothuria klunzingeri* from Kosseir, and Sluiter (1894) referred a specimen from Amboina and one from Macassar to Lampert's species. Panning (1935) treats Lampert's species as a synonym of Ludwig's, and this reference seems almost surely correct. The Barrier Reef specimens are only about half (or less) as big as Ludwig's, which was 150 mm. by 30, but they have a somewhat similar brownish coloring with a double series of darker blotches on the back. The calcareous particles of *notabilis* are distinctive, but Ludwig's figures are inadequate.

Holothuria fusco-olivacea

Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 672; pl. 69, figs. 3, 3*a–f*; pl. 70, fig. 3.

This rare species is included here on the strength of a single specimen, 60 mm. long, from the Low Isles (see H. L. Clark, 1932, p. 232). It is otherwise known only from the unique holotype, taken at the Hawaiian Islands, unless it proves to be identical with *H. olivacea* Ludwig.

Holothuria conica

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 531; fig. 55.

This species is based on 2 specimens from Quail Island, west of Darwin, Northern Territory, taken in 1929, the larger of which was 150 mm. long. A third specimen is in the South Australian Museum; although labeled as from the Semaphore, Lefevre's Peninsula, South Australia, it is more likely to have come from the coast of the Northern Territory. The possibility that *conica* is identical with *bowensis* Ludwig has been suggested, but the difference in the tables seems to me too great to admit of their union.

Holothuria rigida

Stichopus rigidus Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 317; pl. 18, figs. 30, 31.
Holothuria rigida Semper, 1868. Holothurien, p. 79.
Cystipus pleuripus Haacke, 1880. *In* Möbius: Beitr. zur Meeresfauna Mauritius, p. 47.
Holothuria pleuripus Ludwig, 1883. Ber. Oberhess. Gesellsch. Nat.- u. Heilk., vol. 22, p. 174.
H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 235.

This small, sedentary holothurian ranges throughout the Indo-Pacific region from Mauritius to Hawaii and Tahiti, but it has not often been taken and is still imperfectly known. Selenka did not distinguish it from the following species, with

which it is still often confused. In H. L. Clark, 1921 (p. 178) I fail to distinguish it clearly from West Indian forms, as well as from *inhabilis*. Thanks to Deichmann, distinguishing lines may be found between these closely related forms, but further investigation on living material is necessary to determine their validity for separating species. There are specimens of *rigida* in the Museum of Comparative Zoölogy (as determined by Deichmann and confirmed by me) from the Society Islands, Queensland, and the Philippines. The Society Islands specimen is the holotype. The Queensland specimens are from Turtle Bay, Green Island, and Mer; the 2 latter were hitherto regarded by me as *hypamma* (= *inhabilis*). The Philippines specimen, from Port Galera, Mindoro, has also been catalogued as *hypamma*. The Green Island specimen has the upper side brownish, the lower more nearly white. The other specimens all are more or less completely bleached. The longest, the holotype, is about 75 mm. long, but narrow (10–12 mm.) and flat. The specimen from Mer is in better condition but is equally bleached.

Holothuria inhabilis

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 333; pl. 19, figs. 73, 74.
Holothuria hypamma H. L. Clark, 1921. Ech. Torres Strait, p. 177; pl. 38, figs. 20–24.

The holothurians of this type have been a source of confusion and difficulty for over a hundred years. It was noted long ago that more than 1 species was included under the name *Stichopus rigidus* Selenka (which all are agreed is not a *Stichopus*), and possibly one of these was the form called *fuscopunctata* by Jaeger. But Jaeger's name is preoccupied by *Holothuria fuscopunctata* Quoy and Gaimard, and their name is a synonym of *Holothuria monocaria* Lesson. The question as to the correct name for Jaeger's species seems to be debatable. If Semper's figures are to be relied on, the name *rigida* Selenka would seem to be available. Whether *rigida* and *inhabilis* are specifically distinguishable may be open to question, but in my opinion they are distinct and can be told apart by the tables, though each species may have atrophied or hypertrophied tables resembling those normal to the other.

Deichmann's studies on the Museum of Comparative Zoölogy holothurians show that the form I described from the Murray Islands under the name *hypamma* is the same as Selenka's species *inhabilis* from the Hawaiian Islands. The distribution of *inhabilis* is only imperfectly known. The type localities are given by Selenka as Hawaii and the Society Islands. We found it at Mer at the northern end of the Barrier Reef, but it has not yet been found elsewhere in Australia, including Lord Howe Island. That it also occurs on the western coast of tropical America is indicated by specimens in the M.C.Z. In life it may be 250 mm. long or even more, but most preserved specimens are much smaller than that. The body is more or less depressed and tapers somewhat toward each end; the width at the middle may be one-fourth the length. In life the ground color of small specimens is white, but this becomes grayish or pale brown in preserved material, particularly in large specimens. There are often 2 series of dark blotches on the back, with or without numerous blackish spots. The surface of the body is often covered, in the smaller specimens at least, with sand grains held by a cement-like mucus. The animals are apparently very sedentary and commonly solitary, often living buried in the sand under stones or attached to the lower surface of rock fragments partly buried in the sand.

Holothuria bowensis

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 111; fig. 37.

This species is based on a single specimen, 45 mm. long by 15 in diameter; the color is gray, indistinctly marked on the back with blackish. It was taken at Bowen, Queensland. No second specimen has yet been found, and the suggestion has been made that the type of *bowensis* is simply a young *martensii*. This is not incredible, but for the present it is best to let *bowensis* stay in the list of Australian holothurians.

Holothuria impatiens

Fistularia impatiens Forskål, 1775. Descr. anim., p. 121.
Holothuria impatiens Gmelin, 1788. Linné: Syst. Nat., ed. 13, vol. 1, pt. 6, p. 3142.
H. L. Clark, 1921. Ech. Torres Strait, p. 178; pl. 19, figs. 3, 5 (colored).
—— 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 232.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 521.

This big, easily recognized holothurian has a nearly tropicopolitan distribution, though there seem to be no records as yet from the western coast of Africa. It ranges from the Mediterranean and Mozambique, across the Indian Ocean and the Pacific to Hawaii, the Galápagos, and the Panamic region, and also occurs throughout the West Indian area from Bermuda to Trinidad. It has not yet been found in New Zealand, nor does it occur at Lord Howe. But it is widely distributed on the tropical coasts of Australia from Queensland (at least as far south as Great Barrier Island) to Shark Bay on the western coast. It is usually 150–250 mm. long and 20–25 mm. in diameter, but large specimens may be 400 mm. long and 45 mm. in diameter (see Semper, 1868, pl. 22). The diversity of color is remarkable, and the following color forms have been named:

More or less unicolor, though sometimes diversified by various shades:
- Purplish gray ..... var. *concolor*
- Yellow-brown or brownish yellow ..... var. *lutea*

More or less variegated, often transversely banded; ground color gray or brown (sometimes light), with black, white, and dull purple shades and markings; papillae often with light tips ..... *impatiens s. s.*

More or less bicolored, papillae contrasting with ground color:
- Papillae abruptly yellow against dark purple background ..... var. *bicolor*
- Papillae abruptly dark brown against greenish-yellow background ..... var. *pulchra*

Among or under rocks near low-water mark on sandy shores is the favorite habitat of *impatiens*. It is somewhat gregarious in some areas. When the animal is disturbed, the copious Cuvier's organs are commonly discharged, their pure white color contrasting markedly with the animal and its surroundings.

Holothuria altimensis

H. L. Clark, 1921. Ech. Torres Strait, p. 172; pl. 37, figs. 20–29.

This species is known only from a single specimen, 20 mm. long, brown, with pedicels and branches of tentacles deep yellow. It was found on the under side of a rock fragment at Mer, Murray Islands, in 1913. The close resemblance to *Holothuria difficilis* was noted, but there are no Cuvier's organs in *altimensis*.

Holothuria rugosa

Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 110; pl. 7, figs. 33a–c.

A single specimen, found buried in sand under a rock fragment at Mer, Murray Islands, in 1913, is the basis for including this rare species in the Australian fauna. It is 130 mm. long and about 25 mm. in diameter. The color is yellowish white with the tentacles somewhat darker. The species is little known, but has been taken occasionally in the East Indian region and the western Pacific from the Andaman Islands to Samoa. Deichmann thinks it is better placed in *Labidodemas*, but until that genus is more sharply defined, it seems just as well to leave *rugosa* in *Holothuria*.

Holothuria fuscocinerea

Jaeger, 1833. De Hol., p. 22.
Semper, 1868. Holothurien, p. 88; pl. 27 (colored); pl. 30, figs. 22a, *b*.
H. L. Clark, 1921. Ech. Torres Strait, p. 177.
Holothuria curiosa Ludwig, 1874. Arb. Zool.-Zoot. Inst. Würzburg, vol. 2, p. 110; pl. 7, fig. 29.
H. L. Clark, 1932. Sci. rept. Great Barrier Reef Exped., vol. 4, p. 231.

Panning (1935, p. 4) adopts Ludwig's name (*curiosa*) for this species on the ground that Jaeger's name is "burdened with great uncertainty," but Semper (1868) has definitely fixed the name to the form, which he figures beautifully and describes adequately under Jaeger's name. Ludwig (1874) redescribed it under the superfluous name *curiosa*. Panning has also confused *pervicax* with this species, but the two are not difficult to distinguish. The little platelike buttons with only 2 holes are very distinctive.

The distribution of *fuscocinerea* is not clearly known. Erwe's record from Shark Bay, Western Australia, is based on a specimen of *pervicax*. Kent records it from the Barrier Reef, and we found it at Mer and Thursday Island. The type of *curiosa* was taken at Bowen, Queensland, and the Barrier Reef Expedition found a similar specimen at Low Isles. But neither in 1929 nor in 1932 were any holothurians taken by us which can be referred to this species. Outside of Australia, there are records from Ceylon, the Philippines, Celebes, Fiji, and Samoa. It is also reported from Japan, but Mitsukuri (1912) does not include it in his monograph. It is rather large, reaching a length of over 200 mm. The coloration as shown by Semper's figure is notably handsome in life, but preserved specimens are not striking. In some cases the bases of the papillae are surrounded by dark rings, but these are not evident in Semper's figure.

Holothuria macroperona

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 535.

This little holothurian, less than 20 mm. long, lives on the under side of rock fragments on sandy bottom at Rottnest Island, Western Australia. It has not yet been found elsewhere. The color in life is pale gray or sand color, in harmony with the environment. Preserved specimens are white, gray, or brown. Deichmann inclines to the view that these little holothurians are the young of *hartmeyeri*.

Holothuria difficilis

Semper, 1868. Holothurien, p. 92; pl. 30, fig. 21.
(*Actinopyga parvula* H. L. Clark, 1921. Ech. Torres Strait, p. 190; probably also of Fisher, 1907, p. 645, *et al.*)

The confusion between *Holothuria captiva* Ludwig, *H. difficilis* Semper, and *Mülleria parvula* has been so complete that radical treatment is necessary. Deichmann (1930, pp. 70–71), taking *parvula* out of *Mülleria* (= *Actinopyga*), treats it as a *Holothuria*, in spite of calcified anal papillae which occur in many adult specimens, if not all. Those without such "anal teeth" are of course *H. captiva* Ludwig, and that name is thus a synonym of *parvula*.

The same course must be pursued with Indo-Pacific specimens which have been called *parvula*. They must be treated as *Holothuria*, whereupon it is obvious that they are *H. difficilis* Semper. As Deichmann has said (1930, p. 72), it seems better for the present to treat *difficilis* and *parvula* as distinct species, but the differences are rather intangible. The nature of the so-called anal teeth in the 2 species and their relation to the anal teeth of *Actinopyga* need careful study. Are they homologous? Are they perchance a senescent growth? Until such questions can be answered, it is best to keep the West Indian and Indo-Pacific forms separate and leave them in the heterogeneous group *Holothuria*.

At Lord Howe Island, *difficilis* is one of the commonest holothurians. It also occurs at the Capricorn group and probably elsewhere along the Queensland coast. At Mer it is not rare, being found on both sides of the island. Its occurrence west of Torres Strait needs more evidence. We did not find it anywhere, but Erwe (1913) records 3 specimens from west Australia as "*difficilis*" and one from southwest Australia as "*Mülleria parvula*." Outside Australia, this little holothurian has a very great range, from Mauritius to Easter Island, from southern Japan to Lord Howe. It is a small, bright-brown animal, usually 60–80 mm. long (rarely exceeding 100), living on the under side of rock fragments on reef flats. When disturbed it ejects copious white Cuvier's organs.

Holothuria monocaria

Holothuria (*Psolus*, Oken) *monocaria* Lesson, 1830. Cent. zool., p. 225; pl. 78.
Théel, 1886. "Challenger" Hol., p. 172; pl. 8, fig. 10.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 256; pl. 16, fig. 7 (colored).
Holothuria macleari Bell, 1884. "Alert" rept., p. 152; pl. 9, fig. G.

Pearson (1913) has shown what others have suspected, that Bell's species from northeastern Australia is identical with Lesson's, described and figured (after a fashion) half a century earlier. Though there is no little diversity in shades and in the conspicuousness of the white or yellow areas around the papillae, the coloration is on the whole fairly characteristic and reasonably constant. The species is common and widespread from Zanzibar and Mauritius to Hawaii and the Society Islands, north to southern Japan, and south to Lord Howe. From Lord Howe its Australian range extends through Torres Strait to Cape Leveque. We did not find it at Darwin or at Broome or anywhere west of there, but at Allaru Island, west of Port Essington, on the Coburg Peninsula, it is rather common, and in many large specimens the tips and sometimes much more of the papillae were bright grass

green. So striking is this coloring in life, it seems to justify the varietal name *viridis* (see H. L. Clark, 1938, p. 527), but unfortunately the green is fugacious and disappears quickly in alcohol. The absence of *monocaria* from Australia west of Cape Leveque is difficult to explain in view of its very extensive range west, northwest, and north of Australia. Under favorable conditions it grows to a large size, exceeding 400 mm., but as a rule it is less than half that length.

Holothuria remollescens

Lampert, 1885. Seewalzen, p. 242; figs. 8, 9, 22.

This rare holothurian was described from a single very small specimen (23 mm. long) taken at Kosseir (Red Sea). The "Investigator" collected a specimen 50 mm. long at Grand Coco Island, on the eastern side of the Bay of Bengal. The Carnegie Expedition of 1913 took a specimen, 135 mm. long, at Mer, Murray Islands. It was found on the under side of a rock fragment and was dull purplish gray. The previous specimens were brown with darker brown blotches on the back. Obviously more material is necessary.

Holothuria pardalis

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 336; pl. 19, fig. 85.

This common and widespread species ranges from Mozambique and the Red Sea to the Galápagos Islands and Cocos Islands in the extreme eastern Pacific; its northern limit would seem to be in southern Japan, and Lord Howe Island is apparently its farthest south. In Australia it occurs along the coast of Queensland and westward through Torres Strait to the Coburg Peninsula, Cape Leveque, and the Broome region. But it has not been found at Port Hedland or the coast west and south of there. It is a small holothurian, seldom exceeding 100 mm., living in the sand under rock fragments. The color and general appearance show considerable diversity, especially in preserved material. As a consequence, it has received at least half a dozen specific names besides *pardalis* (see Panning, 1935, p. 3), of which *insignis* and *lineata* (both of Ludwig, 1874) are best known.

Holothuria cumulus

H. L. Clark, 1921. Ech. Torres Strait, p. 176; pl. 38, figs. 14–19*a*.

Nothing is known concerning this holothurian beyond what is given in the original account. The unique holotype was about 50 mm. long and whitish in color with yellow pedicels. It was taken from the under surface of a rock fragment at Mer, Murray Islands.

Holothuria hartmeyeri

Erwe, 1913. Fauna Südwest-Australiens, vol. 4, p. 383; pl. 7, figs. 19*a–d*.

Of more than usual interest because it is endemic, this little-known holothurian occurs on the southern coast of Australia from Brighton Beach, South Australia, westward to the corner of the continent and thence northward to Geraldton, Western

Australia. It is 100–150 mm. in length in life, and owing to the flattened ventral surface and the presence of far more pedicels there than dorsally, it is strikingly *Stichopus*-like. There is no little diversity of color, the chief shades being light gray and brown, but it is rarely uniform. The lighter shade is commonly blotched or marked or vermiculated with the darker, sometimes very handsomely.

Holothuria leucospilota

Stichopus (Gymnochirota) leucospilota Brandt, 1835. Prodr. descr. Anim., p. 51.
Holothuria vagabunda Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 334; pl. 19, figs. 75, 76.
Semper, 1868. Holothurien, p. 81; pl. 21 (colored).
Holothuria leucospilota Ludwig, 1881. Ztschr. f. wissensch. Zool., vol. 35, p. 595.
H. L. Clark, 1921. Ech. Torres Strait, p. 179.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 522.

This common Indo-Pacific holothurian, ranging from Natal and the Red Sea to the Hawaiian and Society islands, occurs all along the tropical Australian coast from Lord Howe Island and southern Queensland through Torres Strait to the Coburg Peninsula, Darwin, and Broome, and southward at least to Shark Bay. It is a big, dark brown holothurian, 400–500 mm. long when full grown and well extended. It lies out on sandy or muddy bottoms as does *atra*, and sometimes the two species occur together. But *leucospilota* is brown, not black, the body wall is less firm than in *atra*, and the surface is seldom covered with sand as it often is in *atra*. Finally, the Cuvier's organs in *leucospilota* are abundant and conspicuous, but are lacking in *atra*. Perhaps this is the reason that *leucospilota* is apparently not used for bêche-de-mer.

Holothuria homoea

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 533; fig. 56.

The solitary little holothurian which serves as the holotype of this species was collected at Lord Howe Island, and as yet no second specimen has been found. It is 46 mm. long and is of a peculiar light purplish-gray color. It was 50 mm. long in life and uniformly red-brown in color. Deichmann thinks this is a young *leucospilota*.

Holothuria arenicola

Holothuria maculata Brandt, 1835. Prodr. descr. anim., p. 46 (NOT Chamisso and Eysenhardt, 1821, p. 352).
Holothuria arenicola Semper, 1868. Holothurien, p. 81; pl. 20 (colored); pl. 30, figs. *a*, *b*.

Apparently this is a tropicopolitan species. At least, specimens referred to it are known from many localities in the West Indian region, from the Red Sea, Zanzibar, and Mauritius, from the East Indies, Philippines, and southern Japan, from Fiji, Hawaii, and Tahiti, from the Galápagos and Cocos Island, and from the eastern coast of Australia between Lord Howe Island and the Murray Islands. It has not, however, reached the western coast of America, the northern or western coasts of Australia, or New Zealand. As yet no characters have been noted which will distinguish the West Indian specimens from those of the Indo-Pacific region.

This is a large species, up to 300 mm. in length, but as it lives buried in the sand under rock fragments and its color harmonizes well with its surroundings, it is easily overlooked, especially when small. Moreover, the tentacles are small, so that the oral end is hard to distinguish even when only partly contracted, the animal tapering toward each end as is well shown in Semper's figure. The habits are sluggish, and there are no Cuvier's organs. The color is grayish white, often more or less markedly tinged with yellow or rust color and almost always with spots or blotches of dull purple, blackish brown, or very dark gray. Usually there are 2 dorsal series of these blotches. Frequently there are numerous small dusky spots scattered all over the body, and when these are well developed the blotches may be wanting.

Holothuria verrucosa

Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 338.
Holothuria immobilis Semper, 1868. Holothurien, p. 90; pl. 29; pl. 30, figs. 27*a*, *b*.

Few specimens of this fine species have as yet been taken, but it is reported from Mauritius, the Philippines, Samoa, and Hawaii. We found a single adult specimen on the southeastern reef flat at Mer, Murray Islands, in 1913, but it was only about 200 mm. long, whereas Semper's figured specimen exceeds 300. The color was also quite different; the alcoholic specimen is light grayish buff, with a series of dark blotches along each side. The number of tentacles and the calcareous particles, however, seem to justify considering it *verrucosa*. Deichmann believes Semper's species is identical with Selenka's, described a year earlier, and I have no reason to question her verdict.

ACTINOPYGA

Bronn, 1860. Klass. Ord. Thierreichs, vol. 2, p. 403; pl. 45, fig. 10.

Genotype: *Mülleria lecanora* Jaeger, 1833, p. 18.

As it has been repeatedly explained by Bell, Fisher, and others why Bronn's generic name must replace Jaeger's, owing to multiple preoccupation of *Mülleria*, the matter needs no further discussion here. The genus is a relatively small one with about a dozen species, of which only 1 is strictly West Indian, but 1 other is found at Madeira. The remainder are more or less widely distributed in the Indo-Pacific region. Of these, 6 are known from Australia, and 4 of these occur at the Murray Islands; only 1 was taken at Broome and none at Darwin. In the Torres Strait region, all the species are used for bêche-de-mer and 3 are reckoned as "good fish." The Australian species may be distinguished as follows:

KEY TO THE SPECIES OF ACTINOPYGA

A. Tentacles 25 or more; calcareous particles rods, rosettes, smooth oval grains ..... *mauritiana*
AA. Tentacles 20 or fewer:
  B. Well developed tables present in skin, but scattered and accompanied by large fenestrated ellipses ..... *nobilis*
  BB. No well developed tables in body wall:
    C. Small (less than 50 mm.), with soft body wall containing scattered imperfect, diskless tables and no other deposits ..... *lubrica*

CC. Large, commonly up to 200 mm. or more; deposits rods (often branched) and rosettes:
D. Area around anus conspicuously light-colored; no large rods among deposits ..... *lecanora*
DD. Area around anus not noticeably different from rest of dorsal side:
Large rods, often branched at ends, sometimes with lateral branches, occur abundantly among countless rosettes ..... *echinites*
No large rods; rosettes minute, often incomplete, not usually crowded ..... *miliaris*

Actinopyga mauritiana

Holothuria mauritiana Quoy and Gaimard, 1833. Voy. "Astrolabe," vol. 4, p. 138.
Actinopyga mauritiana Bell, 1887. Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, p. 653; pl. 39, fig. 1.
Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 648; pl. 67, figs. 1–1*d*.

Fisher's account of this holothurian is a model of what such accounts should be. In Australia it is confined to the northeastern corner of the continent, the northern end of the Barrier Reef. It is found at Mer, but is not so common as *lecanora*. It is 150 mm. or more in length when preserved, and in life no doubt may be 200 mm. or more. The geographical range includes the entire Indo-Pacific area from Mozambique, Zanzibar, and the Red Sea to Hawaii, Tahiti, and the Paumotus, northward to southern Japan and southward to Fiji. In Torres Strait it is (or was) much sought as bêche-de-mer and is usually marketed as "redfish."

Actinopyga nobilis

Mülleria nobilis Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 313; pl. 17, figs. 13–15.
Actinopyga nobilis Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 647.

Under the doubly erroneous name *Mülleria maculata*, Erwe (1913) records this species from Shark Bay and Houtman's Abrolhos. As he gives excellent figures (pl. 6, figs. 12*a–d*), his identification cannot be questioned, but we did not find *nobilis* in the Broome region in either 1929 or 1932. Neither did it occur at Darwin nor on the Coburg Peninsula. It was rare at the Murray Islands, but as it was persistently sought by the bêche-de-mer fishermen (to whom it is "teatfish" or "mammy fish"), this is not strange. It grows to a large size (200–300 mm.), perhaps the largest in the genus. The color is black or black and white. Mitsukuri (1912) has given a very full account, with valuable figures, of this holothurian as found in southern Japan. For a discussion of its correct name see H. L. Clark, 1921, page 189. It ranges from Natal to the Red Sea and eastward to Hawaii and Fiji.

Actinopyga lubrica

Mülleria lubrica Sluiter, 1894. Semon's Hol., *in* Jena Denkschr., vol. 8, p. 104.
Actinopyga lubrica H. L. Clark, 1921. Ech. Torres Strait, p. 188.

Based on 2 small specimens, 46 mm. long by 20 mm. wide, this species is open to grave suspicions. The material was collected by Semon at Thursday Island and no similar specimens have since been taken. The description suggests the possibility

that 2 specimens of *Holothuria difficilis* were preserved in formalin, which softened and swelled the body wall and partially decalcified it. No figures of the peculiar calcareous particles have been published.

Actinopyga lecanora

Mülleria lecanora Jaeger, 1833. De Hol., p. 18; pl. 2, figs. 2, 2*b*.
Semper, 1868. Holothurien, p. 75; pl. 30, fig. 7.
Actinopyga lecanora Bronn, 1860. Klass. Ord. Thierreichs, vol. 2, explanation of pl. 45, fig. 10.

This was the only species of *Actinopyga* met with by us in Australia in 1929 and 1932. In the former year we found 2 adult specimens among the corals at Cape Leveque, and in the latter year we took 2 smaller specimens at Broome. It is a large species, exceeding 300 mm. in length when fully grown. The coloration is very distinctive: upper surface dark, ranging from brown to deep brownish black; lower surface and a conspicuous area around the anus much lighter, ashy or olive gray. The shades of color show no little range in life as well as in preserved material, and the extent of the light areas also shows individual diversity. The type locality for *lecanora* is Celebes, but the species ranges from Mauritius to Tongatabu, and north to the Ryukyu Islands. In Australia it has been taken often in Torres Strait and on the northern part of the Barrier Reef, where it is in demand for bêche-de-mer, being sold under the name "stone fish." Apparently it may be expected in any suitable area of tropical Australia, at least as far west as long. 120° E.

Actinopyga echinites

Mülleria echinites Jaeger, 1833. De Hol., p. 17.
Semper, 1868. Holothurien, p. 76; pl. 30, fig. 8.
Actinopyga echinites Kent, 1893. Great Barrier Reef, p. 236.

Commercially important in the Torres Strait region under the name "redfish" (also applied to *A. mauritiana*), this holothurian grows to a length of 300–350 mm. according to Kent, who also figures the color in life as dark reddish brown above and light red on the ventral surface. The colors become darker on preservation. It ranges from Zanzibar to Fiji, north to the Ryukyu Islands, and south to Shark Bay, Western Australia, and Port Denison, Queensland. It was not met with on any of my three Australian visits, but Erwe (1913) records it from Shark Bay, and Kent (1893) reports a single large specimen from Port Denison. He says it inhabits deeper water than *mauritiana*.

Actinopyga miliaris

Holothuria miliaris Quoy and Gaimard, 1833. Voy. "Astrolabe," vol. 4, p. 137.
Actinopyga miliaris Bell, 1887. Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, p. 653; pl. 40, fig. 1.

Ranging from Mozambique and the Red Sea to the Ryukyu, Caroline, and Tonga islands, this is one of the "good fish" of the bêche-de-mer fishermen, who call it "blackfish." The color in life is a deep brown which looks almost black when the animal is strongly contracted, and becomes black when the transformation into

bêche-de-mer is completed. In Australia, *miliaris* is known from "Western Australia," Torres Strait, and the northern end of the Barrier Reef. The Barrier Reef Expedition took it twice north of the Low Isles, near North Direction Island and Eagle Island, in 10–19 fms.

Order MOLPADONIA

This is the smallest of the 4 orders of holothurians met with on the Australian coast, where it is represented by only 7 species. All are lovers of mud or soft sand and live buried beneath the surface. When undisturbed they are supposed to lie with the oral end of the animal flush with the surface of the bottom where they dwell, the greater part of the body buried several centimeters deep in the sand or mud, and the posterior end, which is often constricted into a more or less elongated caudal region, curving upward so that the anal opening is also at the surface of the sand but more or less distant from the mouth. Buried thus, they move about but little if at all, and they would rarely be seen by man were it not for heavy storms which create such surf and undertow that the holothurians are washed out and up onto the beach, sometimes in very large numbers. The surface of the body is smooth and often slimy, making the contracted animal more or less repulsive. Only 1 family is recognized.

Family MOLPADIIDAE

This small family of 8 or 10 genera is not very well represented in Australia, only 3 of the genera having been taken there as yet. These may be distinguished thus:

KEY TO THE GENERA OF MOLPADIIDAE

Tentacles with 3–7 short, blunt digits ..... *Molpadia*
Tentacles with 2 pairs of rather long, pointed digits ..... *Paracaudina*
Tentacles without digits or with a minute one on each side of tip ..... *Acaudina*

MOLPADIA

Risso, 1826. Hist. nat. Europe, vol. 5, p. 292.

Genotype: *Molpadia musculus* Risso, 1826, vol. 5, p. 293.

It is futile to attribute this generic name to Cuvier, as is universally done, since he designates no identifiable type. It is only because Risso himself refers to Cuvier's use of the name that subsequent writers have taken Cuvier as the founder of *Molpadia* and dated it from 1817. If we regard Cuvier as the author of *Molpadia*, we must acknowledge either that it has no type, or else that it is monotypic and the type is unrecognizable. By considering Risso the founder of the genus, though not the author of the name, we avoid all difficulties, since *Molpadia musculus* is a widely distributed and well known holothurian.

This is a relatively large genus with some 30 or more species, but in Australian seas it is represented by only 3, all of which have been discovered in the past thirty-five years. Two were taken by the "Thetis" at her station 46, off Jibbon, New South Wales, and neither has been reported since. The third is known only from a single spot near the jetty at Darwin, Northern Territory.

KEY TO THE SPECIES OF MOLPADIA

A. Tables with irregular disks, 100–200 microns or more in diameter; dark red phosphatic bodies present:
  Disks of tables in tail not narrowed and drawn out into projection at each end, but irregularly oval with 20–40 small holes ..... *dissimilis*
  Disks of tables in tail narrowed and drawn out into projection at each end, with few (5–10) holes ..... *productamensis*
AA. Tables with rather regular disk with 3 large holes, usually 3 smaller ones alternating with them; no dark red phosphatic bodies ..... *altimensis*

Molpadia dissimilis

H. L. Clark, 1909. "Thetis" rept., p. 561; pl. 58, figs. 12–21.

Three specimens of this species, 45–70 mm. in length, with the diameter a third as much or more, were taken by the "Thetis" off Jibbon, New South Wales, in 50–66 fms. The bottom was recorded as "mud and abattoir refuse"; probably the latter supplied nourishment for countless mud-loving animals. The holothurians have a grayish color which is largely obliterated in the adults by the dark red phosphatic deposits, except the oral disk and caudal appendage. The smallest specimen has the ground color yellowish gray with the tentacles yellowish. The phosphatic deposits are yellowish red, an indication of youth. In spite of superficial resemblances to the following species and to *intermedia*, the common Pacific *Molpadia*, the specific characters of *dissimilis* seem to be distinctive. But Deichmann considers it identical with *scabrum* Sluiter. Lack of material for comparison prevents a decision.

Molpadia productamensis

H. L. Clark, 1909. "Thetis" rept., p. 562; pl. 58, figs. 22–30.

The only known specimens of this *Molpadia* were taken with the preceding species off Jibbon, New South Wales, in 50–66 fms. on a muddy bottom enriched by abattoir refuse. It is somewhat larger than its congener, the type being 68 by 35 mm. The coloration is essentially the same, deep purplish red with oral disk and caudal appendage light gray. The differences in the calcareous deposits and in the calcareous ring preclude any possibility that the specimens all belong to one species. Deichmann thinks that *productamensis* may be identical with *Trochostoma andamanense* Walsh. Lack of material for comparison again prevents a decision.

Molpadia altimensis

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 538; figs. 58*a–c*.

This species also is known from just 3 specimens, all taken at a single place, in this case near the jetty at Darwin, Northern Territory. The general appearance is very different from that of the New South Wales material, as the thin and delicate body wall is pale gray, with a more or less rusty tinge and a complete absence of dark red phosphatic deposits. But these tropical Molpadias are very small, less than 25 mm. in length, and the body wall is very rough from the high spires of the tables. The 3 known specimens were dredged in only 7 fms. of water on a bottom of soft, black mud. This is a very shallow habitat for *Molpadia*, and the small

size of the specimens suggests that the adults may live in deeper water. The possibility that the specimens from Darwin are the young of *M. scabrum* (Sluiter) or some other Indian Ocean species cannot be denied, but further material must be obtained before we can know.

PARACAUDINA

Heding, 1932. Vidensk. Medd., vol. 92, p. 455.

Genotype: *Molpadia chilensis* Müller, 1850, p. 139.

A detailed discussion of this genus and its allies was published by me in 1935, which showed that 3 species were recognizable and that 1 of these has an extraordinarily wide range and sufficient diversity to justify recognizing 3 varieties. The 3 species all occur in Australia, some member of the genus being presumably present on any part of the coast where conditions permit. They may be distinguished thus:

KEY TO THE SPECIES OF PARACAUDINA

A. Crossed-cups well developed and in large numbers; perforated plates may also be present ..... *chilensis* var. *ransonnetii*

AA. Crossed-cups reduced to irregular perforated plates, usually with knobs or projections, sometimes showing traces of crossed-cup origin:
Plates of irregular form, usually with about 8 perforations of unequal size and irregular disposition ..... *australis*
Plates oval or squarish, commonly with 4 large, symmetrically placed perforations, sometimes with 1 or more small ones in addition ..... *tetrapora*

Paracaudina chilensis var. ransonnetii

Caudina ransonnetii von Marenzeller, 1881. Verhandl. K. K. zool.-bot. Gesellsch. Wien, vol. 31, p. 126.
Caudina chilensis (J. Müller) Hozawa, 1928. Sci. rept. Tôhoku Univ., ser. 4, vol. 3, p. 361; pls. 14–17.
Pseudocaudina ransonetti Heding, 1931*a*. Vidensk. Medd., vol. 92, p. 283.
Paracaudina ransonetti Heding, 1932. Vidensk. Medd., vol. 92, p. 455.
Paracaudina chilensis var. *ransonnetii* H. L. Clark, 1935. Ann. Mag. Nat. Hist., ser. 10, vol. 15, p. 281.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 540.

This interesting holothurian is common in the sandy mud of Roebuck Bay, northwestern Australia, and probably occurs at many other suitable localities in the Australian tropics. It is also known from the East Indies, China, Japan, the Aleutian Islands, and California. As to where it merges with typical *chilensis*, we have no present knowledge. Deichmann (1938) has recorded *chilensis* from California, Mexico, and Guatemala. Full-grown *ransonnetii* exceed 200 mm. in length; about one-third to one-half of the length may be in the caudal part. The color in life is white, with a slight purplish cast especially near the anterior end; the caudal part is cream color; the tentacles are reddish at the base and on the outer side, apparently from the blood they contain. Preserved specimens are light gray. Those collected at Broome were very inert and apparently lived 5–10 inches below the surface of the mud.

Paracaudina australis

Molpadia australis Semper, 1868. Holothurien, p. 233; pl. 39, fig. 14.
Pseudocaudina australis Heding, 1931*a*. Vidensk. Medd., vol. 92, p. 283.
Paracaudina australis Heding, 1932. Vidensk. Medd., vol. 92, p. 455.

This *Paracaudina* is reported from the eastern and southern coasts of Australia. Semper's type was from Rockhampton, Queensland, and Joshua and Creed (1915) examined more than 40 specimens from "various localities off the South Australian coast." Semper's type was only 100 mm. long and yellowish brown in color, but Joshua and Creed report great diversity in size (70–125 mm.), form, and color. Their largest specimen either was abnormal or had lost its caudal appendage. The color is recorded as "yellow with patches of rusty-pink." The small specimens were white.

Paracaudina tetrapora

Caudina tetrapora H. L. Clark, 1914. Rec. W. Australian Mus., vol. 1, p. 170; fig. 1.
Paracaudina tetrapora H. L. Clark, 1935. Ann. Mag. Nat. Hist., ser. 10, vol. 15, p. 284.

The occurrence of a *Paracaudina* in Western Australia had not been suspected until specimens in the Western Australian Museum, from Cottesloe Beach and the Abrolhos Islands, were examined in 1913. Since then it has become known that specimens are often washed up on Cottesloe Beach after a storm. They grow to be nearly 200 mm. in length and 30 mm. in diameter. The absence of a caudal part in some individuals is probably accidental. All the preserved specimens are more or less white. In the South Australian Museum at Adelaide, 2 specimens of *Paracaudina* were found which were taken near the Semaphore, on Lefevre's Peninsula, South Australia. It was supposed these were *australis*, but examination of the calcareous particles showed them to be *tetrapora*. It is probable, therefore, that this big *Paracaudina* ranges from the Gulf of St. Vincent westward and northward to the Abrolhos Islands, and that *australis* ranges from Discovery Bay eastward and northward to Rockhampton, Queensland. But there are vast areas of these coasts where no Paracaudinas are as yet known.

ACAUDINA

H. L. Clark, 1908. Apod. hol., p. 178.

Genotype: *Molpadia demissa* Sluiter, 1901, p. 110 = *Haplodactyla molpadioides* Semper, 1868, p. 41. See Deichmann, 1940, p. 212.

Recent studies have shown that *Aphelodactyla* and *Acaudina* are synonyms, and the shorter name has priority. Nearly a dozen specific names have been applied to various individuals in this East Indian genus, but it is now generally agreed that the type is the only valid species, save for the 2 following, recently described from northwestern Australia. These differ from the genotype in having characteristic calcareous plates. They differ from each other in the form of these deposits.

Calcareous deposits scattered perforated plates, larger ones with big perforations having serrate margins ..... *delicata*
Calcareous deposits small oval plates with 3 or 4 perforations, a few doughnut-shaped bodies, and short, irregularly branched particles with wide, blunt branches ..... *leucoprocta*

Acaudina delicata

Aphelodactyla delicata H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 542; figs. 59*a*, *b*.

This apparently well marked species was found in muddy sand, in 5–8 fms. of water, southwest of Broome in 1929 and again in 1932. Its small size, 52 mm. or less in length, suggests that the known specimens are not adult. But the calcareous spicules are so characteristic it is hard to doubt the validity of the species. The color was pale gray with the tentacles yellowish or brownish.

Acaudina leucoprocta

Aphelodactyla leucoprocta H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 543; figs. 60*a–c*.

The curious color character of this relatively big molpadiid is notably distinctive, for no other Australian holothurian has the cloacal lining and the adjoining body surface white in contrast with the general dark purple or purplish-brown color. The otherwise very different and much larger *Actinopyga lecanora* has the area around the anus light gray, sometimes almost white, in contrast with a dark general color, but the contrast is not so marked as in the *Acaudina*. Only 3 specimens of this molpadiid were taken, all from the Broome region but at three widely separated points. Two occurred near low-water mark, more or less buried in sand or sandy mud. The third was dredged in sandy mud in 7–8 fms. of water. The specimens ranged from 100 to 140 mm. in length, with the greatest diameter about one-third as much. The body wall is notably slimy and the animal is unusually inert.

Order APODA

The holothurians of this group have, as a rule, more or less elongated bodies; as a consequence, the large species have a superficial resemblance to snakes, and the smaller ones are quite like worms. They are widely distributed in all seas, but are most common in the East Indies. They occur on all sides of the Australian continent, but are most abundant at the northeastern corner, where about half the species are found. The temperate coasts of New South Wales, Victoria, and South Australia are the home of only 4 or 5 species. Two quite distinct families are recognizable, and are easily told apart by the differences in the tentacles and in the calcareous deposits:

Calcareous particles perforated plates, accompanied by anchors; tentacles usually more or less definitely pinnate, never peltato-digitate ..... Synaptidae

Calcareous particles wheels with or without sigmoid bodies, or sigmoid bodies alone; tentacles peltato-digitate ..... Chiridotidae

Family SYNAPTIDAE

Most of the Apoda occurring in Australia belong in this family, 7 genera being represented. They show great diversity in size and color, but otherwise they are distinguished chiefly by the character of the calcareous particles in the body wall

They are commonly found either free-living among sponges or corals, or under rock fragments, where they are usually somewhat buried in the sand or mud. The Australian genera may be distinguished as follows, chiefly by the character of the anchors and anchor plates:

Key to the Genera of Synaptidae

A. Arms of anchors smooth; vertex usually with minute knoblike projections:
  B. Cartilaginous ring, posterior to calcareous ring, usually wanting; stock of anchor irregularly branched:
    Calcareous ring without noticeable anterior projections; anchor plates not abruptly contracted at posterior end, but with large, smooth hole on each side ..... *Euapta*
    Calcareous ring with conspicuous anterior projections; anchor plates abruptly contracted posteriorly and thus lacking large, smooth hole on each side ..... *Opheodesoma*
  BB. Cartilaginous ring commonly present; stock of anchor not branched:
    C. Tentacles numerous, normally 25, but ranging from 16 to 27, apparently according to age but not to size ..... *Polyplectana*
    CC. Tentacles normally 15 or fewer:
      Very large, 500–2000 mm. in length; anchor plates subrectangular or irregular, with numerous smooth holes ..... *Synapta*
      Size diverse, 40–500 mm.; anchor plates rounded in front, narrow behind, with few holes, the largest dentate and regularly arranged ..... *Chondrocloea*

AA. Arms of anchors usually serrate, but sometimes smooth; vertex without knobs:
  Tentacles pinnate, with 5–21 digits (usually more than 7) ..... *Leptosynapta*
  Tentacles digitate, with 3–5 digits ..... *Protankyra*

EUAPTA

Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 112.

Genotype: *Synapta godeffroyi* Semper, 1868, p. 231.

This genus of large tropical synaptids contains, according to Heding (1928), 5 species rather than the 2, one West Indian and the other Indo-Pacific, which have long been recognized. Only 1 species has as yet been taken in Australia.

Euapta godeffroyi

Synapta godeffroyi Semper, 1868. Holothurien, p. 231; pl. 39, fig. 13.
Euapta godeffroyi Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 113.
H. L. Clark, 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 462; pl. 1, figs. 1–4.

Semon took 3 specimens of this holothurian at or near Thursday Island, and we took a single small specimen at Mer. The species ranges from Mauritius to Hawaii, but is apparently not found in Australian waters except in the Torres Strait region. Fully grown specimens are up to 400 mm. in length, with a diameter in life (when

normally extended) of about one-twentieth as much. The coloration is yellow-gray or creamy white, with radii indicated by greenish-brown or pale brown stripes and the dorsal interradii marked with large dusky, greenish-brown blotches. Nothing is known of the habits, but Fisher (1907) gives a very full account of this synaptid and its occurrence in Hawaii.

OPHEODESOMA

Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 723.

Genotype: *Opheodesoma spectabilis* Fisher, 1907, p. 723.

This is a group of 4 or more species widely distributed in the Indo-Pacific region. According to Heding (1928, 1931), there are 11 species, but he makes so little allowance for individual diversity, youthful and senescent features, and abnormalities, we are justified in being skeptical as to the validity of his species. Apparently 2 or possibly 3 species are found on the Queensland coast, one of which is, so far as we now know, endemic. No member of the genus has been found as yet west of Torres Strait. The 3 Australian forms are supposed to be distinguished by the presence or absence of a membrane uniting the bases of the digits of the tentacles, a character in whose consistency I have no faith; and by the size of the anchors and plates, a character subject to the "personal equation" of the observer as well as to age differences in the individuals observed. It is important to remember that age differences and size differences are not the same thing. Differences in the calcareous ring are unreliable, as that organ varies more or less with age, size, and environment. Large series of specimens have not been available for studying any of the Australian Opheodesomas, which are supposed to differ from each other thus:

Key to the Species of Opheodesoma

A. Base of digits united by membrane:
  Anchors rather small and narrow, 275 microns or less in length; width across arms about half as much ..... *glabra*
  Anchors 290–370 microns in length; width across arms about two-thirds as much ..... *australiensis*
AA. Base of digits not united by membrane; anchors 275–357 microns in length; width across arms about three-fourths as much ..... *grisea*

Opheodesoma glabra

Synapta glabra Semper, 1868. Holothurien, p. 12; pl. 2 (colored); pl. 4, fig. 8.
Opheodesoma glabra Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 723.
H. L. Clark, 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 465; pl. 2, figs. 4–6.

The inclusion of this species in the Australian fauna is based wholly upon 2 specimens taken by Semon in the Thursday Island region, but Sluiter (1894) says nothing definite about their size or color. The species has been reported from the Philippines, the Dutch East Indies, and Fiji, and is said to reach a length of 900 mm. The color is recorded as uniformly brown, as shown by Semper, or dark gray, sometimes with white spots due to large heaps of miliary granules. Nothing is as yet recorded as to habitat or habits.

Opheodesoma australiensis

Heding, 1931. Zool. Jahrb., Abt. syst., vol. 61, p. 640; figs. 1, *1–11*; fig. 2, 4.
Opheodesoma ramispicula Heding, 1931. Zool. Jahrb., Abt. syst., vol. 61, p. 643; figs. 1, *12–17*; figs. 2, *1*, 5.

This species is based on 5 specimens from Bowen, Queensland, of which the largest, 340 mm. in length, was considered by Heding a different species from the others. But the peculiarities of this specimen are so trivial, I cannot believe it is anything other than an individual variant, perhaps senescent, and I feel rather sure that all 5 are either *glabra* or *grisea*—if indeed those 2 species prove to be really distinct.

Opheodesoma grisea

Synapta grisea Semper, 1868. Holothurien, p. 11; pl. 4, figs. 6, 7.
Opheodesoma grisea Fisher, 1907. Proc. U. S. Nat. Mus., vol. 32, p. 723.
H. L. Clark, 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 466; pl. 2, figs. 1–3.

We took 5 specimens of this synaptid at Mer, and Semon took 2 at Thursday Island. Two specimens, 1 in the Museum of Comparative Zoölogy from Zanzibar, and 1 taken by the Great Barrier Reef Expedition near North Direction Island in 19 fms., lack their head ends, and their identification is open to question on that account, but the anchors and plates justify calling them *grisea*. In size, this species is not inferior to *glabra;* in color it is much more diversified, ranging from pure white (var. *alba* Sluiter) to mottled dusky greenish or bluish gray, with narrow dusky lines and irregular spots. Synaptids referred to *grisea* have been taken on the East African coast at Lumbo and Zanzibar; at Ceylon; in the Philippines; and in the Dutch East Indies. Heding (1928) reports it from Pearl Harbor, Hawaii, the type locality for *O. spectabilis* Fisher. On the other hand, he found no specimens of *spectabilis* in Mortensen's Pearl Harbor collection, whereas Fisher in 1902 and I in 1913 found it very common there, and it was the only synaptid we did find. Obviously Heding's identifications need confirmation. There are Australian records of *grisea* from Fitzroy Island and Bowen, Queensland. As to habits or habitat, however, nothing is recorded.

POLYPLECTANA

H. L. Clark, 1908. Apod. hol., pp. 16, 22, 76.

Genotype: *Synapta kefersteinii* Selenka, 1867, p. 360.

This has been a monotypic Indo-Pacific genus, well characterized by the large number of tentacles, but in 1928 and 1931 Heding added 9 new species, of which none are reported from Australia. The validity of these species therefore does not concern us here.

Polyplectana kefersteinii

Synapta kefersteinii Selenka, 1867. Ztschr. f. wissensch. Zool., vol. 17, p. 360.
Polyplectana kefersteinii H. L. Clark, 1908. Apod. hol., pp. 16, 77.
—— 1921. Ech. Torres Strait, p. 159.
—— 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 468; pl. 1, figs. 8–12.

The type locality for this species is the Hawaiian Islands, whence it ranges southward to Tahiti and westward to Kosseir on the Red Sea. It does not appear to have been found at Zanzibar or Mauritius, nor as yet at Ceylon. In Australia, it is known only from the Murray Islands and apparently from the Low Isles. The latter record is, however, open to some question, as the specimen was fragmentary and headless and the identification rests wholly on the calcareous particles. Large specimens are up to 450 mm. in length, and the color is some shade of brown, often lighter on the lower side. Spots and blotches of a light gray or whitish color may occur as a result of aggregations of miliary spicules.

SYNAPTA

Eschscholtz, 1829. Zool. Atlas, vol. 2, p. 12.

Genotype: *Synapta mammillosa* Eschscholtz, 1829, p. 12 = *Holothuria maculata* Chamisso and Eysenhardt, 1821, p. 352.

This genus has long been considered monotypic, but Heding (1928) is quite sure that Lesson's (1830) species *oceanica* from Tahiti is distinct from Chamisso and Eysenhardt's *maculata* from the Marshall Islands. The single specimen which I collected at Papeete in 1913 seems to justify his position, but much more material is needed from other islands to settle the matter. All Australian material seems to represent a single species.

Synapta maculata

Holothuria maculata Chamisso and Eysenhardt, 1821. Nova acta Deutsch. Akad., vol. 10, p. 352.

Synapta maculata Jaeger, 1833. De Hol., p. 15.

H. L. Clark, 1908. Apod. hol., p. 78; pl. 1 (colored).

—— 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 471; pl. 3, figs. 1, 2; pl. 4, fig. 1.

Though the western limits of the range of this species, Zanzibar to Kosseir, are well known, there is still doubt as to the eastern limits. If the Tahitian Synaptas represent a different species, as is at least possible, the region where its western range limit meets the eastern limit of *maculata* is completely unknown. Apparently neither form has reached the Hawaiian Islands. The genus enters the Australian fauna only in the region of the northern end of the Barrier Reef. Semon did not find it at Thursday Island, but *maculata* is not uncommon at the Murray Islands, the Museum of Comparative Zoölogy has a specimen from Hope Island, and the Barrier Reef Expedition took at least 2 at the Low Isles. So long and snakelike are these biggest of synaptids and longest of holothurians, accurate statements as to length are not available. There is no doubt that normal adults may exceed a meter even when only naturally extended. That such a specimen could be stretched to 2 meters is not at all unlikely. The color is some shade of brown, often yellow-brown, but the degree of contraction or extension makes much difference. Striped forms are reported, but these may be the other possible species. More careful observations in life are needed. Like all synaptids, *maculata* is very sluggish in all its movements, save for the ceaseless bending and twisting of the tentacles. It frequently occurs unsheltered on "grassy" bottoms, but it is more commonly found, often several individuals together, under rock fragments on the reef flat or near low-water mark.

CHONDROCLOEA

Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 113.

Genotype: *Synapta nigra* Semper, 1868, p. 12.

The question of the type of this genus is complicated by the fact that Östergren included a single West Indian synaptid with the dozen East Indian species which he grouped in his proposed *Chondrocloea*. But this West Indian form had already been made the type of a genus *Synaptula*, and it is now generally agreed that this genus is valid and monotypic. Östergren's proposed name must then be used for the East Indian group of species. In 1908 (p. 80, last line) I suggested that *nigra* "best represented" this group, thus virtually making it the type of *Chondrocloea*. Yet in 1928, Heding (p. 155) says: "The genotype of Chondrocloea is *Synapta indivisa* Semper." In 1938 (p. 546) I thoughtlessly accepted his statement, forgetting my own designation of *nigra*. Heding gives no reason for his choice of *indivisa*, but presumably it is because Östergren (1898, p. 114) in listing his species of *Chondrocloea* arranged them alphabetically and thus put *indivisa* first. There is no indication that *indivisa* was to be considered typical or a type in any sense. Neither *nigra* nor *indivisa* is a satisfactory genotype, as neither is adequately known. But for the present Östergren's name may continue in use for the group which he had in mind. There is little doubt that *recta* is the commonest and best-known species, but of course we cannot now adopt it for genotype.

When we come to consider the component species of *Chondrocloea*, it is evident that complete revision of the group is demanded. This is not the place for such a revision, but the situation must be stated. In 1908, I recognized 8 species of *Synaptula*, but of course 1 of these was the unique genotype, *hydriformis*. The remaining 7 species made up *Chondrocloea*. In 1928, Heding rejected *nigra* as a member of *Chondrocloea*, but added 17 new species and restored 4 old names which I had rejected as synonyms of earlier names. He thus included 28 species in *Synaptula*, not separating the single West Indian form from its multitude of East Indian congeners. In making up his key (1928) he has relied so largely on color that anyone who has handled large quantities of such a diversified species as *recta* (see H. L. Clark, 1938, p. 545) is in despair. It is further noteworthy that most of Heding's 27 East Indian Chondrocloeas are from three localities, 8 species being recorded from Banda, 8 from Toeal and Vatek opposite Toeal, and 3 from Jolo. In 1931, Heding added 2 more species to his genus *Synaptula*, and established a new genus, *Pendekaplectana*, for a single *Synaptula*-like specimen from Ponape. I doubt the validity of both the species and the genus, since it is evident that Heding and I have different concepts of what constitutes a species or a genus.

None of Heding's material is recorded from Australia save the 2 "new species" described in 1931. One of these is based on 2 specimens from Bowen, the other on 8 specimens from Shark Bay. The latter were reported by Erwe (1913) as *Chondrocloea recta*, but Heding has overlooked Erwe's admirable paper. His supposed species from Bowen is also probably *recta*, which is common and widespread in tropical Australia. The other Australian Chondrocloeas are very unsatisfactorily known from inadequate material. They, together with the East Indian forms, require a complete revision.

KEY TO THE SPECIES OF CHONDROCLOEA

A. Tentacles 15:
  Color dark brown or purplish brown; anchors rather stout, with short, divergent flukes; miliary granules, minute irregularly branched plates ..... *nigra*
  Colors greenish brown (olive green in alcohol) and dirty cream color (light buff in alcohol); anchors slender, with longer, less divergent flukes; miliary granules, typical rosettes ..... *macra*
AA. Tentacles 13:
  Gonads unbranched; polian vessels few; tentacles very long and slender, with about 10 pairs of digits ..... *indivisa*
  Not as above ..... *recta*

Chondrocloea nigra

Synapta nigra Semper, 1868. Holothurien, p. 12; pl. 4, figs. 9*a–c*.
Chondrocloea nigra Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 114.
Synaptula nigra H. L. Clark, 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 474; pl. 3, figs. 3, 4; pl. 4, fig. 2.

This synaptid is still very imperfectly known. Its right to a place here rests on the single indefinite record of Lampert (1885) and the half-dozen specimens which we collected at Mer in 1913. Östergren's inclusion of *nigra* in *Chondrocloea* seems to me much more natural than Heding's (1928) suggestion that it be placed in *Polyplectana* or made the type of a new genus. The species is of moderate size, up to 350 mm. long in life, shrinking one-fourth or more in alcohol. The dark coloration is apparently constant, but skepticism on this point is justifiable. The geographical range is unknown, Bohol in the Philippines and Mer, Murray Islands, Australia being the two localities so far defensible. Lampert's (1885) record from the Red Sea needs verification.

Chondrocloea macra

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 547.

The validity of this species, based on a single specimen collected near Allaru Island, Coburg Peninsula, northern Australia, on eelgrass bottom, in shallow water, is obviously open to question. The length in life was about 425 mm. with a diameter of 10. The shrinkage in alcohol was less than 10 per cent. The calcareous particles are essentially like those of *recta*. What may well be a second individual of this species is in the Museum of Comparative Zoölogy collection. It comes from Ponape, Caroline Islands, and is now 425 mm. long. Color, faded yellowish brown.

Chondrocloea indivisa

Synapta indivisa Semper, 1868. Holothurien, p. 13; pl. 4, fig. 1.
Chondrocloea indivisa Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 114.

The validity of this species is indeed dubious. It was described from a single specimen collected at Zamboanga, Philippine Islands, which was only 42 mm. long, the tentacles being 12 mm. of that. The only other reported specimen was collected by Semon in the Thursday Island region and hence entitles the species to a place in the Australian fauna; but Sluiter (1894) gives no data as to Semon's specimen. Heding (1928) includes it in his key to the species of *Synaptula*, considering the

unbranched gonads and excessively long tentacles valid distinguishing characters, but Mortensen collected no specimens. It will probably be discovered that the unique type of *indivisa* was a young individual of some other species of *Chondrocloea*.

Chondrocloea recta

Synapta recta Semper, 1868. Holothurien, p. 14; pl. 4, figs. 2, 3.
Chondrocloea recta Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 114.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 545; pl. 15, figs. 5, 6 (colored).
Synaptula recta H. L. Clark, 1921. Ech. Torres Strait, p. 160.
—— 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 475; pl. 1, fig. 13; pl. 3, fig. 9; pl. 4, fig. 3.

This is another of Semper's Philippine Islands species which has been found in Australia, but in this case it proves to be a common and characteristic species ranging from the Low Isles of Queensland to Shark Bay, Western Australia. It is extraordinarily variable in color and ranges in length up to nearly 400 mm. It occurs among corals and sponges and, at Broome at least, is very gregarious. A careful study of the coloration based on the hundreds of specimens obtainable at Broome would be very rewarding. Further investigation into the number of tentacles and its relation to age would also prove well worth while.

LEPTOSYNAPTA

Verrill, 1867. Trans. Connecticut Acad., vol. 1, p. 325, footnote.

Genotype: *Holothuria inhaerens* O. F. Müller, 1776, p. 232.

This is a genus of world-wide distribution though chiefly in temperate seas. As in the case of *Chondrocloea*, I find myself completely at variance with Heding with reference to the number of species to be recognized. He includes 25 species even after eliminating half a dozen others. At least one-third of these nominal species seem to me invalid, but the only forms that need concern us here are those from Australia, which according to Heding require 7 names. He had examples of 5 of these "species," but also recognized 2 named by me of which he had no material. As I have pointed out previously (1938, p. 549), I am unable to recognize as valid any one of the 4 "new" species to which he gives names. He appears to make no allowance for growth stages and individual diversity. In my judgment, *Leptosynapta* is represented in Australia by not more than 4 species. These may be distinguished by the following key, but it ought to be emphasized that 2 of them are known from only a single specimen each, and a third is probably only a localized extreme of the widespread fourth.

KEY TO THE SPECIES OF LEPTOSYNAPTA

A. Anchor plates more or less oval but not kite-shaped; color white, yellowish, or reddish, often translucent in life:
  B. Anchors 200 microns or more in length; plates 160 microns or more:
    Miliary granules thick C- or O-shaped bodies or slender rods ..... *dolabrifera*
    Miliary granules spherical, ovoid, ellipsoid, or reniform bodies ..... *dyscrita*
  BB. Anchors 160 microns or less in length; plates 110 microns or less ..... *parvipatina*
AA. Anchor plates rounded kite-shape; color more or less blackish or gray with cream-white tentacles ..... *ictinodes*

Leptosynapta dolabrifera

Synapta dolabrifera Stimpson, 1855. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 386.
Leptosynapta dolabrifera H. L. Clark, 1908. Apod. hol., p. 89.
—— 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 480; pl. 7, figs. 1–6.
—— 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 548.
Heding, 1928. Vidensk. Medd., vol. 85, p. 221; figs. 34, *1–4*; figs. 35, *1–5*.
Leptosynapta varioputina Heding, 1928. Vidensk. Medd., vol. 85, p. 226; figs. 36, *1, 2, 5–9*; figs. 37, *1–3*.
Leptosynapta jacksonia Heding, 1928. Vidensk. Medd., vol. 85, p. 228; figs. 36, *3, 4, 10–13*; figs. 37, *4–7*.

This is the common synaptid of the temperate coasts of Australia, from Lord Howe Island and Port Jackson to Fremantle, but it apparently extends its range northward on the western coast well into the tropics. A full account, with a discussion of Heding's proposed species, is given in H. L. Clark, 1938.

Leptosynapta dyscrita

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 551; figs. 61*a–c*.

The validity of this species is open to question, but as it appears to be locally isolated at Broome, it seems best to designate it by a name, which may serve for reference purposes. The dozen specimens were less than 60 mm. in length and translucent white in color. The resemblance to *dolabrifera* is so complete, it will not be surprising if further collecting on the northwest coast shows that *dyscrita* has no validity, the supposed peculiarity of the miliary particles being inconstant and unreliable.

Leptosynapta parvipatina

H. L. Clark, 1921. Ech. Torres Strait, p. 161; pl. 36, figs. 12*a–c*.

The small size of the calcareous particles seems to warrant the belief that the unique and imperfect holotype represents a species distinct from *dolabrifera*. While living it was translucent white with numerous minute pinkish spots. Preservation in alcohol has intensified the reddish shade. In life, the length was undoubtedly over 100 mm., but as the anterior end is missing, we can only guess as to this. The specimen was found in the sand under a rock fragment on the reef flat southwest of Friday Island, Torres Strait.

Leptosynapta ictinodes

H. L. Clark, 1924. Bull. Mus. Comp. Zoöl., vol. 65, p. 481; pl. 7, figs. 7–11.

This species also rests on a single specimen, in this case from the opposite side of the continent. It is, however, complete though very small, only 45 mm. long. The color as preserved is pale gray, but the body is covered with verrucae full of a dark purplish-brown pigment; where they are crowded together, as they are anteriorly, they cause the body wall to look almost black, with the cream-colored tentacles contrasting sharply. The specimen was collected at Western Port, Victoria,

and is, so far as is known, unique, but Joshua (1914) speaks of a synaptid, considered *dolabrifera* by him, collected at Wilson's Promontory, that was "deep purple-black." There can be little doubt that it was the present species.

PROTANKYRA

Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 116.

Genotype: *Synapta abyssicola* Théel, 1886, p. 14.

This is a large genus of more than 30 nominal species. Heding (1928) lists 31 (he says 32) species and names 2 others as probably valid. But he discusses none from Australia, so his treatment of the genus requires no further comment here. The Australian species are all from shallow water on the tropical coasts of the continent, and 2 are still known from quite inadequate material.

Key to the Species of Protankyra

A. Accessory calcareous particles (in addition to anchors and plates) short, straight rods more or less forked at each end ..... *similis*
AA. Accessory calcareous particles not short, straight, forked rods:
  B. Accessory calcareous particles granules and small perforated plates ... *bisperforata*
  BB. No small perforated plates:
    Anchor arms long (more than 0.40 length) and wide-spreading (more than 0.70 length); width of stock about 0.33 anchor length ..... *insolens*
    Anchor arms short (less than 0.35 length) and not wide-spreading (less than 0.60 length); width of stock more than 0.40 anchor length ..... *verrilli*

Protankyra similis

Synapta similis Semper, 1868. Holothurien, p. 10; pl. 3, fig. 2; pl. 4, figs. 14*a–d*.
Protankyra similis Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 117.

This species is still very inadequately known. It is included in the Australian fauna on the strength of Sluiter's (1894) record of a headless fragment, taken by Semon near Thursday Island. The record needs confirmation, especially as Sluiter makes no direct reference to the form of the calcareous particles.

Protankyra bisperforata

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 553; figs. 62*a–f*.

This well marked species is known as yet only from the vicinity of Broome, Western Australia. The holotype is 130 mm. long and 5–6 mm. in diameter, somewhat larger in life. All the other specimens taken are smaller. The color in life is translucent flesh pink. On being placed in alcohol, it becomes quite red, but this color subsequently fades. In life, these synaptids occur in firm, sandy mud near low-water mark.

Protankyra insolens

Synapta insolens Théel, 1886. "Challenger" Hol., p. 13; pl. 1, figs. 3*a–c*.
Protankyra insolens Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 117.

This synaptid is still known only from the unique holotype, taken by the "Challenger" at her station 188 at the western end of Torres Strait, in 28 fms. It was 110 mm. long and yellowish white in color (when preserved).

Protankyra verrilli

Synapta verrilli Théel, 1886. "Challenger" Hol., p. 12; pl. 1, figs. 1*a–d*.
Protankyra verrilli Östergren, 1898. Öfvers. K. Vetensk.-Akad. Förh., vol. 55, p. 117.
H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 552; pl. 15, fig. 4 (colored).

This species was also one of the "Challenger" 's Torres Strait prizes, but was taken at station 186 in only 8 fms. Two small specimens were obtained, the larger only 23 mm. long. At Broome, however, we found this to be a common holothurian, and took it as far to the southwest as the northern end of Eighty-Mile Beach. The little one secured at that point was less than 25 mm. long, colorless and nearly transparent. Adults are 100–150 mm. long, 8–10 mm. in diameter, and milk white in color, with scattered spots of crimson. They are fairly common in the firm, sandy mud of Roebuck Bay. We should have found *verrilli* at the Coburg Peninsula and at Darwin, but failed to do so.

Family CHIRIDOTIDAE

This little family of small holothurians is represented in Australia by only 5 genera and 10 species. Though the type genus is world-wide in distribution, the others are for the most part found in the southern hemisphere or in Japan. One or 2 of the species reach a considerable size, but as a rule, individuals are less than 100 mm. long. The Australian genera may be easily distinguished as follows:

Key to the Genera of Chiridotidae

A. No sigmoid bodies; wheels in little heaps:
  Tentacles 12 (10–14) ..... *Chiridota*
  Tentacles 18 (16–20) ..... *Polycheira*
AA. Sigmoid bodies present:
  B. Wheels present:
    Wheels gathered into sharply defined papillae ..... *Taeniogyrus*
    Wheels scattered in skin, often crowded into ill defined heaps, sometimes so few and scattered as to be easily overlooked ..... *Trochodota*
  BB. Wheels wanting ..... *Scoliorhapis*

CHIRIDOTA

Eschscholtz, 1829. Zool. Atlas, vol. 2, p. 12.

Genotype: *Chiridota discolor* Eschscholtz, 1829, p. 12.

A genus of world-wide distribution, *Chiridota* is poorly represented in Australia, for although more than 20 species are known, only 4 are reported from that continent and 2 of these are each known only from a unique holotype which is itself only a fragment. The 4 are easily distinguished by the following characters:

Key to the Species of Chiridota

A. Recent species; calcareous wheels less than 150 microns in diameter:
  B. Small, 125 mm. or less in length; calcareous particles in body wall (in addition to wheels) small (30–40 microns) bent, or more or less straight, rods with rough or irregular tips ..... *rigida*
  BB. Large, exceeding 150 mm. in length and 8 mm. in diameter when adult:
    Calcareous particles (besides wheels) big, slightly curved rods, 100 microns long and 20–25 microns wide, with rough ends ..... *gigas*
    Calcareous particles very small bracket-shaped bodies, 30–40 microns long and 5 or 6 microns wide, with smooth, enlarged ends, sometimes notched as if to fork ..... *magna*
AA. Extinct species; wheels more than 250 microns in diameter ..... *ingens*

Chiridota rigida

Semper, 1868. Holothurien, p. 18; pl. 3, fig. 3; pl. 5, figs. 3, 13.

At Lord Howe Island this little holothurian is quite common, but it is not otherwise reported from Australia, save for the single small individual that we took at Mer in 1913. Even the largest specimen taken at Lord Howe did not exceed 50 mm. when living. The color is more or less bright reddish, with the tentacles and wheel papillae white. The animals live in the sand under rock fragments near low-water mark. The species ranges throughout the East Indian region, but the eastern and western limits of its distribution are yet to be established.

Chiridota gigas

Dendy and Hindle, 1907. Jour. Linn. Soc. (Zool.), vol. 30, p. 110; pl. 12, figs. 9–11*h*.

Originally described from a single specimen 113 mm. long in alcohol, from the Chatham Islands, New Zealand, this big *Chiridota* was next reported from the coast of Victoria. Joshua (1914) has given a brief but good account of its Australian occurrence, particularly at Torquay, Wilson's Promontory. He says that when extended it may be 450–500 mm. long. It is bright scarlet, with prominent white papillae. Smaller specimens, now in the Museum of Comparative Zoölogy, were taken at Wynyard on the northeastern coast of Tasmania in 1927, but these are dull purplish brown and show no trace now of scarlet coloring.

Chiridota magna

H. L. Clark, 1938. Mem. Mus. Comp. Zoöl., vol. 55, p. 556; fig. 63.

This species rests on a single fragment of a specimen in the Australian Museum, which was taken in Port Jackson, off Sow and Pigs reef, in 6 fms. The fragment is 47 mm. long and 13 mm. in diameter near the larger end. The color is yellowish white to pale brown, with the longitudinal muscles brown.

*Chiridota ingens

Chiridota sp.? Hall, 1902. Proc. Roy. Soc. Victoria, n. s., vol. 15, p. 82; pl. 11, fig. 8.
Chiridota ingens Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 8.

This is the first and only fossil holothurian remnant as yet reported from Australia. The exceptionally large size of this single wheel (Hall says 0.27 mm., Joshua says 200 microns) seems to justify Joshua in giving it a specific name, but he could give no further information concerning the animal. It is supposed to date back to Tertiary times, but even that is not certain. The wheel was found in the Bird Rock zone at Spring Creek, Victoria, and Hall states that the material is "Eocene?"

POLYCHEIRA

H. L. Clark, 1908. Apod. hol., pp. 17, 22, 120.

Genotype: *Chiridota rufescens* Brandt, 1835, p. 59.

Originally monotypic, this genus is considered by Östergren to contain at least 3 and possibly 4 species. Only the following is found in Australia.

Polycheira rufescens

Chiridota rufescens Brandt, 1835. Prodr. descr. anim., p. 59.
Polycheira rufescens H. L. Clark, 1908. Apod. hol., p. 120; pl. 7, figs. 14–18.

This East Indian species ranges from Ceylon to Fiji, north to Japan, and south to Queensland. The first Australian record was Semper's from Cape York (1868, p. 231, as *Chiridota variabilis*), and no other was established until Heding's (1931) report of one from Bowen, Queensland. Later the Great Barrier Reef Expedition found *Polycheira* common at the Low Isles. The usual size of preserved specimens is less than 100 mm. by 10–15, but a field note with some specimens in the Museum of Comparative Zoölogy from Fiji says the largest was "10 inches" (=250 mm.) in length when fully extended, living. The color shows no little diversity in life, ranging from pale brown or purplish to red-brown, deep brown, brownish purple, or almost black. Apparently adults are very dark, especially at the anterior end. The field notes with the Fijian specimens just referred to say the color becomes "brilliant red" when the animal is killed with acid, but can be restored by ammonia. Heding (1928, p. 322) gives an interesting note on the habits of this "nearly black synaptid" at Koh Lom in the Gulf of Siam.

TAENIOGYRUS

Semper, 1868. Holothurien, p. 23.

Genotype: *Chiridota australiana* Stimpson, 1855, p. 386.

Originally monotypic, this little genus now contains half a dozen nominal species, but the validity of 1 or 2 admits of question. All occur in the southern oceans between Kerguelen and the Strait of Magellan, or northward in Australia, Japan, and Hawaii. Only 3 occur in Australia, and these on opposite sides of the continent. They differ thus:

KEY TO THE SPECIES OF TAENIOGYRUS

A. Sigmoid bodies in groups, at least dorsally ..... *australianus*
AA. Sigmoid bodies not in groups, but scattered:
  Sigmoid bodies of 1 kind; tentacle rods slender, more or less forked at tip ..... *cidaridis*
  Sigmoid bodies of 2 kinds, large and small; tentacle rods rather stout, with knobs and projections along sides ..... *heterosigmus*

Taeniogyrus australianus

Chiridota australiana Stimpson, 1856. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 386.
Taeniogyrus australianus Semper, 1868. Holothurien, p. 23.
Heding, 1928. Vidensk. Medd., vol. 85, p. 315; figs. 67, 9–16.

So far as is at present known, this little holothurian is found only in Port Jackson, New South Wales, where it occurs, as Whitelegge (1889) says, with *Leptosynapta dolabrifera* "under stones in muddy places." It may reach a length of 50 mm., but most specimens are not so large. The color is yellowish, more or less translucent.

Taeniogyrus cidaridis

Ohshima, 1914. Synaptidae of Japan, p. 477 (*nomen nudum*).
—— 1915. Proc. U. S. Nat. Mus., vol. 48, p. 286.
Heding, 1928. Vidensk. Medd., vol. 85, p. 316; figs. 68, 1–9.

The inclusion of this species in the Australian fauna is due to the taking of a single small specimen at Rottnest Island, Western Australia, in January 1931, by G. Bourne. It is only about 22 mm. long. The sigmoid bodies resemble those of *cidaridis* more nearly than they do those of the somewhat geographically nearer species *keiensis*, but it is quite possible that the two supposed species are not valid.

Taeniogyrus heterosigmus

Heding, 1931. Zool. Jahrb., Abt. syst., vol. 61, p. 691; figs. 16, 1–15.

The unique holotype of this species is in the Hamburg Museum. It is only a fragment, 3 mm. long, and was originally identified by Erwe (1913) as *Chiridota contorta*. In spite of its being so labeled, Heding makes no reference to Erwe or his report on Michaelsen's collection. The fragment was collected in Koombana Bay, southwestern Australia. It will be surprising if good series of *Taeniogyrus* from Western Australia justify the maintenance of 2 species.

TROCHODOTA

Ludwig, 1892. Bronn's Klass. Ord. Thierreichs, vol. 2, pt. 3, bk. 1, p. 359.

Genotype: *Holothuria purpurea* Lesson, 1830, p. 155.

This genus of small chiridotids seems to contain 9 or 10 species, of which 1 occurs in the Mediterranean Sea, 3 in Japan, and the remainder in the southern hemisphere, 3 in Australia. Few of the species are known from adequate material and several are imperfectly described. The Australian species may be distinguished thus:

KEY TO THE SPECIES OF TROCHODOTA

A. Wheels with inner margin of rim uniformly serrated; tentacles with 4 digits ..... *roebucki*

AA. Wheels with inner margin of rim not uniformly serrated, but teeth present in well separated groups; tentacles with 8–10 digits:
Sigmoid bodies 120–130 microns in length, not in heaps or groups, but well scattered in body wall ..... *allani*
Sigmoid bodies only 66–77 microns in length, chiefly in little heaps or groups ..... *maculata*

Trochodota roebucki

Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 9; pl. 1, figs. 4*a–c*.

This little holothurian attains a length of 75 mm. and a diameter of 6. The color is red. The dorsal tentacles are distinctly longer than the ventral. At Torquay, Victoria, a number of specimens were taken by Roebuck, and Joshua collected others at the same place. In 1929, we collected several Trochodotas at Geraldton, Western Australia, and more were found at Rottnest Island. They are apparently identical with the Victorian form. Probably the species occurs wherever conditions are favorable along the whole temperate coast of southern Australia.

Trochodota allani

Taeniogyrus allani Joshua, 1912. Proc. Roy. Soc. Victoria, n. s., vol. 25, pt. 1, p. 79; pls. 3, 4.
Trochodota allani Joshua, 1914. Proc. Roy. Soc. Victoria, n. s., vol. 27, pt. 1, p. 8.

This little holothurian, up to 80 mm. long and carmine in color in life, has been adequately described and discussed by Joshua, who says it is "extraordinarily abundant on the sludge banks which form the greater part of the bottom of Port Phillip Bay." He adds: "I have seen the dredge presenting the appearance of having been dragged through a mass of blood slime from the thousands of this species adhering to it. Accompanying it, usually are about one per cent of *Leptosynapta dolabrifera*." Later Joshua and Creed (1915) report a specimen from Kangaroo Island, South Australia. A single specimen was taken by me in the estuary of the Derwent, Tasmania, in November 1929, but it lacked the carmine color; probably from immaturity, as it was less than 30 mm. long.

Trochodota maculata

H. L. Clark, 1921. Ech. Torres Strait, p. 163; pl. 36, figs. 14–21.

A single *Trochodota*, only 26 mm. long, is the basis of this species. It was taken from under a rock fragment on the southeastern reef flat at Mer, Murray Islands, and further search proved futile. The color in life was pale pink with numerous minute spots of a darker shade. In its preserved condition the holotype is bright brown, covered with minute papillae tipped with bright brown-red.

SCOLIORHAPIS, nom. nov.

Scoliodota Heding, 1928. Vidensk. Medd., vol. 85, p. 319 (NON H. L. Clark, 1908, p. 125).

Heding's attempt to resuscitate *Scoliodota* is futile. The genus was established with only a single species, hence that species must be the type. Furthermore, this species was definitely named as "*Chirodota japonica* v. Marenzeller" from Enosima, Japan. Ohshima (1913) has shown that von Marenzeller's specimens, and hence the species based upon them, were Trochodotas, hence *Scoliodota* is a dead synonym of *Trochodota*. Now Heding's specimens are not Trochodotas, but represent a new genus. To his species he gives the name *théelii*, but he leaves it generically nameless, as he cannot revive *Scoliodota*. The fact that I had also referred to *Scoliodota* chiridotids from Port Jackson does not alter the fact that that generic name was stillborn by reason of my definite selection of Japanese material for type. Hence it is necessary to make a new generic name for the Australian species, and I propose the somewhat similar *Scoliorhapis* (σκολιός = crooked + ῥαπίς = rod, in reference to the sigmoid bodies).

Genotype: *Scoliodota théelii* Heding, 1928, p. 319.

Scoliorhapis théelii

Scoliodota théelii Heding, 1928. Vidensk. Medd., vol. 85, p. 319; figs. 69, *1–16*.

This interesting chiridotid was first collected in Port Jackson by the "Challenger," but Théel (1886, p. 17) decided that the imperfect specimens were best referred to von Marenzeller's Japanese species, *Chiridota japonica*. Years later Ohshima (1913) pointed out that the Japanese form was undoubtedly a *Trochodota*. In October 1914, Mortensen collected specimens in Port Jackson that seem to be identical with the "Challenger" material, and Heding (1928) has given an excellent account of these with good figures. He shows that the Port Jackson chiridotid is not a *Trochodota* and so revives the invalid name *Scoliodota* for them. He thus uses a generic name proposed in 1908, but designates as type a species unknown, or at least undescribed, until 1928.

As yet this chiridotid is reported only from Port Jackson, New South Wales. Complete specimens are still unknown, but certainly exceed 175 mm. There are 10 tentacles with 7 or 8 pairs of digits. The color of the preserved animals is gray, light posteriorly, but anteriorly numerous dark brown or purple papillae give a dark brownish or purplish appearance.