

HOLOTHURIOIDEA

INTRODUCTION AND GLOSSARY

Elementary accounts of the class are given by A. M. Clark (603 in reference list) and Nichols (645), also a more detailed one by Hyman (626). However, no recent comprehensive systematic work exists, although the following papers cover the families shown in some detail—

Holothuriidae—Panning (488), Deichmann (190) and Rowe (516).

Stichopodidae—H. L. Clark (170).

Cucumariidae—Panning (491), for outline revised classification only.

Phyllophoridae—Heding and Panning (303).

Molpadiidae—H. L. Clark (154) and Heding (296).

Synaptidae—H. L. Clark (154) and Heding (293).

Chiridotidae—H. L. Clark (154) and Heding (293).

There are also important recent papers of Cherbonnier (83–93).

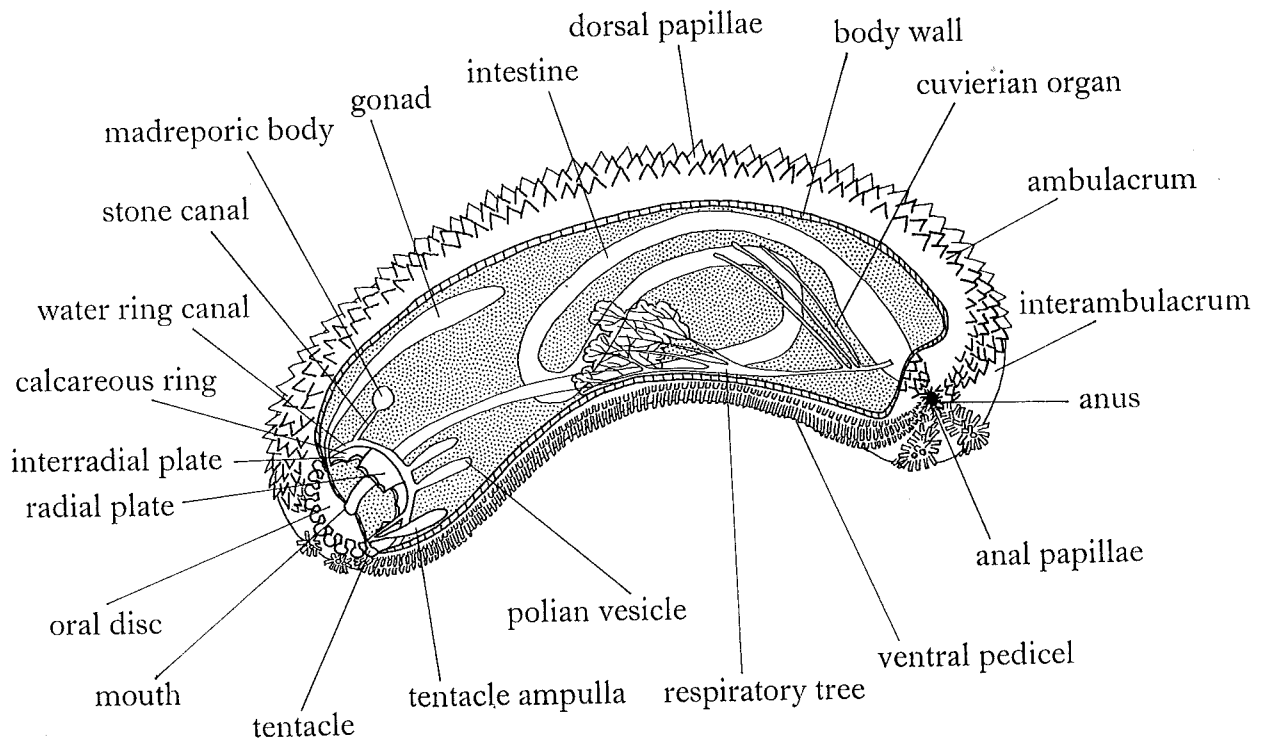


FIG. 84. Introductory figure for holothurians.

For this class only, in addition to the main table, a supplementary one is included for species of doubtful systematic position of which there are no records subsequent to the original one. It seems desirable to draw attention to these in the hope that future work may clarify their

systematic relationships. Also included in the supplementary list are a few species the main geographical range of which is outside the limits set for this work but with reliable records from within the fringe areas covered.

A glossary of the more important terms used in describing holothurians follows—

Ambulacra—Holothurians are orientated in a plane at right angles to that of echinoids and elongated between the two primary apertures. The ambulacra run longitudinally in such a way that two can be described as dorsal and three as ventral. However, this arrangement of the pentaradiate condition may not be obvious either in the Aspidochirotida or in some Dendrochirotida (Psolidae), which are particularly modified dorso-ventrally with a more or less flattened 'sole' having locomotory podia formed by the three ventral ambulacra and known as the trivium. The dorsal side is arched with scattered modified non-locomotory podia, which are sensory in function, and includes the other two ambulacra, being known as the bivium. In the Molpadida and Apodida little dorso-ventral specialization exists and podia are very reduced or absent. In the Apodida no internal radial canals are present, the pentaradiate symmetry being shown only by the five longitudinal muscle bands, which may be evident through the somewhat translucent body wall.

Anal papillae or 'teeth'—five radially placed calcareous papillae encircling the anus, particularly well developed in *Actinopyga*.

Calcareous ring—an internal collar of plates, usually ten in number, encircling the pharynx and possibly homologous with the Aristotle's lantern of echinoids. The plates usually alternate in size, the radial plates (opposite the ambulacra) being the larger. These plates may be relatively short and simple or long and compound, broken up into smaller pieces, forming a sleeve-like structure.

The ring supports the water vascular ring canal, the nerve ring and the pharynx, while the radial plates afford an attachment surface for the longitudinal and (where present) retractor muscles.

Cartilaginous ring—a secondary ring found immediately behind the calcareous ring in some Synaptids (Apodida), composed of dense connective tissue. (After Hyman, 1955:198.)

Caudal appendage—the abruptly narrowed posterior part of the body of Molpadida only, resembling a tail.

Ciliated funnels or urns—found in the Apodida only, are usually attached to the mesenteries or the body-wall and open into the coelom. They appear to collect coelomocytes laden with excretory matter but the means of disposal of these has not yet been clarified.

Eye spots—photoreceptors appearing as a pair of pigmented spots located near the base of each tentacle in some of the Synaptidae.

Introvert—the flexible anterior end of Dendrochirotida extending for some distance behind the oral disc and tentacle ring and capable of being invaginated by retractor muscles in order to protect the vulnerable tentacles.

In the Aspidochirotida there is no specialized introvert, though the tentacle ring can be sufficiently retracted within a fold of the body wall as to be concealed from sight.

Podia—the tube feet which arise as cylindrical projections of the body wall, their lumen continuous with the water vascular system. They are often restricted to the ambulacral areas but may be irregularly scattered, extending on to the interambulacra. When dorso-ventral specialization occurs, those on the ventral side with well-developed terminal discs and having locomotory function are generally termed *pedicels* while the non-locomotory dorsal ones are called *papillae*. In some species the large number of spicules in the podia renders them unretractible. The tentacles surrounding the mouth are highly modified podia.

Polian vesicles—elongated sacs, sometimes single, hanging from the water vascular ring canal

into the coelom, which appear to function as expansion chambers for the water vascular system. (After Hyman, 1955:150.)

Respiratory trees—a pair of branching arborescent tubes arising from the cloaca and attached to the viscera by mesenteries; found in all holothurians except the Apodida. (After Nichols, 1962:80.)

Sensory cups—small stalked cup-shaped sense organs found on the inner surface of the bases of the tentacles in various members of the Apodida.

Stone canals—calcified tubes, sometimes single, arising dorsally from the water ring canal and terminating in an internal madreporic plate or perforated swelling usually opening into the coelom. (Only in a few holothurians, notably of the deep-sea Elaspoda, is the connection to the exterior, which is found in other echinoderm classes, retained.) (After Hyman, 1955:150-153.)

Spicules (see figs. 85, 87, 92, 95, 96, 98, 99):

Anchors—anchor-shaped spicules attached at the posterior end of the shaft, the *stock*, by connective tissue to the narrower end of an accompanying perforated plate. The stock may be finely rugose or else branching. The arms or *flukes* may be smooth or laterally toothed on the outside and are slightly raised distally out of the horizontal plane; the central area or *vertex* between the arms opposite the shaft bears minute knobs in genera where the arms are smooth.

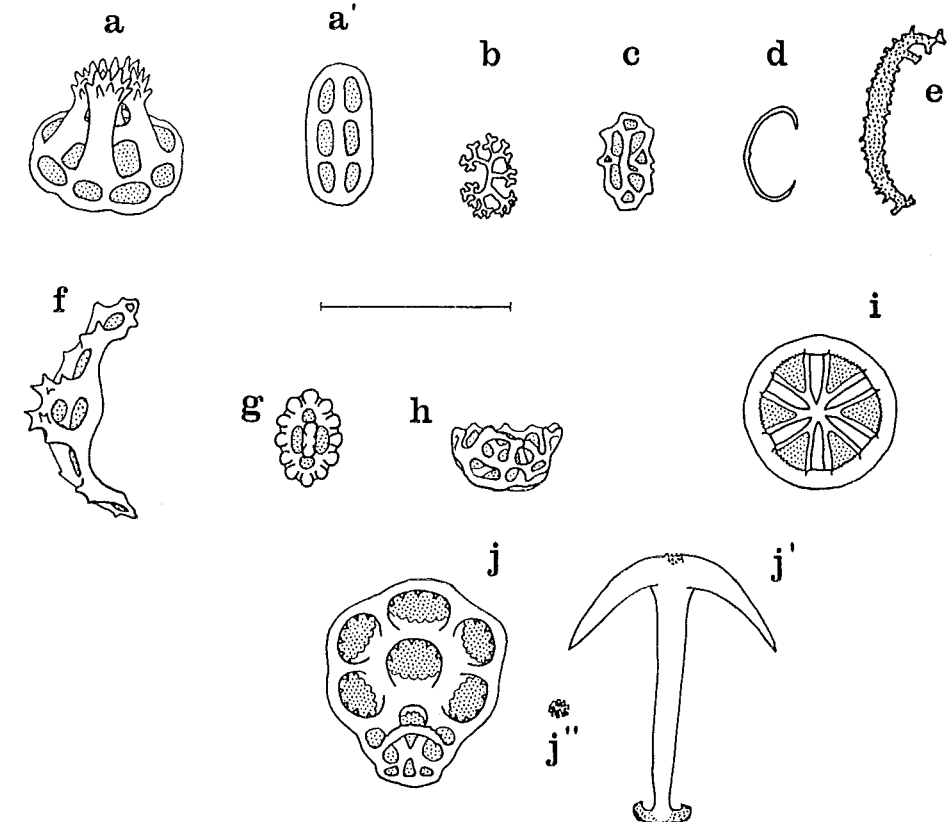


FIG. 85. Spicules of: a, a'. *Holothuria (Thymiosycia) impatiens*, table and button, b. *Actinopyga echinites*, branched rod, c. *Holothuria (Acanthotrapeza) coluber*, rosette, d. *Stichopus variegatus*, C-shaped spicule, e. *Holothuria (Semperothuria) cinerascens*, spinose rod, f. *Stolus conjugens*, table with arched disc, g. *Stolus buccalis*, knobbed button, h. *Pentacta cucumis*, basket, i. *Polycheira rufescens*, wheel, j, j', j''. *Synaptula recta*, anchor plate, anchor, and miliary granule. The scale equals 0.1 mm. for a-i and 0.2 mm. for j.

Anchor plates—rounded, oval, pear-shaped or rectangular perforated plates corresponding to the anchors, often with symmetrical holes, their anterior end often wider than the posterior, which is rarely narrowed abruptly to give a racket-like shape. An arch-like smooth or toothed

transverse bar, usually more or less well developed, is present near the posterior end of the plate, with which bar the stock of the anchor articulates.

Baskets—concave perforated plates with smooth or toothed edges.

Buttons—elongated (rarely circular) two-dimensional spicules pierced by a varying number of holes which are usually similar in size and arranged in pairs. The surface of the button may be smooth or knobbed.

End plates—circular perforated plates found at the ends of pedicels and some papillae for the attachment of muscles.

Fenestrated ellipsoids—modified and three-dimensional buttons with interconnecting knobs forming an elongated hollow fenestrated structure.

Fenestrated spheres—modified tables with the spire low, its peripheral spines connected to projections from the margin of the disc, forming a rounded hollow fenestrated structure. (After Deichmann, 1958: 321.)

Lenticulate plates—very thick perforated plates like a double-convex lens in shape, often with the holes obliterated by the thickening of the plate. These may also be referred to as *scales*.

Miliary granules—small solid rounded or slightly elongated bodies.

Perforated plates—irregular plates usually with numerous holes and of various shapes, which cannot be fitted into any other category.

Phosphatic bodies—deposits transformed from calcareous anchors and rosettes with increasing maturity; found only in Molpadida. (After H. L. Clark, 1907: 157). Coated with iron phosphate which may totally replace the calcium carbonate. (After Hyman, 1955: 138.)

Pseudo-buttons—incomplete or imperfect buttons, usually twisted and reduced to a single row of holes; sometimes rather similar in shape to rosettes.

Rods—elongated bar-like spicules, usually with more or less expanded and sometimes perforated or branched ends, the branching often dichotomous and complex. Sometimes rods may be expanded and branched near the middle and those in the podia can be angular or even boomerang-like in shape.

Rosettes—two-dimensional perforated spicules formed from branched rods and often rather button-like, though differing in having the holes of various sizes and often a terminal one each end.

Sigmoid bodies—three-dimensional curved smooth rods, the curve at one end pointed while that at the other is blunt, the two halves curving in planes at right angles to each other.

Tables—three-dimensional spicules with a circular perforated disc from which arise two to four vertical pillars placed equidistant from each other and linked by transverse bars or *bridges* to form a *spire*, this usually terminates in a few short spines. Measurements of the spire are made relative to the diameter of the disc, low, moderate and high spires being respectively less than, equal to or greater than the disc diameter in height. Tables vary in different species in the size and number of holes in the disc and in the shape of its edge, as well as in the height and elaboration of the spire. They occur more superficially in the body wall than two dimensional spicules such as buttons and rosettes.

Wheels—circular spicules with six or more spokes leading to the peripheral rim; found only in the Chiridotidae of the Apodida and often restricted in location to wheel papillae spaced in the body wall.

DISTRIBUTION TABLE
FOR
HOLOTHURIOIDEA

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
HOLOTHURIIDAE						
<i>Actinopyga bannwarthi</i> Panning	..	..	..	89 * 490	89	..
<i>crassa</i> Panning	..	*	490 *	..	89	..
<i>echinites</i> (Jaeger) { 1833	385 *	*	348 *	..	89	..
<i>lecanora</i> (Jaeger)	..	280 378	489 496	..	574	..
<i>mauritianae</i> (Quoy & Gaimard) } 1833	302 *	378 * 510	490 *	87 346	..	..
<i>miliaris</i> (Quoy & Gaimard)	280 346	280 378	317 *	305 *	..	..
<i>obesa</i> Selenka	..	..	..	..	..	..
<i>palauensis</i> Panning	..	..	..	..	..	..
<i>plebeja</i> (Selenka) ¹	..	490	490 527	490	..	..
<i>serratidens</i> Pearson	..	..	..	89 490	..	..
<i>Bohadschia argus</i> Jaeger — 1833	346	..	..	..	..	..
<i>bivittata</i> (Mitsukuri) ²	..	..	..	..	..	..
<i>cousteaui</i> Cherbonnier	..	..	..	87 *	..	..
<i>draschi</i> Cherbonnier	..	..	..	87	..	..
<i>graeffei</i> (Semper)	..	..	..	566	..	..
<i>koellikeri</i> (Semper) ³ } 1866	346	..	379	..	..	..
<i>marmorata</i> Jaeger	..	280	496 563	89	..	..
<i>paradoxa</i> (Selenka) 1867	..	..	..	..	..	..
<i>similis</i> (Semper) ³ } 1866	..	*	..	..	..	..
<i>steinltzi</i> Cherbonnier	..	..	..	93	..	..
<i>subrubra</i> (Quoy & Gaimard) 1833	..	310 510	..	..	..	..
<i>tenuissima</i> (Semper) ³	..	..	..	89 * 93	..	..
<i>vitiensis</i> (Semper) ³ } 1866	..	..	..	..	..	..
<i>Labidodemas rugosum</i> (Ludwig)	..	..	..	..	..	..
<i>semperianum</i> Selenka	..	..	..	..	..	..
<i>Holothuria</i> sensu extenso—subgenera:						
<i>(Acanthotrapeza) coluber</i> Semper						
<i>kubaryi</i> Ludwig	..	..	..	..	..	..
<i>pyxis</i> Selenka	..	..	..	..	..	..
<i>(Cystipus) inhabilis</i> Selenka						
<i>jousseauae</i> Cherbonnier	..	..	..	87	574	..
<i>rigida</i> (Selenka) ⁴	..	280 378	385 527	346	..	..
<i>sucosa</i> Erwe	..	..	..	243 *	..	..
<i>(Halodeima) atra</i> Jaeger						
<i>edulis</i> Lesson	302 *	*	380 * 496	89*	89*	301
<i>pulla</i> Selenka	..	..	385 528	89*	529 *	..
<i>(Holothuria) massaspicula</i> Cherbonnier						
..	..	..	..	87 243	..	..
<i>(Lessonothuria) glandifera</i> Cherbonnier						
<i>insignis</i> Ludwig ⁵	..	..	346	376 492	..	301
<i>pardalis</i> Selenka ⁵	385	280 * 385	527 *	89 * 346	574 *	..
<i>verrucosa</i> Selenka	..	280 378	346	..	..	..
<i>(Mertensiothuria) fuscocinerea</i> Jaeger						
<i>leucospilota</i> Brandt	302 * 346	380	496	346	..	..
<i>papillifera</i> Heding	..	347 *	527 * 528	89 * 566	529	301 331
<i>pervicax</i> Selenka	346	280 * 378	496 * 527	141 * 379	89	..
<i>(Metriatyla) aculeata</i> Semper						
<i>albiventer</i> Semper	..	..	346 385	89 * 308	..	..

FOR HOLOTHURIOIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..
..	..	..	..	490	..	..	..	..	..
..	..	380	497 *	315 *	169 *	218	430 490	581 *	..
..	..	380	41 331	315 377	169 * 180	346 528	61 430	22 *	..
..	147 * 331	331 *	36 * 40	320 * 377	169 * 231	216 221	61 430	21 * 22	84 246
..	..	37 380	38 40	377 541	179 * 233	216 541	430	510 553	..
..	..	..	..	..	..	78 216	78	..	246 257
..	..	..	..	..	..	..	..	490	..
..
..	..	495 500	500	302	..	218	..	..	..
..	..	37	36 40	315 377	169 * 319	221 346	430 490	378 * 553	..
..	..	..	..	..	..	221	430 482	490 584	..
..
..	147 * 498	..	..	321	..	221 528	..	490	..
..	..	..	..	..	..	..	..	528	..
..	..	495 563	38 * 40	315 * 539	169 * 180	221 528	430 528	61 *	..
..	..	..	..	..	..	216 218	..	..	(246) 527
..	..	..	..	..	..	528	..	88	..
..
..
..	*	495	331	377 536	..	528	530	528	..
..	..	498	528	320 541	232	216 218	430	528 * 553	..
..	498	..	331 *	377 541	169 182	216	..	375 * 553	..
..	*	..	331	536 * 541	169 180	216	..	375 528	527
..	..	..	..	541	179 * 182	216 528	..	..	..
..	..	..	..	..	..	..	..	375 *	..
..	..	..	38 * 331	527 539	..	..	..	..	..
..	..	..	..	..	169 * 182	169	..	488 527	527
..
..	*	..	..	..	..	182 *	..	527 553	..
..
..	302 *	..	380 * 496	89*	89*	301	..	..	..
..	..	..	385 528	89*	529 *	..	430 *	219 *	246 591
..	..	..	34	..	..	..	430	22 553	..
..	..	..	..	87 243	..	..	..	..	..
..	..	..	..	..	..	301	..	88	..
..	..	..	346	376 492	..	..	298 445	22	..
385	280 * 385	527 *	89 * 346	574 *	..	522 *	298 430	21 * 375	246 527
..	280 378	346	..	..	..	..	..	182?	527
..	..	380	496	346	..	..	298 377	88 553	..
302 * 346	347 *	527 * 528	89 * 566	529	301 331	*	378 * 430	61 * 527	553 * 527
..	..	..	299	..	..	..	..	..	..
346	280 * 378	496 * 527	141 * 379	89	..	..	..	375 * 553	246 527
..
..	..	346 385	89 * 308	..	..	..	..	553	..

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>bowensis</i> Ludwig
<i>brauni</i> Helfer	305	..	..
<i>martensi</i> Semper	496	..	89	..
<i>michaelseni</i> Erwe
<i>ocellata</i> Jaeger	243 560	..	..
<i>scabra</i> Jaeger	..	280 378	346 * 496	243 * 376	89 * 378	..
<i>(Microthele) nobilis</i> (Selenka)	500	280	500 527	89 * 500	..	..
<i>(Platyperona) difficilis</i> Semper	346 500	280 378	..	299 * 346	..	..
<i>(Selenkothuria) erinaceus</i> Semper ⁶	318(?)	..	..	..
<i>moebii</i> Ludwig ⁶	..	553	..	..	..	..
<i>parva</i> Krauss in Lampert ⁶	346 * 348	89 302	89*	30I 33I
<i>(Semperothuria) cinerascens</i> (Brandt)	302 346	280 * 378	318 * 528	89 * 346	89*	..
<i>flavomaculata</i> Semper	93 566	..	..
<i>imitans</i> Ludwig
<i>(Stauropora) discrepans</i> Semper
† <i>fusoolivacea</i> Fisher ⁷	566	..	..
† <i>hawaiiensis</i> Fisher
<i>ludwigi</i> Lampert ⁷
<i>modesta</i> Ludwig	346?	..	..
<i>olivacea</i> Ludwig ⁷
<i>(Theelothuria) hamata</i> Pearson	89 498	..	..
<i>klunzingeri</i> Lampert	89 346	..	..
<i>kurti</i> Ludwig ⁸	93	..	..
<i>maculosa</i> Pearson	498	..	..	..	..	..
<i>notabilis</i> Ludwig
<i>samoana</i> Ludwig
† <i>spiniifera</i> Théel	89 * 30I	..	30I
<i>squamifera</i> Semper ⁸
<i>(Thymiosycia) aphanes</i> Lampert	246	89	..
<i>arenicola</i> Semper	385	280 * 378	346 489	89 * 308	..	..
<i>hilla</i> Lesson ⁹	385 *	280 385	317 * 496	93 566	89	33I
<i>impatiens</i> (Forskål)	346 * 385	280 378	348 385	252 * 566	574 *	30I *
<i>gracilis</i> Semper	346	..	..	..
<i>remollescens</i> Lampert	346	..	..
<i>strigosa</i> Selenka	527	376	..	..
<i>truncata</i> Lampert
STICHOPODIDAE						
<i>Stichopus anapinusus</i> (Lampert)
<i>chloronotus</i> Brandt	302 * 346	280 378	496 * 529	..	..	..
<i>ellipes</i> H. L. Clark
<i>horrens</i> Selenka
<i>monotuberculatus</i> (Quoy & Gaimard)	..	510 *	*	89	89	..
<i>naso</i> Semper
<i>paradoxus</i> Lampert
<i>variegatus</i> Semper	378?	280 378	348 496	346 *	*	30I 33I
<i>Thelenota ananas</i> (Jaeger)	..	*
<i>anax</i> H. L. Clark

FOR HOLOTHURIOIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	..	..	..	..	375	..	..	*	..
..
..	498	..	*	320 528	169 * (553)	528 *	530	..	..
..	..	..	..	..	180 242	..	..	..	..
..	*	..	(33I) 497	315 542	179 * 553	..	530	..	..
..	*	380 *	38 * 33I	315 * 553	179 * 553	22I * 528	430 445	553 584	..
..	147 * 302	500	..	38I * 500	169 * 242	216 528	430	6I * 553	527
..	147 * 500	*	33I	38I 54I	169 233	216	430	187 * 528	246
..	..	380	36 * 33I	38I * 540	179 * 528	528 *	..	528 *	..
..	..	267 33I	33I *	377 540	180 539	430	78 378	180 510	..
..
..	302 * 498	498 *	..	528 * 54I	?242 *	407 528	61 407	553 *	225 527
..	..	..	..	38I 540	..	346	..	528 * 584	..
..	..	380	..	..	..	..	..	375 58I	..
..	498 *	..	..	..	..	..	..	528 * 553	..
..	..	..	..	..	179 *	..	..	..	246 *
..	..	..	..	..	..	..	..	..	246 *
..	..	..	..	..	..	..	..	347	..
..	..	..	..	54I	180 * 375	..	..	..	..
..	..	..	..	38I 538	..	..	..	..	..
..	*
..
..	..	33I 495	..	383 538	(*)	..	..	..	..
..
..	..	..	..	38I 540	179 * 375	..	..	..	..
..	..	..	..	..	..	..	..	375	..
..	..	380 498	..	..	180	553 *	..	..	..
..	..	..	..	528 * 542	..	528 *	..	528	..
..	*	..	..	54I	..	..	..	..	..
..	*	..	40 * 33I	528 * 54I	169 * 179	216 528	6I 430	528 * 553	246 527
..	147 * 33I	380 * 495	33I * 528	54I * 553	34 * 180	216 528	407 430	352 * 553	527 59I
..	147 * 302	33I * 380	33I * 497	346 * 540	169 * 180	430 * 528	430 530	430 * 553	246 * 553
..	..	..	..	..	..	346 * 528	..	528	..
..	..	..	33I	..	169	..	..	..	..
..
..	..	..	..	540	346 *	*	..	..	..
..	..	..	..	346 54I	..	..	..	..	..
..	147 *	267 * 380	36 * 38	38I * 547	169 * 319	216 218	61 430	346 * 430	170 527
..	..	..	..	..	180	..	..	..	..
..	*	..	..	38I * 54I	169 * 170	170 346	556	88 * 527	170 * 246
..
..	..	*	..	..	..	346 * 528	..	..	..
..
..	..	..	..	..	346?	..	..	..	..
..	*	380	38 * 33I	302 54I	180 * 430	346 * 528	430	553 584	..
..	147 *	..	..	315 357	169 319	..	430	357 * 553	..
..	..	..	..	..	169	..	..	..	..

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
PSOLIDAE						
<i>Psolus appendiculatus</i> de Blainville	..	53	..	..	..	..
<i>boholensis</i> Semper
<i>complanatus</i> Semper
CUCUMARIIDAE¹⁰						
<i>Aslia †forbesi</i> (Bell)
<i>Cucumaria adela</i> H. L. Clark
<i>Havelockia conciliatrix</i> (Sluiter)
<i>herdmani</i> Pearson
<i>mirabilis</i> (Ludwig)	317	..	..	..
(?) <i>novacorona</i> (Cherbonnier) ¹¹
<i>transitoria</i> (Vaney) ¹²	574	..
<i>versicolor</i> (Semper)
<i>Hemithyone †semperi</i> (Bell)	496	..	..	..
<i>Leptopentacta bacilliformis</i> (Koehler & Vaney) ¹³
† <i>grisea</i> H. L. Clark
<i>javanicus</i> (Sluiter)	*	..
<i>punctabipeda</i> Cherbonnier
<i>Ocnus †capensis</i> (Théel) * 553
<i>cataphracta</i> (Sluiter)
<i>cylindricus</i> Semper	..	528	..	..	..	..
<i>Orbithyone megapodia</i> H. L. Clark	? *
<i>Paracucumaria glaberrima</i> (Semper)	378 529	..
<i>Pentacta anceps</i> (Selenka) ¹⁴
<i>armatus</i> (von Marenzeller)
<i>australis</i> (Ludwig) ¹⁵
<i>crassa</i> (Ekman)
<i>cucumis</i> (Semper)
<i>dispar</i> (Lampert)
<i>jaegeri</i> (Semper)	89 574	..
<i>loepenthini</i> (Heding)	301
<i>minuta</i> (Ludwig)
<i>nipponensis</i> H. L. Clark
<i>pusilla</i> (Helfer)	305	..	..
<i>quadrangularis</i> (Lesson)
<i>robusta</i> (Oestergren)
<i>scandens</i> (Sluiter)
<i>tristis</i> (Ludwig)	375 491	..	..	..
<i>Plesiocolochirus¹⁶ †challengeri</i> (Théel)
<i>gazellae</i> (Lampert)
<i>spinus</i> (Quoy & Gaimard) 510
<i>Pseudocolochirus arae</i> (Boone) ¹⁷
<i>axiologus</i> (H. L. Clark)
<i>tricolor</i> (Sluiter) ¹⁸
† <i>violaceus</i> (Théel)

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FOR HOLOTHURIOIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..
..	528 *	..	..	..
..	..	267	..	..	..	528 *	..	..	..
36 * 331	36 331	..	..	..	..	..	..
..	182 228	..	..	..	..
..	541	..	..	..	..	..
..	..	495	331?	..	..	..	..	..	..
..	320 (541)	228 * 375	..	530	..	..
..	92	..	..
..
..	571	*	491 * 528	..	..	..
331	..	650 *	41 497	575	34 * 180	..	..	..	..
..	331 332	..	..	..	..	..	..
..	180 *	..	..	..	..
..	*?	..	36 *	377 * 536	..	..	..	..	..
..	92	..	..
..
..	(541)	..	481	430 (481)	..	..
..	541	..	..	..	..	..
..
..	180	..	..	..	..
..
..
..	377 * 528	169 * 491	528 *	377 * 527	491 553	..
..	..	*	40	..	242	..	378 (*) 407	..	..
..	536 *	180 * 375	..	..	..	..
..	571	180 * 228	..	..	..	..
..	497	536 541	179 * 539	528 553	530 553	..	..
..	228 346	..	..	..	..
..	528	179 *	..	..	..
..
..	179 * 375	..	..	..	..
..
..	(180) 430	..	..
..	..	495	41 *	352 * 377	180 * 491	528 * 553	78 * 553	..	..
..	*?	228	..	478	..	..
..	536 * 540	..	..	..	..	..
..
..
..	(541)	553 *	..	..	..	..
..	(541)	347	..	..	..	..
..
..	34 * 357	..	..
..
..	59	..	..
..	159 228	..	..	..	..
..	..	495	..	(541)	..	..	..	..	..
..	298 445	..	..
..	331	320 *	*	553 *	530	..	..

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>Pseudocnus echinatus</i> (von Marenzeller)	93	..	..
<i>salmini</i> (Ludwig)
<i>Sclerodactyla</i> † <i>multipes</i> (Théel)
<i>Stawrothyone</i> <i>distincta</i> H. L. Clark
<i>rosacea</i> (Semper)	49I 529	..
<i>Stolus</i> <i>buccalis</i> (Stimpson) 659	346 * 527	..	89 49I	30I
<i>canescens</i> (Semper)
<i>conjugens</i> (Semper) ¹⁹
<i>molpadoides</i> (Semper)
<i>rapax</i> (Koehler & Vaney)
<i>Thorsonia</i> <i>adversaria</i> (Semper)
<i>fusiformis</i> Heding	301
<i>investigatoris</i> (Koehler & Vaney)
<i>Thyone</i> <i>curvata</i> Lampert ²⁰	346	..	..	..
<i>dura</i> Koehler & Vaney	30I
<i>grisea</i> H. L. Clark
<i>micra</i> H. L. Clark
† <i>okeni</i> Bell 34
† <i>papuensis</i> Théel
† <i>perforata</i> H. L. Clark
<i>perissa</i> H. L. Clark ²¹
<i>vilis</i> Sluiter
<i>villosa</i> Semper
<i>Trachythyone</i> <i>alcocki</i> (Koehler & Vaney)
<i>crucifera</i> (Semper)	385	..	348 380	89	49I 529	..
<i>dollfusi</i> Cherbonnier	87	..	..
<i>imbricata</i> (Semper) ²²
<i>pygmaea</i> (Semper)
† <i>typica</i> (Théel) ²²
PHYLLOPHORIDAE¹⁰						
<i>Afrocucumis</i> <i>africana</i> (Semper)	385	280 378	385 528	..	..	..
<i>Actinocucumis</i> <i>typicus</i> Ludwig
<i>Cladolabes</i> <i>acicula</i> (Semper)	..	280 303	..	..	..	..
<i>crassus</i> (H. L. Clark)
<i>hamatus</i> (Sluiter)
<i>perspicillum</i> (Selenka) * 527
<i>roxasi</i> (Domantay)
<i>schmeltzi</i> (Ludwig)
<i>Globosita</i> <i>argus</i> (Heding & Panning)
<i>Mensamaria</i> <i>intercedens</i> (Lampert) 346
<i>Neocucumis</i> † <i>proteus</i> (Bell) ²³
<i>Neothyonidium</i> <i>magnum</i> (Ludwig)
<i>Ohshimella</i> <i>ehrenbergi</i> (Selenka)	17I 496	303 * 654	89 574	..

HOLOTHURIOIDEA

FOR HOLOTHURIOIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	33I	..	..	..	407 (*) 430	..	..
..	375	..	..	..	..	..
..	430 * 553	..	..
..	180	..	..	..	..
*	..	384	..	..	347?	..	..	..	..
30 *	..	495 *	36 * 497	536 * 54I	169 * 553	22I 528	407 430	..	..
522 *	320 * 536	..	528	..	..	..
..	..	267 495	..	..	..	528 *	..	..	..
..	536	..	..	528	..	..
..	331	..	..	..	..	..	..
..	536	..	(528)	..	..	..
..	331	..	..	..	..	..	..
..
..
(331)
..	180	..	..	..	..
..	180	..	..	..	..
..	180	..	..	..	..
..	169 *	..	..	..	..
..	..	495	(497)	54I	180 * 553	..	..	..	..
..	179	..	..	..	..
..	180	..	..	..	..
..	541	..	..	..	..	..
..
..	49I 528	..	..	..
..	331	..	..	..	..	..	..
..
..
..	..	495	33I 497	320 54I	..	528	..	..	..
..	528	..	..	..
..	..	380	..	..	..	..	380 * 553	..	..
..	*	..	36 *	32I 54I	169 * 528	..	430 * 479	22 * 430	..
522 *	..	267 *	4I * 522	32I * 54I	375 * 553	..	78 298	..	..
*	38 *	377 540	169	169 216	..	303 * 528	..
..	180 298	..	..
..	542	180	..	..	..	..
..	35	528	..	..	..
..	215	..	..	..
..	54I	180 * 375	54I	..	..	..
..	(303)	..	..	..	..	..
..	303 320	169 * 228	..	78 *	..
..	34 * 347	..	..	..
..	377 54I	..	216	..	..
*	147 *	495	..	..	..	..	..	..	..

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>mauritiensis</i> Heding & Panning	..	303	..	..	..	..
<i>Phyllophorus (Phyllophorella) calypsoi</i> Cherbonnier	87	..	..
<i>dubius</i> Cherbonnier
<i>parvipedes</i> H. L. Clark
<i>purpureopunctata</i> (Sluiter)
<i>robusta</i> Heding & Panning
<i>spiculata</i> Chang
<i>Phyllophorus (Phyllothuria) cebuensis</i> (Semper)
<i>hypsiopyrga</i> (von Marenzeller)
<i>ordinata</i> Chang
<i>Phyllophorus (Urodemella) brocki</i> Ludwig
<i>holothurioides</i> Ludwig 375
<i>tenuis</i> Haacke	..	280 378	..	..	..	..
<i>Phyrella fragilis</i> (Ohshima)
† <i>trapeza</i> (H. L. Clark)
<i>Selenkiella siamense</i> (Heding & Panning)
<i>Semperiella tenera</i> (Ludwig)	303 346	..	..
<i>Thyonidiella oceana</i> Heding & Panning	..	303	..	..	..	..
MOLPADIIDAE						
<i>Molpadia altimensis</i> H. L. Clark
CAUDINIDAE						
<i>Acaudina delicata</i> (H. L. Clark)
<i>gephyra</i> (Sluiter)
<i>irania</i> (Heding)	301	..
<i>leucoprocta</i> (H. L. Clark)
<i>molpadioides</i> (Semper)
<i>Paracaudina chilensis</i> (J. Müller) ²⁴
SYNAPTIDAE						
<i>Anapta gracilis</i> Semper	*
<i>subtilis</i> Sluiter
<i>Eunapta godeffroyi</i> (Semper)	..	280 378	*	89	..	..
<i>magna</i> Heding
<i>tahitiensis</i> Cherbonnier
<i>Labidoplax dubia</i> (Semper)
<i>incerta</i> (Ludwig)
† <i>variabilis</i> (Théel)
<i>Leptosynapta tchela</i> Mortensen	437 *	..	..
<i>dyscrita</i> H. L. Clark
<i>latipatina</i> H. L. Clark
<i>Opheodesoma australiensis</i> Heding
<i>clarki</i> Heding
<i>glabra</i> (Semper)

FOR HOLOTHURIOIDEA

	W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..
..	92	..	..
..	..	627	..	..	303	180	..	..	..	..
..	541 575	..	..	..	..	..
..	303	..	..	..	..	..
..	78	..	..
..	495	..	(303 54I)	182	528 (* 553)	92	..	..
..	(54I)	..	..	407 * 479	..	..
..	79	..	..
..	495	..	(303) 381	180	(303)	..	..	..
..	536 * (54I)	179 * 228	..	..	..	..
..
..	236 * 536	..	..	479 573	..	..
..	179 *	..	..	..	..
..	303	..	..	..	..	..
..	38I	..	..	..	(375)	..
..	303	..	..	..	..	..
..	180	..	..	..	..
..	180	..	..	..	..
..	542	..	..	..	..	..
..	180	..	..	..	..
..	380 * 555	38 * 33I	377 * 54I	..	528	78 * 528	..	..
..	(535)	..	180	..	378 407	..	..
..	522	542	..	295 * 528	..	295 *	..
..	536	..	..	..	..	..
..	..	147 *	..	..	54I	169 539	216	..	346 * 528	246 293
..	293
..	88	..
..	536 540	..	528	..	..	..
..	375 (54I)	..	..	..	..	..
..	(293)	..	..	173 * 553	..	..
..
..	180	..	..	..	..
..	169	..	..	..	..
..	295	..	..	88	..
..	293 * 553	..	..	..
..	293 54I	539	528	..	61 553	..

DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>recta</i> (Semper)	560 * 566	..	..
<i>reticulata</i> (Semper)
<i>rubra</i> Heding
<i>striata</i> (Sluiter)
<i>tualensis</i> Heding
<i>varians</i> (Nair)
<i>violacea</i> Heding
<i>virgata</i> Sluiter
CHIRIDOTIDAE						
<i>Chiridota amboinensis</i> Ludwig
<i>eximia</i> Haacke	..	280	..	..	..	..
<i>hawaiiensis</i> Fisher
<i>†intermedia</i> Bedford
<i>liberata</i> Sluiter
<i>rigida</i> Semper
<i>stuhlmanni</i> Lampert	295 348	..	..	..
<i>violacea</i> (J. Müller)	469 * 529	..	..	..
<i>Polycheira echinata</i> (von Marenzeller)
<i>(rufescens</i> (Brandt) <i>syn. d. fulva</i> (Parker)	34 *	..	294 348	..	..	..
<i>vitiensis</i> (Semper)
<i>Trochodota maculata</i> H. L. Clark

FOR HOLOTHURIOIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	*	267	36 * 40	293 * 320	173 * 180	173 528	..	173	..
..	293 * 320	346 347	528	..	22 *	..
..	295	..	..	..	..
..	..	476 495	33I	293 536	..	..	..	..	..
..	293	..	295	..	..	..
..	475	..	..	..	..	..	..
..	293	..	..	..	..	..
..	293 541	..	..	..	..	..
..	381	..	..	..	..	..
..
..	246 293
..	21 *	..
..	381 * 536	..	..	..	21 *	..
..	381 541	169 233	216 528	..	22 294	..
..	293	..
..	*
..	293	..	..	..	..	..
..	..	37 *	36 * 33I	293 * 541	295 * 528	216 528	61 78	295 * 510	..
..	528	..
..	169	..	..	..	..

SUPPLEMENTARY
DISTRIBUTION TABLE
FOR
HOLOTHURIOIDEA
OF
UNCERTAIN RELEVANCE
TO THIS
MONOGRAPH

NOTES TO HOLOTHURIAN TABLE

¹ *Actinopyga plebeja* (Selenka, 1867). Although Panning (1929) considered this to be a synonym of *A. miliaris* (Quoy & Gaimard), in 1944 he treats it as a subspecies of *A. echinites* (Jaeger), together with *A. crassa* Panning. Cherbonnier (1955b) believes that *A. crassa* and *echinites* rank as distinct species. I also consider that *A. plebeja* merits specific rank.

² *Bohadschia bivittata* (Mitsukurin, 1912). Although Panning (1929) originally considered this to be a valid species of *Bohadschia*, in 1944 he treats *bivittata*, *tenuissima*, *vitiensis* and *koellikeri* (all of Semper, 1868), as subspecies of *B. marmorata* Jaeger, with *similis* still a synonym of *B. marmorata vitiensis*. Cherbonnier (1954, 1955a and b and 1963) maintains that *B. marmorata*, *tenuissima*, *vitiensis* and *similis* all rank as distinct species. Similarly I consider that *B. bivittata* also merits specific rank.

³ *Bohadschia koellikeri* (Semper, 1868). Although Panning (1929) considered *B. similis*, *tenuissima* and *koellikeri* (Semper) to be synonyms of *B. vitiensis* (Semper), in 1944 he treats *tenuissima*, *vitiensis* and *koellikeri* as subspecies of *B. marmorata* Jaeger, with *similis* still a synonym of *marmorata vitiensis*. Cherbonnier (1954, 1955a and b and 1963) maintains that *B. similis*, *tenuissima* and *vitiensis* all rank as distinct species. Similarly I consider that *B. koellikeri* also merits specific rank.

⁴ *Cystipus* Haacke, 1880. Panning (1934) inadmissably treats *Holothuria rigida* Selenka, 1867 and *Cystipus pleuripus* Haacke, 1880, as junior synonyms of *Holothuria fossor* Deichmann, 1926, despite their priority of date. The name *H. rigida* has since been used by H. L. Clark (1946) and Deichmann (1958) with *C. pleuripus* as a synonym. Deichmann (1958) considers *H. fossor* to be a junior subjective synonym of *H. cubana* Ludwig, 1875, which is certainly consubgeneric with *H. rigida* but is confined to the West Indian region, Panning's Indo-Pacific records of *H. fossor* being based on *H. rigida*.

Although she regarded *Cystipus pleuripus* as conspecific with *H. rigida*, Deichmann (1958) proposes a new name *Fossothuria* for a genus (here treated as a subgenus of *Holothuria*), with *rigida* designated as type-species, despite the availability of *Cystipus*, of which *Fossothuria* is a junior subjective synonym.

Later in the same paper, Deichmann describes another new nominal genus, *Jaegerothuria*, with *Holothuria inhabilis* Selenka, 1867 as type-species. Since *Holothuria rigida* and *H. inhabilis* are now considered to be consubgeneric (Rowe, 1969), *Jaegerothuria* also becomes a synonym of *Cystipus*.

⁵ *Holothuria insignis* Ludwig, 1875. There are conflicting views regarding the validity of this species as distinct from *H. pardalis* Selenka, 1867, though Heding (1934) maintains that there is enough evidence to keep the two separate and I respect his judgement. Due to differing interpretations in the past, however, there must be some overlapping of the records for *insignis* and *pardalis*.

⁶ *Holothuria erinaceus* Semper, 1868. Panning (1929-35) treats *H. erinaceus* as a synonym of *H. lubrica* var. *glaberrima* Selenka, 1867, simultaneously reducing not only *glaberrima* but also *H. moebii* Ludwig, 1875, *parva* Lampert, 1889 and *marenzelleri* Ludwig, 1883 to the rank of subspecies of *H. lubrica* Selenka, 1867. Deichmann (1958) restores all four to specific rank but refers the name *marenzelleri* to the synonymy of *erinaceus*. She also refers them to a new nominal genus *Selenkothuria*, here treated as a subgenus of *Holothuria*.

⁷ *Holothuria fusco-olivacea* Fisher, 1907, *ludwigi* Lampert, 1889 and *olivacea* Ludwig, 1888. From their original descriptions it is almost impossible to separate these three nominal species on any aspect of their morphology. Lack of material prevents resolution of this problem. Should re-examination of the type-material show that they are conspecific then the name *olivacea* has priority.

⁸ *Holothuria squamifera* Semper, 1868 and *kurti* Ludwig, 1889-1892. One of Semper's own slides of spicules from *H. squamifera* is in the British Museum collections; it shows not only the large irregular tables which he figures (reproduced by Panning, 1929-1935) but also some tables with cruciform disc (pl. 28 fig. 17) not shown by Semper. They resemble the tables figured by Sluiter (1889) from the holotype of *H. lamperti*, the name of which is preoccupied and was replaced by *H. kurti* Ludwig, 1889-1892. It is possible that Semper's omission to figure the tables of *H. squamifera* misled Sluiter and Ludwig into thinking that they had a distinct species but re-examination of the relevant type-material is needed to ascertain whether *H. kurti* is a synonym of *squamifera*.

⁹ *Holothuria hilla* Lesson, 1830 has been validated by the International Commission on Zoological Nomenclature (1970) and takes the place of *Psolus monacaria* Lesson, 1830 (commonly used in the combination *Holothuria monacaria*), suppressed. [Opinion 914. *Bull. zool. Nom.* 27(1):31-32.]

¹⁰ The classification of the Dendrochirotida adopted here is the traditional one of Heding, Panning, Deichmann and others who consider that the number of tentacles should be used to separate two families, Cucumariidae and Phyllophoridae. However, it must be pointed out that Pawson and Fell (1965) consider that the number of tentacles is not a satisfactory classificatory criterion for dendrochirotids; instead they place emphasis on the importance of the shape of the calcareous ring, the shape of the tentacles and of the calcareous deposits in the body wall. This results in the various subfamilies of the Cucumariidae and Phyllophoridae, as accepted by other authors, becoming intermixed. Although there are clear parallels in the forms of the calcareous rings and body wall deposits in these subfamilies, supporting the contention of Pawson and Fell, I feel that for the purposes of this work it is better to follow the conservative classification.

¹¹ *Havelockia*(?) *novacorona* (Cherbonnier, 1960). *Pentathyone*(?) *novacorona* Cherbonnier is here referred to *Havelockia*, following Panning's synonymy of the two nominal genera in 1949.

¹² *Havelockia transitoria* (Vaney, 1905). *Cucumaria transitoria* Vaney has been referred to *Thyone* by Panning (1949) and to *Athyone* by Cherbonnier (1955b) but judging from Vaney's description I consider that it is congeneric with *Havelockia herdmanni* Pearson, the type-species of *Havelockia*, of which the calcareous ring and type of spicule are similar.

¹³ *Leptopentacta bacilliformis* (Koehler & Vaney, 1908). *Cucumaria bacilliformis* Koehler and Vaney has been referred to *Pseudocumis* by Panning (1949) but judging from Koehler and Vaney's description and figures I consider that it is congeneric with *Leptopentacta grisea* H. L. Clark, the type-species of *Leptopentacta*, of which the calcareous ring and type of spicule are similar.

¹⁴ *Pentacta anceps* (Selenka, 1867) and *tuberculosa* (Quoy & Gaimard, 1833). Cherbonnier (1952) could not trace the holotype of *P. tuberculosa* and concludes from the description that it is not a dendrochirote at all but an aspidochirote of uncertain

affinity. *Pentacta anceps*, formerly treated as a synonym of *tuberculosa*, as the first available name becomes the proper one for this species of Dendrochirotida.

¹⁵ *Pentacta australis* Ludwig, 1875 has been validated by the International Commission on Zoological Nomenclature (1966) and takes the place of *P. pentagona* (Quoy & Gaimard, 1833), suppressed.

¹⁶ *Plesiocolochirus*, with type-species *Holothuria spinosa* Quoy and Gaimard, 1833, was established by Cherbonnier in May, 1946. In December of the same year, H. L. Clark's new name *Apentacta*, also with type-species *H. spinosa*, was published; this falls into the synonymy of *Plesiocolochirus*.

¹⁷ *Pseudocolochirus arae* (Boone, 1938). From Boone's description and figures of *Pentacta arae* from South Vietnam, I can find no good reason to accept her contention that it is congeneric with *Pentacta doliohum* (Pallas), the type-species of *Pentacta*. Rather I consider *arae* to be congeneric with *Pseudocolochirus violaceus* (Théel), the type-species of *Pseudocolochirus*. I suspect that when material is available for comparison, *P. arae* will prove to be a synonym of *P. violaceus*, which has also been recorded from the coasts of Vietnam (by Serène, 1937).

¹⁸ *Pseudocolochirus tricolor* (Sluiter, 1901). *Cucumaria tricolor* Sluiter has been referred to *Paracucumaria* by Panning (1949) but judging from Sluiter's description and figures I consider that it is congeneric with *Pseudocolochirus violaceus* (Théel), the type-species of *Pseudocolochirus*, of which the calcareous ring and type of spicule are similar.

¹⁹ *Stolus conjugens* (Semper, 1868). *Cucumaria conjugens* Semper has been referred to *Havelockia* by Panning (1949) but judging from Semper's description and figures and after examination of an original Semper slide, presumably from the type-material, as well as other specimens in the collections of the British Museum, I consider that *conjugens* is congeneric with *Stolus buccalis* (Stimpson), the type-species of *Stolus*.

²⁰ *Thyone curvata* Lampert, 1885 may prove to be a phyllophorid, in which case it could be a senior subjective synonym of *Phyllophorus* (*Urodemella*) *brocki* Ludwig, 1888, judging from the form of its spicules. However, since Lampert records only ten tentacles in the holotype, until this can be re-examined it seems better to retain *curvata* in the genus *Thyone*, though with reservations.

²¹ *Thyone perissa* H. L. Clark, 1938. According to H. L. Clark (1946), Deichmann (MS) believes the holotype of this nominal species to be a phyllophorid, possibly conspecific with *Neothyonidium magnum* (Ludwig), 1882.

²² *Trachythyone imbricata* (Semper, 1868) and *typica* (Théel, 1886). In view of the confusion which has existed over the distinctness of these two nominal species, which cannot be resolved at present, they are treated here separately, although this inevitably means some overlapping in the records.

Trachythyone javanicus (Sluiter, 1880), which has also been considered as very closely allied to *T. imbricata* and *typica* has been placed by Deichmann (1941) in the genus *Leptopentacta* by virtue of the form of its calcareous ring. This move is followed in the present work.

²³ *Neocucumis proteus* (Bell, 1884). Lampert (1889) doubtfully refers his new nominal species *sluiteri* to the genus *Thyone*, being unwilling to dissect the holotype to ascertain the number of its tentacles. Deichmann (MS), according to H. L. Clark (1946) considers that it is probably a phyllophorid and identical with *Neocucumis proteus* (Bell). A comparison of the description with the holotype of *N. proteus* inclines me to agree with Deichmann, so that *T. ? sluiteri* is here referred to the synonymy of *N. proteus*.

²⁴ *Paracaudina chilensis* (J. Müller, 1850). The records given refer to the subspecies *ransonetti* von Marenzeller, 1881.

KEY TO THE HOLOTHURIOIDEA

(Supra-specific taxa only)

- 1 Podia (pedicels and papillae) present, body usually stout, body wall more or less thick and muscular, usually 1-15 mm. thick (measurements taken of contracted preserved specimens in all cases given); dominant spicules in the form of tables, perforated plates, buttons, cups, rods or rosettes (fig. 85a-h) present in the body wall ASPIDOCHIROTIDA and DENDROCHIROTIDA 2
- 1' Podia absent, though warty prominences may be present; body either vermiform, body wall thin, usually only 1 mm. thick or less, often translucent, with smooth, rough or warty surface, or body stout and sausage-shaped with a caudal appendage; dominant spicules in the form of either anchors with associated anchor plates (fig. 85j) (Synaptidae) or wheels and grains (fig. 85i) (Chiridotidae) or perforated plates, irregular tables, irregular rods or cups (fig. 96a), rarely modified anchors lacking associated plates (Molpadida). APODIDA and MOLPADIDA 56
- 2 Tentacles leaf-shaped (peltate or peltato-digitate) (fig. 86a); no true anterior introvert with associated retractor muscles, though the tentacle ring can be retracted out of sight within a fold of skin ASPIDOCHIROTIDA 3

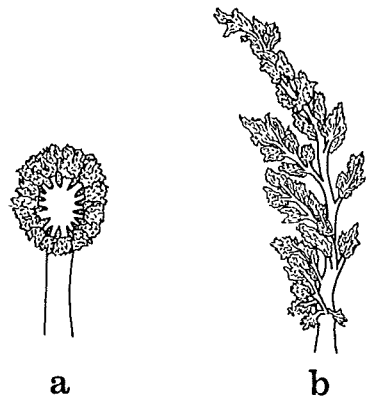


FIG. 86. Tentacles of: a. an aspidochirotid (from Hyman, 1955) and b. a dendrochirotid.

- 2' Tentacles bush or tree-shaped, much branched (dendritic) (fig. 86b); anterior end in the form of a thin-walled introvert capable of retraction by special muscles. DENDROCHIROTIDA 21
- 3 Gonads in a single tuft to the left of the dorsal mesentery; spicules diverse in form and combination, 'S' and 'C'-shaped rods not present HOLOTHURIIDAE 4
- 3' Gonads in two tufts, one each side of the dorsal mesentery; spicules: primarily tables, branched rods and 'S'- or 'C'-shaped rods (fig. 85d; pl. 27, figs. 18-20), the latter very rarely absent, or slender dichotomously-branched rods (fig. 87a; pl. 27, fig. 17), buttons rarely, if ever, present STICHOPODIDAE 20
- 4 Spicules: rods only, usually dichotomously-branched or lobed (fig. 85b; pl. 27, figs. 1-8), tables and buttons never present; calcareous ring very stout, both radial and interradial plates with their anterior margin scalloped and sometimes with their sutures indistinct, radial plates usually about twice as large as the interradials and possessing a median anterior ampullary notch, interradial plates with a short anterior median tooth-like projection; 20-30 tentacles; body wall very thick and muscular, usually about 5 mm. (1-15 mm.) thick; pedicels and papillae small and numerous, indistinguishable from each other, scattered ventrally and dorsally; size moderate to very large, up to 40 cm long 5
- 4' Spicules: tables nearly always present, buttons, rods, perforated plates and rosettes present or absent, minute dichotomously-branched or lobed rods rarely present and if so then only in combination with tables (fig. 85a, c, e); other characters exhibiting a wide range 6
- 5 Anus guarded by five calcified papillae; 20-30 tentacles ACTINOPYGA Bronn, 1860
- 5' No calcified anal 'teeth' present though five groups of papillae may be evident; 20 tentacles BOHADSCHIA Jaeger, 1833
- 6 Spicules: tables scattered, variously developed, either with disc reduced and spire low and ending in a ring of spines (pl. 28, fig. 12) or else disc well-developed and spinose, with spire of moderate height and usually very spinose (pl. 28, figs. 12, 14), buttons when present smooth and irregular, often incomplete (pl. 28, figs. 12, 14) or deformed and suggesting clumsy 'C'-shaped bodies; calcareous ring ribbon-like, radial plates usually shorter than broad, interradial plates also shorter than broad, tending to be curved (fig. 88a); body wall fairly thick, usually about 1.5 mm. (1-2 mm.), soft and leathery; body cylindrical or

- vermiform with pedicels and papillae confined to the five ambulacral areas; size moderate, up to c.15 cm. long LABIDODEMAS Selenka, 1867
- 6' Spicules: variously developed and in various combinations; calcareous ring never ribbon-like, radial plates either as long as broad or longer, interradial plates usually half as long as broad but never curved (fig. 88b); body wall variously developed, often rather thick; body form showing a wide range but pedicels usually irregularly arranged on a more or less flattened ventral 'sole' and papillae irregularly arranged on the arched dorsal surface; size ranging from small to massive, up to 45 (?60) cm. long. HOLOTHURIA Linnaeus, 1767 (sensu extenso) 7
- 7 Spicules: tables only present in combination with rosettes, rods or perforated plates, occasionally tables absent or present only in a very reduced form, buttons never present 8
- 7' Spicules: tables always present, either alone or in combination with buttons, never with rods or rosettes only though either of the latter may be present 11

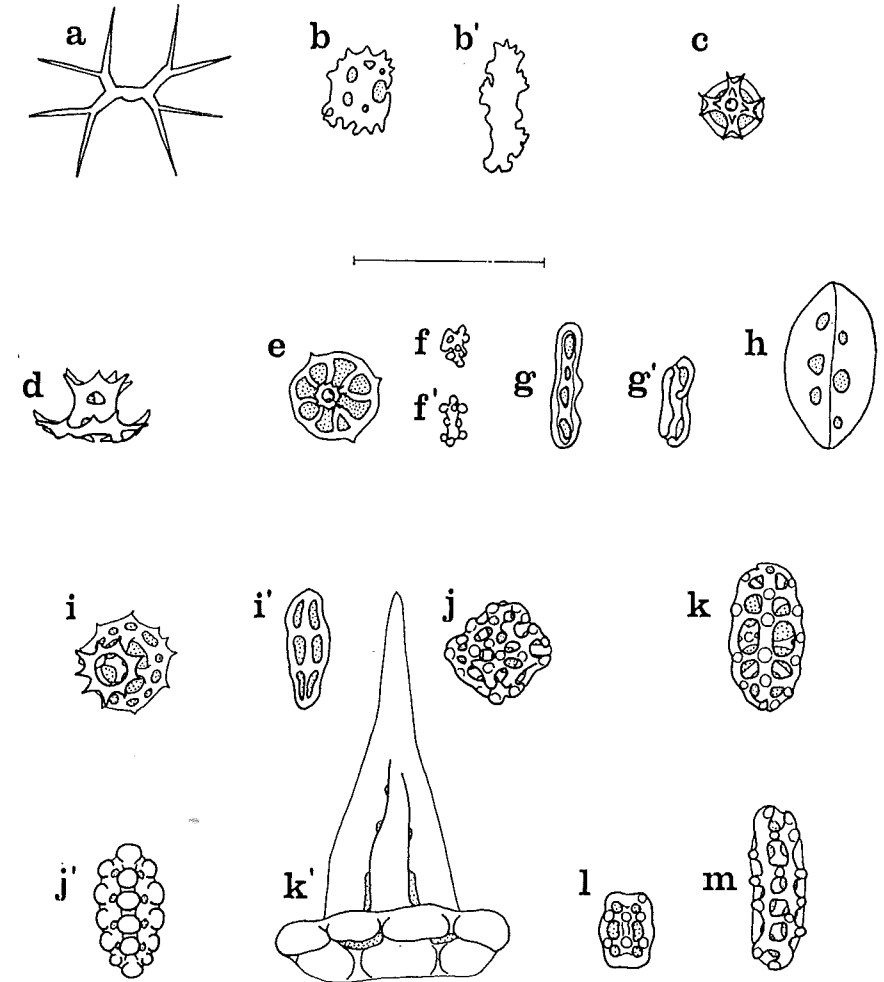


FIG. 87. Spicules of aspidochirotids: a. *Thelethota ananas*, dichotomously branched rod; b, b'. *Holothuria (Selenkothuria) erinaceus* (var. *pygmaeus*), perforated plate and irregular rod; c. *H. (Semperothuria) cinerascens*, table viewed from above, showing maltese cross formation of terminal spines of spire; d. *H. (Acanthotracheza) coluber*, table from the side showing 'cup and saucer' analogy; e. *H. (Stauropora) discrepans*, table from above showing cruciform central hole; f. *H. (Stauropora) annulifera*, small knobbed bars (or incomplete buttons); g. *H. (Lessonothuria) pardalis*, pseudobuttons; h. *H. (Platyperona) difficilis*, flattened oval button with median optical discontinuity; i, i'. *H. (Merteniothuria) leucospilota*, table from above showing ring of apical spines on spire and irregular button; j, j'. *H. (Cystipus) rigida*, modified table forming fenestrated sphere and button with large regular knobs; k, k'. *H. (Thelethothuria) spinifera*, modified button forming fenestrated ellipsoid and tack-like table with large almost solid pointed spire; l. *H. (Meiriatyla) scabra*, button with moderate irregularly placed knobs; m. *H. (Microthele) nobilis*, modified button forming fenestrated ellipsoid. The scale equals 0.1 mm.

- 8 Spicules: perforated or thorny rods or plates (fig. 87b; pl. 28, fig. 5), *tables* said to be present in some species but if so always very reduced in form and sparsely distributed in the body wall; calcareous ring with radial plates usually longer than broad, up to three times as long as the interradial plates, the latter usually with the outer surface slightly concave; 20 tentacles; body wall soft, not very thick, usually about 1 mm. (1-3 mm.); body usually with pronounced ventral 'sole' crowded with pedicels, though these may be in three distinct series, papillae small, usually scattered dorsally; size moderate, up to 15 (rarely 20) cm. long subgenus *SELENKOTHURIA* Deichmann, 1958
- 8' Spicules: *tables* always present, usually well-developed, either in combination with rosettes or rods in the body wall; other characters exhibiting a wide range 9
- 9 Spicules: *tables* in combination with rods (fig. 85e), the former usually with disc reduced or absent, spire moderately high, terminating in a few spines which form a single or double maltese cross when viewed from above (fig. 87c; pl. 27, figs. 12, 15, 16), rosettes *never* present; calcareous ring quite well developed, radial plates up to three times as long as the interradial plates, the latter without any concavity on the outer surface; 20 tentacles; body wall soft, quite thick, usually c.2 mm. (1-4 mm.); body rather slender and cylindrical, pedicels more or less in three rows ventrally, papillae scattered dorsally; size moderate, up to 15 (rarely 20) cm. long subgenus *SEMPEROTHURIA* Deichmann, 1958
- 9' Spicules: *tables* in combination with rosettes (fig. 85c), the former sometimes with reduced disc and the spire ending in a few spines forming a maltese cross, *no* rods present in the body wall; other characters exhibiting a wide range 10
- 10 Spicules: *tables* usually with reduced disc, spire moderate to high, ending in a few spines forming a maltese cross when viewed from above (pl. 27, figs. 11, 14); calcareous ring quite stout, radial plates up to three times the length of the interradials; 20 tentacles; body wall soft, quite thick, usually c.2-3 mm. (1-5 mm.); body rather cylindrical, pedicels in three distinct but crowded rows on the more or less distinct ventral 'sole', papillae small, irregularly arranged dorsally; size moderate to large, up to 35 cm. long subgenus *HALODEIMA* Pearson, 1914
- 10' Spicules: *tables* usually large and clumsy with spinose well developed disc and low to moderately high spire, the rim of the disc often turned up to give the table a 'cup and saucer' appearance in side view (fig. 87d; pl. 27, fig. 13), in small specimens (? juveniles) the tables have a high spire and smooth rim; calcareous ring stout, radial plates squarish, up to twice as long as the interradial plates; 20 tentacles; body wall soft, fairly thick, usually c.3 mm. (2-5 mm.); body cylindrical, pedicels irregularly arranged ventrally, papillae either small or large and conical, usually irregularly arranged dorsally; size moderate to large, up to 35 cm. long subgenus *ACANTHOTRAPEZA* Rowe, 1969

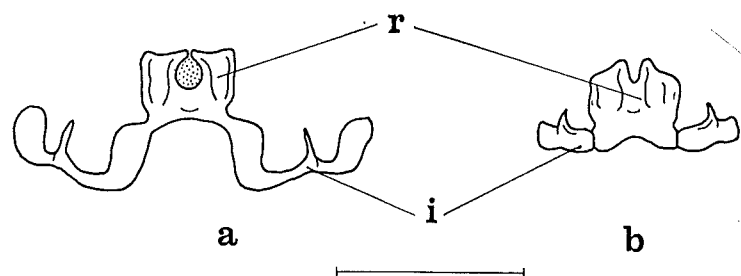


FIG. 88. Parts of calcareous rings of: a. *Labidodemas rugosum* and b. *Holothuria (Stauropora) discrepans*, showing one radial (r) and two interradials (i). The scale equals 5 mm.

- 11 Spicules: *tables* always present, with low, moderate or high spire, disc usually squarish to octagonal with a large centrally-placed cruciform hole, one or more smaller holes alternating with each arm of the central cross giving the table a very characteristic appearance (fig. 87e), the rim of the disc smooth or spinose, flat or slightly turned up to give a 'cup and saucer' appearance to the table in side view, *buttons* usually present, rarely totally absent, when present very variable, oval, smooth or rugose, occasionally incomplete or even reduced to small bars with lateral lobes (fig. 87f), complete buttons usually with three to six pairs of holes (pl. 28, fig. 4); calcareous ring with radial plates up to three times the length of the interradial plates (fig. 88b); 18 to 30 tentacles; collar of papillae around the base of the tentacles occasionally present but never obviously so; body wall soft, not very thick, usually c.1 mm. (1-2 mm.); body with flattened ventral 'sole', pedicels confined to the three ventral ambulacral areas, papillae small, irregularly arranged dorsally; size small, up to 10 (rarely to 12.5) cm. long subgenus *STAUROPORA* Rowe, 1969
- 11' Spicules: *tables* variously developed, never with the characteristic cruciform central hole in the disc, *buttons* variously developed, never totally absent, rosettes sometimes present; other characters exhibiting a wide range 12

- 12 Spicules: *tables* variously developed, *buttons* smooth, regularly or irregularly developed (figs. 85a', 87h, i'), or in the form of *pseudo-buttons* (fig. 87g) 13
- 12' Spicules: *tables* always strongly developed, sometimes modified to form hollow fenestrated spheres (fig. 87j), *buttons* always knobbed or rugose sometimes modified to form hollow fenestrated ellipsoids (figs. 87j', k, l, m) 16
- 13 Spicules: *tables* usually well developed, rim not spinose, *buttons* smooth, sometimes flat and thin, with or without a median optical discontinuity, outline regular or irregular, rarely buttons with slight nodules or forming ellipsoids 16
- 13' Spicules: *tables* more or less well developed, rim usually spinose, *buttons* irregular or *pseudo-buttons*, never flattened, or with a median optical discontinuity 15
- 14 Spicules: *tables* well developed, disc smooth and round with varying numbers of peripheral holes, spire of moderate height, ending in several spines, *buttons* oval, thin, flat, very rarely with a few knobs, a median optical discontinuity present, three to six pairs of relatively small holes (fig. 87h; pl. 27, fig. 9); calcareous ring stout, radial plates about twice as long as the interradial plates; 18 to 20 tentacles; distinct collar of papillae present around the base of the tentacles; body wall soft, not very thick, usually c.1-2 mm. (1-5 mm.); body with a flattened ventral 'sole', pedicels crowded, irregularly arranged except in smaller individuals where they appear to be arranged in three distinct bands, papillae small, irregularly arranged on the arched dorsal surface; anal papillae usually apparent; size small to moderate, up to 20 cm. long subgenus *PLATYPERONA* Rowe, 1969
- 14' Spicules: *tables* fairly stout, disc smooth, squarish in outline, usually with eight to ten peripheral holes, spire of moderate height ending in a cluster of small spines (fig. 85a), *buttons* regular (fig. 85a') or irregular in outline with three or more pairs of comparatively large holes (except in *H. (T.) arenicola* which has comparatively small holes), not flattened, lacking any appearance of having a median optical discontinuity (fig. 85a'; pl. 28, fig. 3, 6, 8, 9) rarely buttons with slight nodules or forming hollow fenestrated ellipsoids; calcareous ring stout, radial plates up to three times the length of the interradial plates; 18 to 20 tentacles; collar of papillae around the base of the tentacles more or less apparent; body wall not very thick, usually c.2 mm. (1-5 mm.), often gritty to touch; body rather vermiform, pedicels and papillae usually irregularly arranged along the ventral and dorsal surface respectively or occasionally arranged along the five ambulacral areas, anal papillae not apparent; size small to moderate, up to 20 (rarely to 25) cm. long subgenus *THYMIOSYCIA* Pearson, 1914
- 15 Spicules: *tables* not strongly developed, disc with rim usually spinose, spire low, ending usually in a ring (fig. 87i) or cluster of spines (pl. 28, fig. 19), tables occasionally degenerate or incomplete, *buttons* irregular, usually with three pairs of holes (fig. 87i'; pl. 28, fig. 19), sometimes incomplete; calcareous ring stout, radial plates about twice as long as the interradial plates; 18 to 20 tentacles; no apparent collar of papillae around the base of the tentacles; body wall variable, soft, ranging from thin to fairly thick, usually c.2-3 mm. (1-4 mm.); anal papillae not apparent; body cylindrical with a more or less flattened ventral 'sole' crowded with pedicels which are arranged in three bands in the smaller (? juvenile) individuals, papillae small, not regularly arranged dorsally; size moderate to large, up to 25 cms. long subgenus *MERTENSIOTHURIA* Deichmann, 1958
- 15' Spicules: *tables* clumsy, spires low to moderate, usually terminating in a ring or cluster of small spines, disc well developed, spinose, often turned up to give a 'cup and saucer' appearance to the table in lateral view (cf. fig. 87d; pl. 28, fig. 7) rarely some tables with smooth rimmed disc also present, *pseudo-buttons* abundant, smooth, usually irregular and often reduced to a single row of three or four holes (fig. 87g), occasionally quite regular buttons present, with three pairs of holes (pl. 28, fig. 7, 11); calcareous ring fairly stout, radial plates about twice as long as the interradial plates; 17 to 30 tentacles; collar of papillae evident around the base of the tentacles; body wall soft, not very thick, usually c.1 mm. (1-3 mm.); anal papillae usually apparent; body cylindrical with a more or less distinct flattened ventral 'sole', pedicels and papillae irregularly arranged; size small to moderate, up to 15 cm. long subgenus *LESSONOTHURIA* Deichmann, 1958
- 16 Spicules: *tables* simple, irregular with rather spinose disc which may be somewhat reduced, *buttons* simple, quite large, always with numerous small rounded or pointed knobs, giving the button a very rugose appearance, three to ten pairs of holes which sometimes become obliterated by the thickening of the button; calcareous ring fairly stout, radial plates about twice as long as the interradial plates; 20 tentacles; collar of papillae present around the base of the tentacles; body wall soft, thick and muscular usually c. 3 mm. (1-6 mm.); anal papillae more or less apparent; body cylindrical with pedicels crowded irregularly on the flattened ventral 'sole', papillae usually large, irregularly arranged dorsally; size small to large, up to 30 cm, long subgenus *HOLOTHURIA* Linnaeus, 1767
- 16' Spicules: *tables* usually strong and well developed, simple or modified to form hollow fenestrated spheres (fig. 87j), *buttons* with large or moderate-sized rounded knobs, never with numerous small knobs giving the button a rugose appearance, buttons either simple or modified to hollow fenestrated ellipsoids (figs. 87j', k, l, m) 17

- 17 Spicules: *tables* with disc usually knobbed, spire low, bearing many short spines which are sometimes so numerous and closely crowded that they may either almost obscure the disc or become connected to the knobs of the margin of the disc thus forming a fenestrated sphere (fig. 87j; pl. 28, figs. 13, 18), *buttons* usually simple with large, more or less regularly arranged knobs, generally three to four or more pairs of relatively small holes which may become obscured somewhat by the large size and arrangement of the knobs (fig. 87j', pl. 28, figs. 13, 18), rarely the buttons modified into fenestrated ellipsoids; calcareous ring fairly stout, radial plates about twice as long as the interradial plates, radials not showing any signs of posterior bifurcation; 20 tentacles; no apparent collar of papillae around the base of the tentacles; anal papillae not conspicuous; body wall not very thick, usually c.2 mm. (1-8 mm.), usually gritty to the touch; body rather vermiform or dorso-ventrally flattened; pedicels more or less confined to the ventral ambulacral areas, papillae small, scattered dorsally though a lateral flange of papillae may be present; size small to moderate, up to 20 cm. long . . . subgenus **CYSTIPUS** Haacke, 1880
- 17' Spicules: *tables* stout, well developed, spire moderate or high, never modified into hollow fenestrated spheres, *buttons* either simple with irregular knobs of moderate size or modified into hollow fenestrated ellipsoids (figs. 87k, l, m); calcareous ring very stout and strongly developed, radial plates sometimes showing indication of posterior bifurcate prolongations . . . 18
- 18 Spicules: *tables* well developed, disc smooth or spinose, sometimes multi-armed, spire either moderate or high, usually terminating in a cluster of small spines (pl. 28, figs. 16, 17), modified *tables* with spire perfectly smooth and tapering to end in a point, giving the whole table a tack-like appearance, usually also present (fig. 87k'), *buttons* either simple with irregular, moderate-sized knobs (pl. 28, figs. 16, 17), or modified into hollow fenestrated ellipsoids (fig. 87k); calcareous ring stout and well developed, radial plates usually with more or less well developed paired posterior processes (fig. 89), both radial and interradial plates sometimes longer than broad, in any species the radial plates are about twice as long as the interradial plates; 18 to 20 tentacles; collar of papillae present around the base of the tentacles; anal papillae apparent; body wall usually very thin and parchment-like, rarely more than 1 mm. (1-2 mm.) thick, gritty to the touch; body with distinct flattened ventral 'sole' with pedicels not regularly arranged, dorsal papillae usually large, conical, rarely small, irregularly-arranged except for the lateral flange of papillae; size moderate to large, up to 25 cm. long . . . subgenus **THEELOTHURIA** Deichmann, 1958

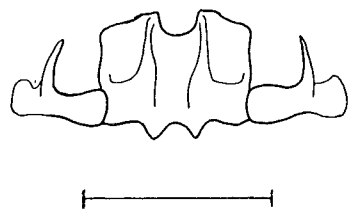


FIG. 89. Part of calcareous ring of *Holothuria (Theelothuria) squamifera*, syntype. The scale equals 5 mm.

- 18' Spicules: *tables* well developed, disc smooth, often squarish in outline, spire of moderate height or high, terminating in small spines, never pointed and giving the table a tack-like appearance, *buttons* simple with moderate-sized knobs or modified into hollow fenestrated ellipsoids (figs. 87l, m); calcareous ring moderately well to very strongly developed, never with any indication of posterior processes on the radial plates; body wall thin to very thick and muscular, 1-5 mm. (1-10 mm.); anal papillae variously developed; pedicels and papillae variously developed; size small to massive, up to 45 (?60) cm. . . 19
- 19 Spicules: *tables* well developed with smooth disc, spire of moderate height or high, terminating in several small spines, *buttons* simple, with moderate sized, irregularly arranged knobs, three to six pairs of relatively large holes (fig. 87l; pl. 28, figs. 1, 2, 10, 15) never modified into hollow fenestrated spheres; calcareous ring moderately well developed, anterior margin not scalloped, radials longer than broad, up to three times as long as the interradials; 20 tentacles; collar of papillae often present around the base of the tentacles; anal papillae variously developed; body wall usually thin and parchment-like, c.2 mm. (1-5 mm.) thick; pedicels irregularly arranged on the flattened ventral 'sole', papillae usually large and conical, irregularly arranged dorsally, a lateral fringe of papillae more or less evident; size small to moderate, up to about 20 cm. long . . . subgenus **METRIATYLA** Rowe, 1969
- 19' Spicules: *tables* stout and well-developed with smooth squarish disc, spire of moderate height terminating in many small spines (pl. 27, fig. 10; pl. 28, fig. 20), *buttons* usually always hollow fenestrated ellipsoids (fig. 87m) though a few simple knobbed buttons may be present (pl. 27, fig. 10; pl. 28, fig. 20); calcareous ring massive with scalloped anterior margin, radial and interradial plates squarish, the radials being about twice the length of the interradials; 20 tentacles; no apparent collar of papillae around the base of the tentacles; body wall very thick and muscular, usually c.5 mm. (5-10 mm.); anus usually with five calcified papillae only, though in smaller specimens (up to 20 cm) more papillae may be present,

- and in the very large specimens (over 40 cm.) papillae may be lacking; pedicels and papillae indistinguishable, scattered ventrally and dorsally; size large or even massive, up to 45 (?60) cm. long . . . subgenus **MICROTHELE** Brandt, 1835
- 20 Spicules reduced: grains and dichotomously-branched rods (fig. 87a; pl. 27, fig. 17); pedicels crowded ventrally, papillae resembling large leaf-shaped structures dorsally . . . **THELENOTA** H. L. Clark, 1921
- 20' Spicules: *tables*, branched rods and 'S'- and 'C'-shaped rods (fig. 85d) (the latter absent only in some growth stages of *S. horrens* Selenka, according to H. L. Clark, 1922), buttons rare (present in one species only) (pl. 27, figs. 18-20) . . . **STICHOPUS** Brandt, 1835
- 21 Body with well-defined 'sole' ventrally; conspicuous macroscopic plates present dorsally; mouth and anus dorsal in position . . . **PSOLUS** Oken, 1815
- 21' Body cylindrical or fusiform (cigar-shaped), without a well-defined ventral 'sole'; no conspicuous dorsal plates; mouth and anus terminal in position . . . 22
- 22 Tentacles 10 . . . **CUCUMARIIDAE** 23
- 22' Tentacles more than 10 . . . **PHYLLOPHORIDAE** 40
- 23 Calcareous ring without posterior bifurcate prolongations on the radial plates but sometimes with a notch in the posterior margin (fig. 90a, b) . . . 24

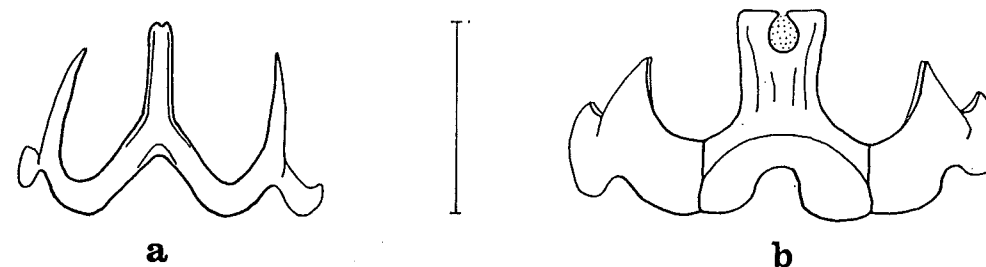


FIG. 90. Parts of calcareous rings of: a. *Aslia forbesi*, holotype and b. *Pentacta quadrangularis*. The scale equals 5 mm.

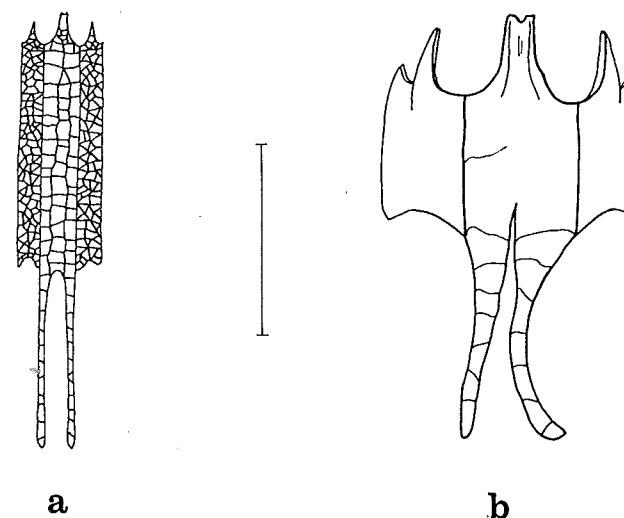


FIG. 91. Parts of calcareous rings of: a. *Thyone papuensis*, holotype and b. *Havelockia versicolor*. The scale equals 5 mm.

- 23' Calcareous ring with distinct posterior bifurcate prolongations on each radial plate (fig. 91a, b) . . . 33
- 24 Spicules; knobbed or smooth buttons and plates, branched rods, cruciform plates and baskets, the last sometimes developed into hollow fenestrated spheres . . . 25
- 24' Spicules: as above but no baskets or spherical bodies present, rarely (*Orbithyone*) spicules totally lacking from the body wall . . . 28
- 25 Spicules: nodular buttons and baskets (fig. 85h) which are often modified into hollow fenestrated spheres (fig. 92a; pl. 29, figs. 8-11), sometimes also large lenticular plates present; calcareous ring stout, well developed, without long anterior projections (fig. 90b); body form stout, quadrangular in cross-section; pedicels in three bands on the flattened ventral surface, papillae usually large, conical, irregularly or regularly placed dorsally . . . **PENTACTA** Goldfuss, 1820

- 25' Spicules: nodular or smooth swollen buttons, baskets always simple, not modified into fenestrated spheres; calcareous ring narrow with anterior margin of each radial and interradial plate produced into a long narrow projection; body form stout and quadrangular or slender and pentagonal in cross-section; pedicels and papillae always confined to the ambulacral areas 26

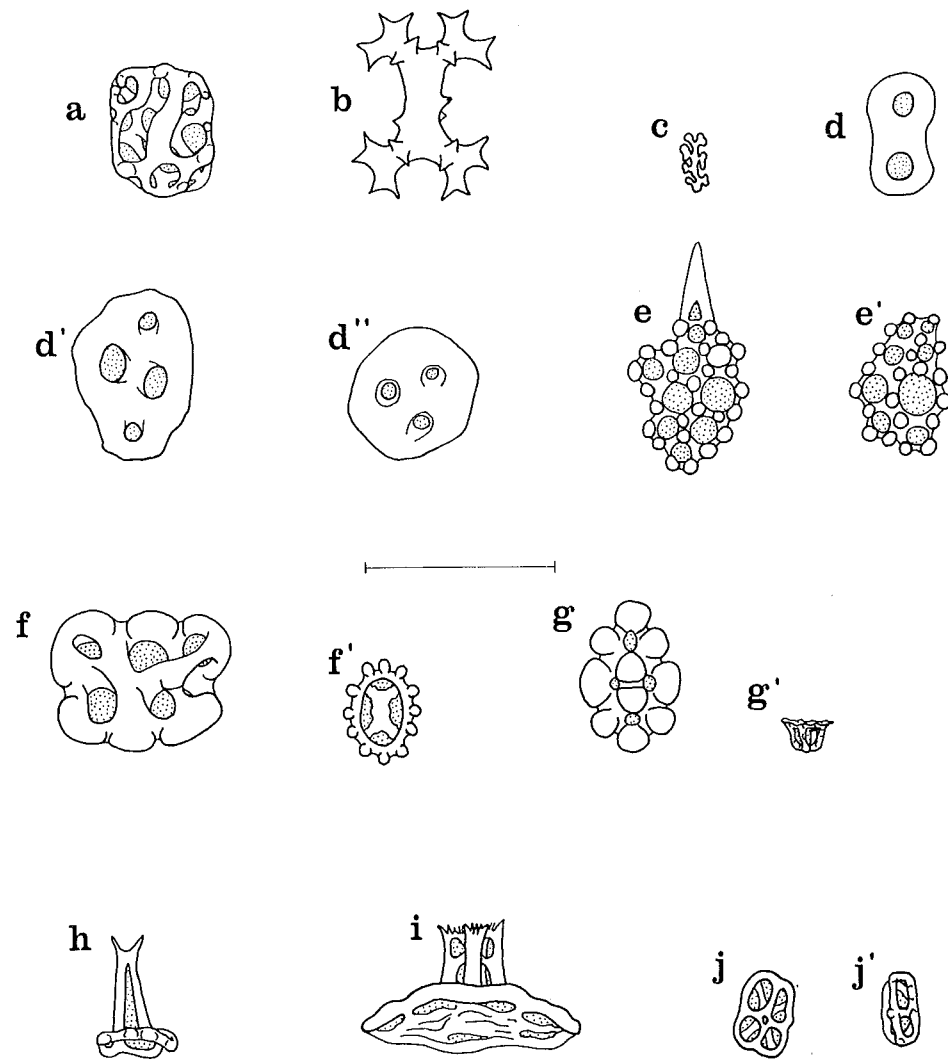


FIG. 92. Spicules of Cucumariids: a. *Pentacta quadrangularis*, spherical hollow fenestrated body (?modified basket), b. *Trachythyone crucifera*, cruciform plate, c. *Staurothyone rosacea*, branched rod, d, d', d''. *Pseudocolochirus violaceus*, holotype, smooth swollen perforated plates, e, e'. *Pseudocnus echinatus*, fircone-shaped knobbed button and more regular button from deeper layer, f, f'. *Plesiocolochirus challengerii*, holotype, swollen smooth nodular button and basket viewed from above, g, g'. *Leptopentacta grisea*, paratype, four-holed button with large knobs and basket in side view, h. *Havelockia versicolor*, table with two-pillared spire in side view, i. *Sclerodactyla multipes*, holotype, table with four-pillared spire (the spicule somewhat corroded), j, j'. *Hemithyone semperi*, holotype, hollow fenestrated bodies (? modified baskets), from above and the side. The scale equals 0.1 mm.

- 26 Spicules: swollen rather nodulated but smooth perforated buttons (pl. 29, fig. 4) and small baskets (pl. 29, fig. 4), cruciform plates sometimes present (fig. 92b); calcareous ring narrow with a distinct notch in the posterior margin of each radial plate; small slender forms, usually curved, pentagonal in cross-section; pedicels and papillae in irregular single rows along the ambulacral areas, interambulacral areas often appearing indistinctly reticulate due to aggregation of spicules **TRACHYTHYONE** Studer, 1876
- 26' Spicules: knobbed buttons and baskets, no cruciform plates; calcareous ring with posterior margin undulating; stout forms, more or less quadrangular in cross-section; pedicels and papillae arranged in two or three irregular rows on each ambulacrum 27
- 27 Spicules: small regular four-holed knobbed buttons and baskets (pl. 29, fig. 3); pedicels and papillae in two or three irregular rows along each ambulacrum **ASLIA** Rowe, 1970

- 27' Spicules: knobbed irregular buttons with usually more than four holes though some four-holed ones may be present, baskets present (pl. 29, fig. 6); pedicels and papillae arranged in a double row along each ambulacrum **OCNUS** Forbes & Goodsir *in* Forbes, 1841
- 28 Spicules totally absent from the body wall, only end plates in the pedicels and branched or simple rods in the tentacles present **ORBITHYONE** H. L. Clark, 1938
- 28' Some kind of spicules always present in the body wall 29
- 29 Spicules: cruciform plates and minute branched rods (fig. 92c; pl. 29, fig. 2) **STAUROTHYONE** H. L. Clark, 1938
- 29' Spicules: generally abundant knobbed or smooth perforated buttons and plates, no cruciform plates 30
- 30 Spicules: small smooth or knobbed perforated plates, sometimes reduced or even absent; calcareous ring usually well-developed, not narrow and without prominent anterior projections; body form stout (plump) or cucumber-like, body-wall usually soft and not at all rigid; moderate to large forms (adults above 5 cm. long); pedicels usually arranged along the ventral ambulacral areas but the papillae may be scattered dorsally 31
- 30' Spicules: either thick fenestrated smooth plates in one layer or knobbed buttons in two layers; calcareous ring narrow with a prominent anterior projection on each of the radial and interradial plates; body short and stout, somewhat attenuated at each end, body wall rigid with spicules; small to moderate forms (up to c.5 cm. long); pedicels and papillae distinctly restricted to the ambulacral areas 32
- 31 Spicules: small smooth perforated plates (fig. 92d), sometimes absent in larger specimens, length > c.8 cm.; calcareous ring strong, posterior margin undulating, anterior margin distinctly scalloped; body cucumber-like; pedicels in three distinct rows ventrally, confined to the ambulacral areas, papillae small, scattered dorsally **PSEUDOCOLOCHIRUS** Deichmann, 1930
- 31' Spicules: perforated plates, knobbed and often reduced, pedicels with vestige of end plate or none, rods, often three-armed, or plates in the pedicel wall, tentacles and introvert with perforated plates and rods; calcareous ring fairly well developed but never very strong or with scalloped anterior margin; body stout (plump); pedicels more or less confined to the ambulacral areas ventrally but papillae sometimes scattered dorsally **CUCUMARIA** de Blainville, 1834
- 32 Spicules: fenestrated plates and buttons, usually smooth and thick, arranged in one layer and imbricating **PARACUCUMARIA** Panning, 1949
- 32' Spicules: in two layers, upper of fircone-shaped smooth or knobbed buttons (fig. 92e), lower of more regularly rounded smooth or knobbed buttons with fewer holes (fig. 92e') **PSEUDOCNUS** Panning, 1949
- 33 Calcareous ring stout and short, the radial and interradial plates entire or composed of few pieces, usually in the latter case only the rather short posterior bifurcate prolongations compound (fig. 91b) 34
- 33' Calcareous ring long and tubular, the radial and interradial plates composed of a mosaic of pieces or fewer relatively large pieces, posterior bifurcate prolongations usually long (fig. 91a) 38
- 34 Spicules: nodular buttons, small baskets and large lenticulate plates in the body wall, no tables 35
- 34' Spicules: tables, rosettes and fusiform plates may be present but no buttons, baskets or large lenticulate plates 36
- 35 Spicules: smoothly nodular buttons (fig. 92f) with four to twelve holes, baskets (fig. 92f') and large lenticulate plates (pl. 29, fig. 12); body form stout, quadrangular in cross-section, not curved; pedicels in irregular zig-zag rows on the flattened ventral surface, papillae more or less confined to the two dorsal ambulacral areas, plate-like aggregations of spicules irregularly distributed in the interambulacral areas and tending to imbricate in the regions of the mouth and anus **PLESIOCOLOCHIRUS** Cherbonnier, 1946
- 35' Spicules: smooth nodular buttons with usually only four holes (fig. 92g), also baskets (fig. 92g'); pl. 29, fig. 5), large lenticulate (convex lens-shaped) plates also present; body form small and slender, pentagonal in cross-section, body usually curved; pedicels in a double row along each of the ambulacral areas ventrally, papillae usually in single rows along the dorsal ambulacral areas; aggregations of spicules giving the interambulacral areas a reticulate appearance **LEPTOPENTACTA** H. L. Clark, 1938
- 36 Spicules: tables with disc forming two to five lobes, spire composed of two or possibly four pillars, high and solid, also smaller tables with more regular multi-holed disc, sometimes oval or fusiform plates lacking a spire present, in pedicels and papillae the tables small and usually with two-armed arched disc and tall spire, no branched rods present in body wall; calcareous ring with radials having long posterior bifurcate prolongations; body U-shaped, attenuated at each end **THORSONIA** Heding, 1940
- 36' Spicules: tables with disc usually regular in outline, rarely lobed, spire not solid, composed of 2 or 4 pillars which are joined near their apex, branched or knobbed rods sometimes present in the body wall; calcareous ring with short posterior processes on the radial plates; body not U-shaped or attenuated at each end 37
- 37 Spicules: tables with disc rather squarish, sometimes irregular and lobed, usually with four large holes and four smaller peripheral holes, spire of two pillars joined just below the apex and generally terminating in a few spines (fig. 92h), tables in the papillae somewhat larger and less regular (pl. 29, fig. 13); posterior prolongations of the radial plates whole or compound **HAVELOCKIA** Pearson, 1903

- 37' Spicules: tables with elongate oval (fusiform) multi-holed disc, spire with two or four pillars (fig. 92i); radial plates with whole or compound posterior bifurcate prolongations . . . **SCLERODACTYLA** Ayres, 1851
- 38 Spicules: tables or derivatives of tables, no buttons in the body wall (pl. 29, fig. 17); pedicels and papillae scattered over the body . . . **THYONE** Oken, 1815
- 38' Spicules: nodular buttons (fig. 85g) or fenestrated ellipsoidal modified baskets (fig. 92j), plates also sometimes present but tables *absent* from the body wall, though present in the walls of the pedicels, their disc arched . . . 39
- 39 Spicules: small nodular buttons with few holes, usually four (fig. 85g), sometimes larger perforated plates present (pl. 29, figs. 7, 14, 16) . . . **STOLUS** Selenka, 1867
- 39' Spicules: fenestrated ellipsoids (fig. 92j) and perforated fusiform plates (pl. 29, fig. 15) . . . **HEMITHYONE** Pawson, 1963
- 40 Spicules: tables with spire composed of three or four pillars, or derivatives of such tables; calcareous ring simple, separate pieces sometimes distinct, no posterior bifurcate prolongations on the radial plates (fig. 93a, b); 20 or 30 tentacles in one to three circles . . . 41



FIG. 93. Parts of calcareous rings of: a. *Cladolabes aciculus* and b. *Actinocucumis typicus*. The scale equals 5 mm.

- 40' Spicules: tables or modified rods; calcareous ring with short or long bifurcate prolongations on the posterior margin of the radial plates, sometimes tubular, the radial and interradial plates having apparently fused along their lengths, radial and interradial plates often composed of few large or many small pieces giving the appearance of a mosaic pattern (fig. 94a, b); 15, 20 or 25 tentacles . . . 45



FIG. 94. Parts of calcareous rings of: a. *Semperiella tenera* and b. *Phyllophorus (Urodemella) holothurioides*. The scale equals 5 mm.

- 41 Spicules: tables with spire of usually two but sometimes four pillars, or else derivatives of tables, branched and simple rods; calcareous ring often with a deep posterior notch in each radial plate; 20 or 30 tentacles . . . 42
- 41' Spicules: contorted, approximately figure-eight-shaped hollow fenestrated ellipsoids (fig. 95e) and irregular tables with strong, often excentric, four-pillared spire (pl. 30, fig. 4), rosette-like plates also present in the pedicels (fig. 95e'); pedicels and papillae scattered over the body but in young animals confined to the ambulacral areas, in shape characteristically pointed or conical; 20 tentacles in one ring . . . **ACTINOCUCUMIS** Ludwig, 1875

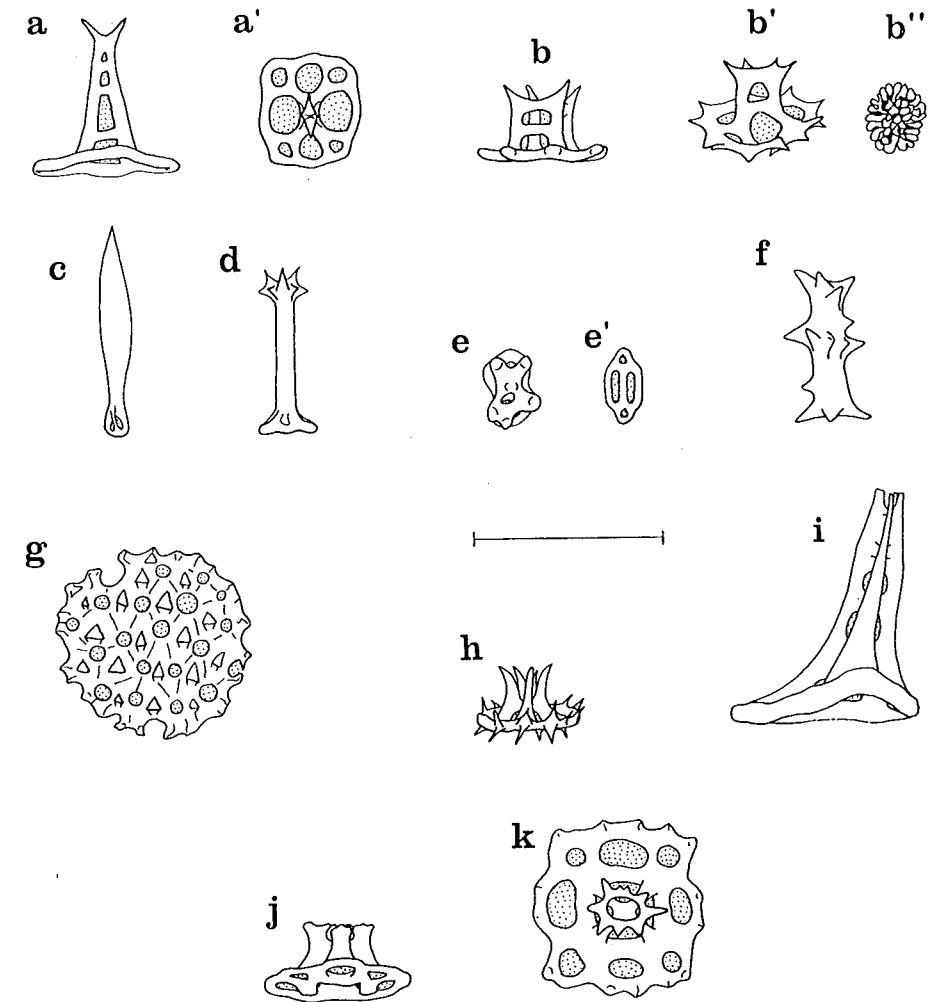


FIG. 95. Spicules of Phyllophorids: a, a'. *Mensamaria intercedens*, table in side view and from above, b, b', b''. *Neocucumis proteus*, holotype, tables with four- and two-pillared spires and branched rod from body wall, c. *Cladolabes aciculus*, d. *C. schmeltzi*, e, e'. *Actinocucumis typicus*, fenestrated figure-eight-shaped spicule and rosette, f. *Ohshimella ehrenbergi*, modified rod, g. *Afrocucumis africana*, lenticulate plate, h. *Phyllophorus (Urodemella) holothurioides*, spinose reduced table in side view, i. *P. (Phyllothuria)* sp. [*Orcula hypsipyriga*: Théel, non von Marenzeller], tall-spired table, j. *Semperiella tenera*, table in side view, k. *Phyrella trapeza*, paratype, table from above. The scale equals 0.1 mm. for a-f and h-k or 0.2 mm. for g.

- 42 Spicules: tables with disc usually having four large holes and four smaller peripheral holes, spire high, two-pillared, terminating in two diverging spines, several bridges joining the pillars at points along their length (fig. 95a; pl. 29, fig. 20); calcareous ring consisting of ten separate pieces; 30 tentacles . . . **MENSAMARIA** H. L. Clark, 1946
- 42' Spicules: tables with two- or four-pillared spire or else derivatives of tables; 20 tentacles . . . 43
- 43 Spicules: two- or four-pillared tables, spire low, medium or high, slender, terminating in several short spines (fig. 95b, b'), branched rods usually present (fig. 95b''); 20 tentacles in two rings . . . **NEOCUCUMIS** Deichmann, 1944
- 43' Spicules: rods derived from tables, with small disc and enormous spire ending in a single spine (fig. 95c) or a cluster of spines (fig. 95d; pl. 30, figs. 6, 7), tables in the introvert with larger disc and shorter spire of two pillars, branched or delicate simple rods present in the introvert and tentacles; 20 tentacles in two or three rings . . . **CLADOLABES** Brandt, 1835
- 44 Tables absent . . . 45
- 44' Tables present . . . 47
- 45 Spicules: thick plates, simple and branched rods . . . 46
- 45' Spicules: spinose, often cruciform rods with spines usually around the middle and at each end of the rod (fig. 95f; pl. 30, fig. 5), compact branched rods also present in the tentacles (pl. 30, fig. 5); calcareous ring

with entire pieces, posterior bifurcate prolongations present on each radial plate only

OHSIMELLA Heding & Panning, 1954

46 Spicules: large lenticulate perforated plates, perforations almost or completely obliterated (fig. 95g; pl. 30, fig. 3); calcareous ring with rather short posterior bifurcate prolongations on the radial plates which are formed of several small pieces

AFROCUCUMIS Deichmann, 1944

46' Spicules: small rounded swollen smooth plates, holes almost or completely obliterated; calcareous ring with some indication of fragmentation of the radials, short posterior bifurcate prolongations present on the radial plates

GLOBOSITA Cherbonnier, 1958

47 Spicules: four-pillared tables or derivatives of these; calcareous ring consisting of ten pieces which are usually themselves compound, posterior bifurcate prolongations present on the radial plates only, no fusion of the radials with the interradials to form a mosaic-like tubular extension of the calcareous ring (fig. 94b); 20 tentacles in two rings

PHYLLOPHORUS Grube, 1840 (with subgenera) 48

47' Spicules: two- to four-pillared tables, perforated plates or spicules absent; calcareous ring with radial and interradial plates either composed of a mosaic of small pieces and fused along their lengths to form a tubular extension of the ring (fig. 94a) or composed of only a few relatively large pieces, with little fusion between the plates, the radial plates each with a compound bifurcate posterior prolongation; 15, 20 or 25 tentacles in two rings. 50

48 Spicules: reduced tables or thorny plates (fig. 95h; pl. 29, fig. 18); calcareous ring with short posterior bifurcate prolongations on the radial plates composed of several rather small pieces (fig. 94b)

PHYLLOPHORUS subgenus *URODEMELLA* Deichmann, 1944

48' Spicules: four-pillared tables, spire low medium or high, tables rarely drastically reduced; calcareous ring with radial plates composed of fewer and rather larger pieces 49

49 Spicules: four-pillared tables, spire high, joined along its length by several bridges and terminating in a group of small spines (fig. 95i; pl. 29, fig. 19) . subgenus *PHYLLOTHURIA* Heding & Panning, 1954

49' Spicules as above but the tables with low spire, the four pillars joined by only one bridge or poorly-developed subgenus *PHYLLOPHORELLA* Heding & Panning, 1954

50 Spicules: four-pillared low-spired tables and plates, present or absent; calcareous ring compact, composed of several large pieces; 15 or 25 tentacles 51

50' Spicules: two- to four-pillared tables, spire low to moderate in height, and perforated plates; calcareous ring composed of a mosaic of small pieces, the posterior extension of each interradial plate fusing with the adjacent radial plates to form a tubular structure (fig. 94a); 15 or 20 tentacles 52

51 Spicules absent from the body wall, except for end plates in the pedicels and papillae; calcareous ring with radial and interradial plates of almost equal length, interradial plates sometimes composed of two or three pieces; 15 tentacles in two rings

THYONIDIELLA Heding & Panning, 1954

51' Spicules: four-pillared low-spired tables; pedicels and papillae with end plates; calcareous ring strong and compact, radial plates with strong posterior bifurcate prolongations composed of a few large pieces; 25 tentacles in two rings

SELENKIELLA Heding & Panning, 1954

52 Spicules: low-spired four-pillared tables with slightly nodular or irregular disc (fig. 95j); 15 tentacles in two rings

SEMPERIELLA Heding & Panning, 1954

52' Spicules: two- to four-pillared tables, or derivatives of such tables, and perforated plates; calcareous ring with elaborate mosaic-like posterior extension; 20 tentacles in two rings 53

53 Spicules: tables with two-pillared spire, which is low to moderate in height terminating in one or two short, usually diverging spines, disc quite regular in outline, perforated plates present or absent

NEOTHYONIDIUM Deichmann, 1938

53' Spicules: tables with four-pillared spire, which is low, usually terminating in a ring of short spines (fig. 95k; pl. 30, figs. 1, 2), perforated plates also present

PHYRELLA Heding & Panning, 1954

54 Spicules: tables, cups, fusiform rods or perforated plates, modified anchors may occur but wheels or sigmoid bodies (modified rods) do not; 15 digitate tentacles; anal papillae, tentacle ampullae and respiratory trees present; body stout, sausage-shaped, usually with a distinct caudal appendage

MOLPADIDA 55

54' Spicules: anchors and anchor-plates, wheels or rods; 10-20 or more pinnate or digitate tentacles; anal papillae, tentacle ampullae and respiratory trees absent; body vermiform with smooth, rough or warty surface

APODIDA 57

55 Spicules: irregular tables and anchors, fusiform or fenestrated plates, sometimes also phosphatic bodies; tentacles with a terminal digit and one to three pairs of lateral digits; caudal appendage usually conspicuous

(MOLPADIIDAE) *MOLPADIA* Cuvier, 1817

55' Spicules: cups (fig. 96a), perforated plates, often doughnut-like with only one hole (fig. 96b), or irregular rods, no phosphatic bodies present; tentacles without a terminal digit and with only one or two pairs of lateral digits; caudal appendage more or less conspicuous

CAUDINIDAE 56

56 Spicules: smooth or spinose thick plates usually with one or sometimes a few holes (fig. 96b; pl. 31, fig. 12); tentacles with only one pair of lateral digits; caudal appendage virtually absent, not conspicuous

ACAUDINA H. L. Clark, 1907

HOLOTHURIOIDEA

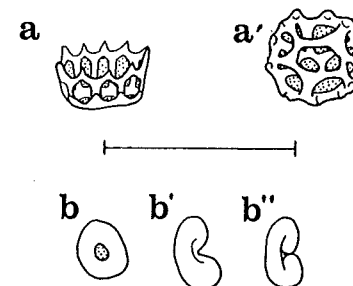


FIG. 96. Spicules of Molpadids: a, a. *Paracaudina chilensis* var. *ransonetti*, cup in side view and spherical body, b, b', b". *Acaudina molpadioides*, doughnut-shaped bodies. The scale equals 0.1 mm.

56' Spicules: cups (fig. 96a), perforated plates, often three-dimensional (fig. 96a) and irregular rods; tentacles with two pairs of lateral digits; caudal appendage conspicuous

PARACAUDINA Heding, 1931

57 Spicules: anchors and anchor-plates (fig. 85j, j'), rods and granules (fig. 85j"), never wheels or sigmoid particles, rarely spicules wanting; tentacles pinnate (fig. 97a) or digitate (fig. 97b), never peltato-digitate

SYNAPTIDAE 58

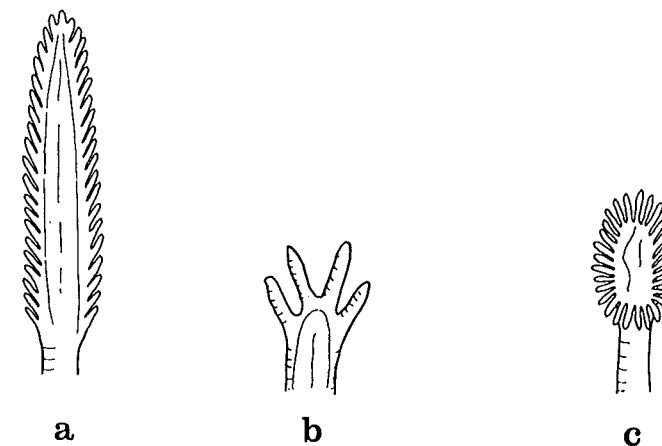


FIG. 97. Tentacles of Apodids: a. *Synaptula* sp., b. *Protankyra* sp. and c. *Polycheira* sp.

57' Spicules: wheels with not more than six spokes (fig. 85i) and sigmoid bodies (fig. 99d), no anchors or anchor-plates; tentacles peltato-digitate (fig. 97c)

CHIRIDOTIDAE 69

58 Spicules: reduced or wanting, probably best described as miliary granules; twelve pinnate tentacles, each with nine to thirteen digits; body covered with small papillae

ANAPTA Semper, 1868

58' Spicules: anchors and anchor-plates, miliary granules also present

59 Arms of anchors smooth, vertex of anchor with minute knob-like projections (figs. 85j', 98b'; pl. 30, fig. 13)

59' Arms of anchors serrate (fig. 98a; pl. 31, fig. 8) or sometimes smooth but vertex always smooth without knobs (fig. 99a', a", b', b")

60 Stock of anchor irregularly branched (fig. 98b'); usually no cartilaginous ring present posterior to the calcareous one

60' Stock of anchor unbranched (fig. 85j'); cartilaginous ring commonly present.

61 Anchor-plates not abruptly contracted at the posterior end but with a large hole on each side (pl. 30, fig. 8); calcareous ring without conspicuous anterior projections; stone canals always few in number (one to three).

EUAPTA Østergren, 1898

61' Anchor-plates abruptly contracted posteriorly thus lacking a large smooth hole on each side (fig. 98b; pl. 30, figs. 10-12); calcareous ring with conspicuous anterior projections; stone canals always very numerous

OPHEODESOMA Fisher, 1907

62 Tentacles numerous, 16-27, usually 25 (pl. 31, fig. 1)

POLYPLECTANA H. L. Clark, 1907

62' Tentacles usually 15 or less

63 Spicules: characteristically large, anchors up to c.900 μ , anchor-plates up to c.650 μ in length, anchor-plates subrectangular or irregular, broad posteriorly with numerous smooth holes (pl. 30, fig. 9)

SYNAPTA Eschscholtz, 1829

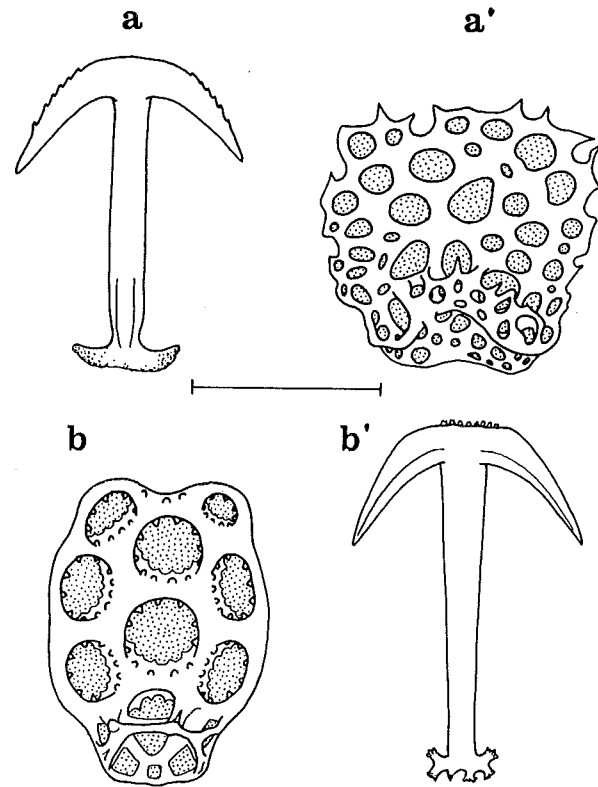


FIG. 98. Spicules of Apodids: a, a'. *Protankyra similis*, anchor and anchor-plate, b, b'. *Opheodesoma kamaranensis*, holotype, anchor-plate and anchor. The scale equals 0.2 mm.

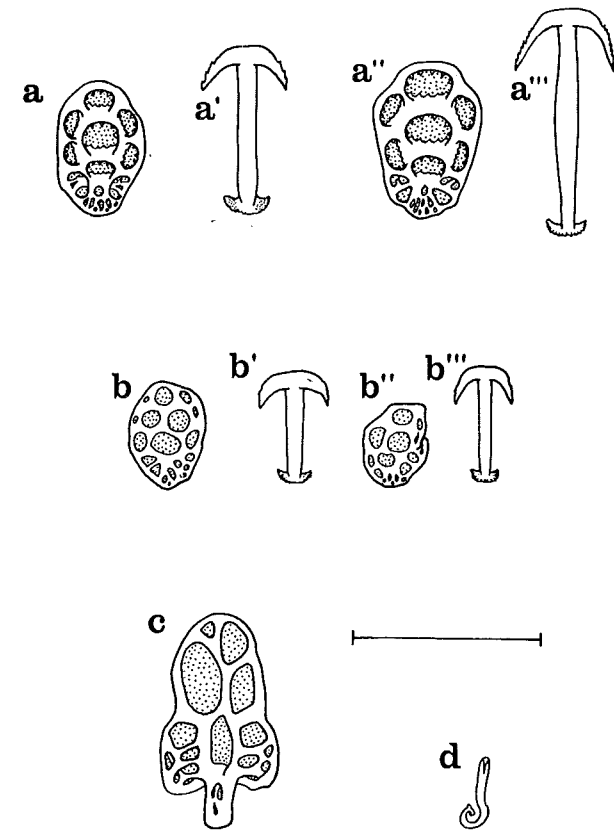


FIG. 99. Spicules of Apodids (continued): a, a', a'', a'''. *Leptosynapta chela*, anchor plate and anchor from anterior end of body and the same from posterior end, b, b', b'', b'''. *Patinapta laevis*, paratype, anchor plates and anchors from anterior and posterior ends, c. *Labidoplax dubia*, anchor plate, d. *Trochodota maculata*, sigmoid body (from H. L. Clark). The scale equals 0.2 mm.

- 63' Spicules: size diverse but never particularly large, anchors rarely exceeding 400 μ or anchor-plates 300 μ in length, anchor-plates rounded anteriorly and narrowing posteriorly, with a few holes and these generally regularly arranged and toothed (pl. 30, figs. 13-16) 64
- 64' Miliary granules when present (absent in one species and in the form of rings of minute granules in three others, probably as a result of partial dissolution in preservation) having the form of curved knobbed rods (fig. 85j''), never resembling irregularly dichotomously-branched granules *SYNAPTULA* Ørsted, 1849
- 64' Miliary granules irregularly and dichotomously branched *PENDEKAPLECTANA* Heding, 1931
- 65' Tentacles pinnate with five to twenty-one (usually more than seven) digits or simply pinnately notched without proper digits 66
- 65' Tentacles digitate with three to five digits 67
- 66' Spicules often slightly different in the two ends of the body, both anchors and anchor-plates from the posterior end being larger than the corresponding anterior ones (fig. 99a, a', a'', a'''), anchor-plates normally with seven large toothed holes, a well-defined bridge lacking (fig. 99a, a''); one to nine pairs of digits to each tentacle *LEPTOSYNAPTA* Verrill, 1867
- 66' Spicules very characteristic, the anchors from the anterior end of the body always shorter and with thicker arms than those from the posterior end (fig. 99b, b', b'', b'''; pl. 31, figs. 2, 3) but anchor-plates larger in the anterior part of the body than posteriorly (fig. 99b, b''; pl. 31, figs. 2, 3), anchor-plates usually with more than seven holes, mostly smooth though the larger ones often toothed; four to five pairs of digits to each tentacle *PATINAPTA* Heding, 1928
- 67' Anchor-plates ovate and irregular with numerous small smooth or toothed holes (fig. 98a'), not narrowed into a 'handle' posteriorly (pl. 31, figs. 5-8) *PROTANKYRA* Østergren, 1898
- 67' Anchor-plates subrectangular in outline, more or less narrowed into some sort of 'handle' posteriorly, central holes of the plate generally larger than those at each end 68
- 68' Anchor plates with a distinct 'handle' posteriorly, all holes of the plates rather large and irregular (fig. 99c; pl. 31, fig. 4); no eye spots present on the oral disc *LABIDOPLAX* Østergren, 1898
- 68' Anchor plates without a distinct posterior 'handle' though a suggestion of one can be seen on some of the larger plates, two central holes of the plates usually conspicuously larger than those at each end; eye spots present on the oral disc (one between each of the twelve tentacles) *RYNKATORPA* Rowe & Pawson, 1967
- 69' Wheels scattered throughout the skin, not collected into wheel papillae, sigmoid bodies present (fig. 99d) *TROCHODOTA* Ludwig, 1892

- 69' Wheels present in small papillae, no sigmoid bodies present 70
- 70' Tentacles twelve (ten to fourteen); ciliated funnels single and scattered or at most in small clusters (fig. 100a; pl. 31, figs. 9, 10) *CHIRIDOTA* Eschscholtz, 1829

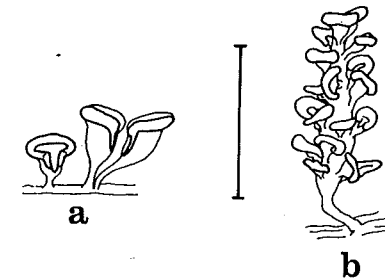


FIG. 100. Arrangement of ciliated funnels in Chiridotids: a. *Chiridota liberata* and b. *Polycheira rufescens*. The scale equals 0.2 mm.

- 70' Tentacles eighteen (sixteen to twenty); ciliated funnels always collected into stalked clusters which are often quite large (fig. 100b; pl. 31, fig. 11) *POLYCHEIRA* H. L. Clark, 1907

SUMMARY OF TAXONOMIC CHANGES—HOLOTHURIOIDEA

Actinopyga plebeja (Selenka, 1867), restored to specific rank from synonymy of *A. echinites* (Jaeger)—see note 1.
Bohadschia bivittata (Mitsukuri, 1912), restored to specific rank from a subspecies of *B. marmorata* Jaeger—see note 2.
Bohadschia koellikeri (Semper, 1868), restored to specific rank from synonymy of *B. marmorata* Jaeger—see note 3.
Fossothuria and *Jaegerothuria* Deichmann, 1958, considered to be junior subjective synonyms of *Cystipus* Haacke, 1880—see note 4.

- Pentathyone*(?) *novacorona* Cherbonnier, 1960, referred to *Havelockia*—see note 11.
Athyone (formerly *Cucumaria* or *Thyone*) *transitoria* (Vaney, 1905), referred to *Havelockia*—see note 12.
Pseudocnus (formerly *Cucumaria*) *bacilliformis* (Koehler & Vaney, 1908), referred to *Leptopentacta*—see note 13.
Apentacta H. L. Clark, 1946, a synonym of *Plesiocolochirus* Cherbonnier, 1946—see note 15.
Pentacta arae Boone, 1938, referred to *Pseudocolochirus*—see note 17.
Paracucumaria (formerly *Cucumaria*) *tricolor* (Sluiter, 1901), referred to *Pseudocolochirus*—see note 18.
Havelockia (formerly *Cucumaria*) *conjugens* (Semper, 1868), referred to *Stolus*—see note 19.
Thyone(?) *sluiteri* Lampert, 1889, a synonym of *Neocucumis proteus* (Bell, 1884)—see note 23.

SUMMARY OF RELATIONSHIPS NEEDING FURTHER INVESTIGATION

- Holothuria fuscoolivacea* Fisher, 1907, *ludwigi* Lampert, 1889 and *olivacea* Ludwig, 1888—see note 7.
Holothuria kurti Ludwig, 1889–1892 and *squamifera* Semper, 1868—see note 8.
Stichopus anapinusus (Lampert, 1885) and *mollis* Hutton, 1872—see H. L. Clark, 1922.
Stichopus paradoxus Lampert, 1885 and *Holothuria leucospilota* Brandt, 1835—see H. L. Clark, 1946.
Pentacta arae Boone, 1938 and *Pseudocolochirus violaceus* (Théel, 1886)—see note 17.
Phyllophorus (*Urodemella*) *brocki* Ludwig, 1888 and *Thyone curvata* Lampert, 1885—see note 20.