

Dendrochirote and dactylochirote sea cucumbers (Echinodermata: Holothuroidea) of China, with descriptions of eight new species

Yulin Liao and David L. Pawson

(YL) Institute of Oceanology, Academia Sinica, 7 Nanhai Road,
Qingdao, 266071 People's Republic of China;

(DLP) National Museum of Natural History, Smithsonian Institution, Mail Stop MRC163,
Washington D.C. 20560-0163, U.S.A.

Abstract.—The dendrochirote and dactylochirote holothurian fauna of China is now known to comprise 56 species in 16 genera. An annotated checklist of species is included here. Eight species are described as new: *Actinocucumis chinensis*, *Phyllophorus (Phyllothuria) donghaiensis*, *P. (Isophyllophorus) orientalis*, *Neothyonidium spiniferum*, *Stolus crassus*, *S. micronodosus*, *Thyone purpureopunctata* and *T. sinensis*. *Phyllophorus (Isophyllophorus)*, a new subgenus, is also diagnosed. Preliminary analysis reveals that affinities of the dendrochirote/dactylochirote fauna lie with the tropical Indo-West-Pacific, for approximately 70% of the species are more or less widely distributed in the Indo-West-Pacific. Ten species are now known from the Yellow Sea, 26 from the East China Sea, and 39 from the South China Sea.

Until recently, the dendrochirote and dactylochirote holothurians of China have not been studied as a group. There are a number of scattered records in publications by Chang (1934, 1935, 1943, 1948), Yang (1937), Chang et al. (1964). Other records can be found in Liao & Clark (1995) and Liao (1997). In the present paper an attempt is made to list all of the dendrochirotes and dactylochirotes currently known from China. Eight new species are described, and new material sheds light on the systematic status of 14 already-described species. A new phyllophorid subgenus is also defined. Broad distribution patterns are briefly discussed. The classification of the Dendrochirotida and Dactylochirotida employed here is that of Pawson & Fell (1965). Type and other specimens are deposited at the Institute of Oceanology, Academia Sinica (IOAS), Qingdao, People's Republic of China. A few type specimens and some non-type material are deposited at the USNM, as noted in the text.

Y. L. is grateful to the Short-Term Visitor

Program of the Office of Fellowships and Grants, Smithsonian Institution, which enabled him to study holothurians of China and elsewhere at the National Museum of Natural History (USNM), Smithsonian Institution, in September 1992 and October 1994. This is Contribution No. 2769 from the Institute of Oceanology, Academia Sinica, Qingdao.

Order Dendrochirotida

Family Cucumariidae Ludwig, 1894
Subfamily Thyonidiinae Heding &
Panning, 1954

Actinocucumis chinensis, new species

Fig. 1

Material examined.—Holotype IOAS E1064, off Sanya, Hainan Island, 18°N, 109°E, 14 May 1960, 45 m, shelly sand.

Diagnosis.—Small form, length 25 mm, with stout, barrel-shaped body. Tubefeet large, restricted to five double rows in radii. Tentacles 20, varying in size, in a single ring. Calcareous ring simple, no posterior projections. Color in alcohol uniformly

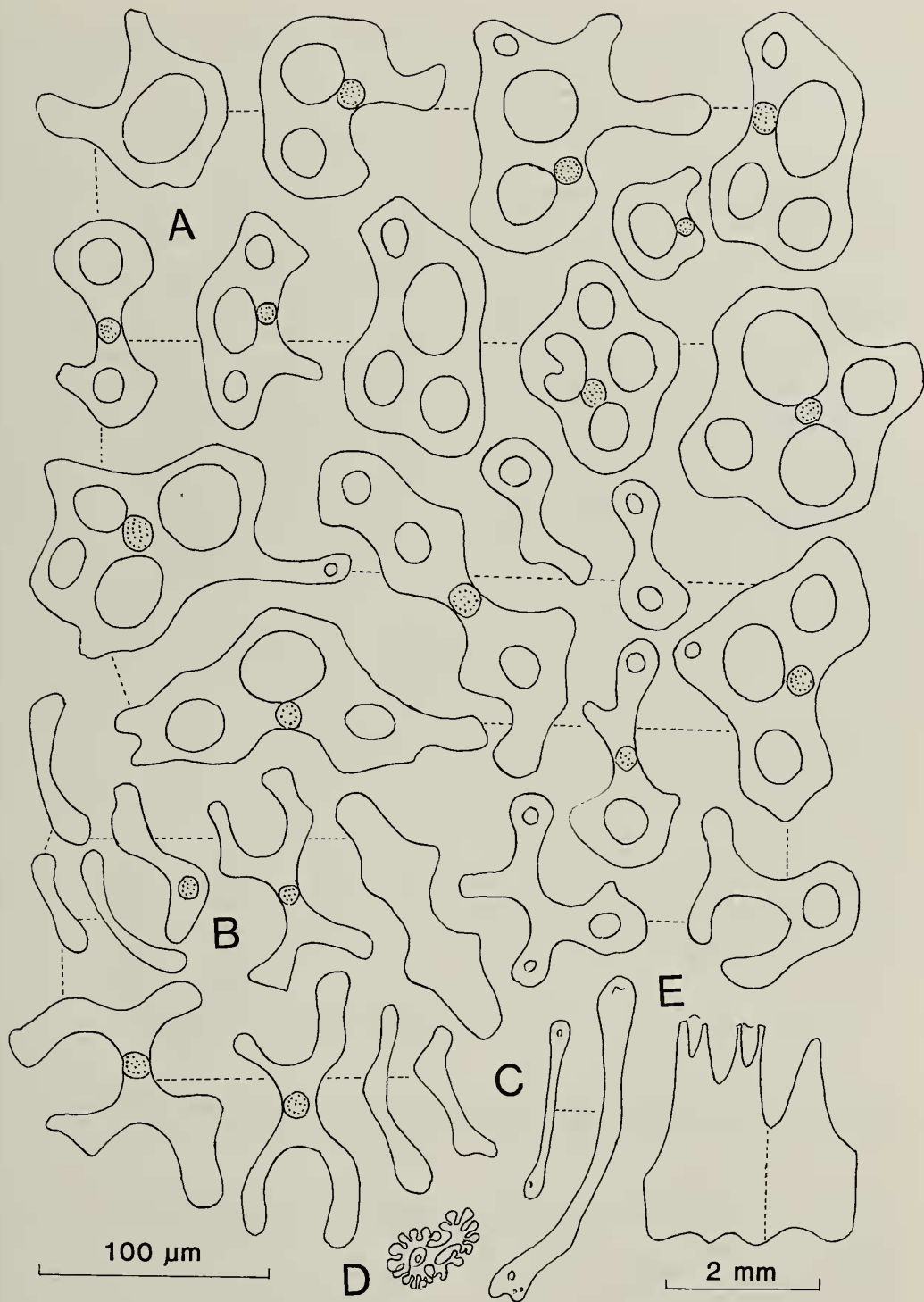


Fig. 1. *Actinocucumis chinensis* new species. A, perforated plates from body wall; B, rods from body wall; C, rods from tentacles; D, rosette from introvert; E, radial and interradial pieces of calcareous ring.

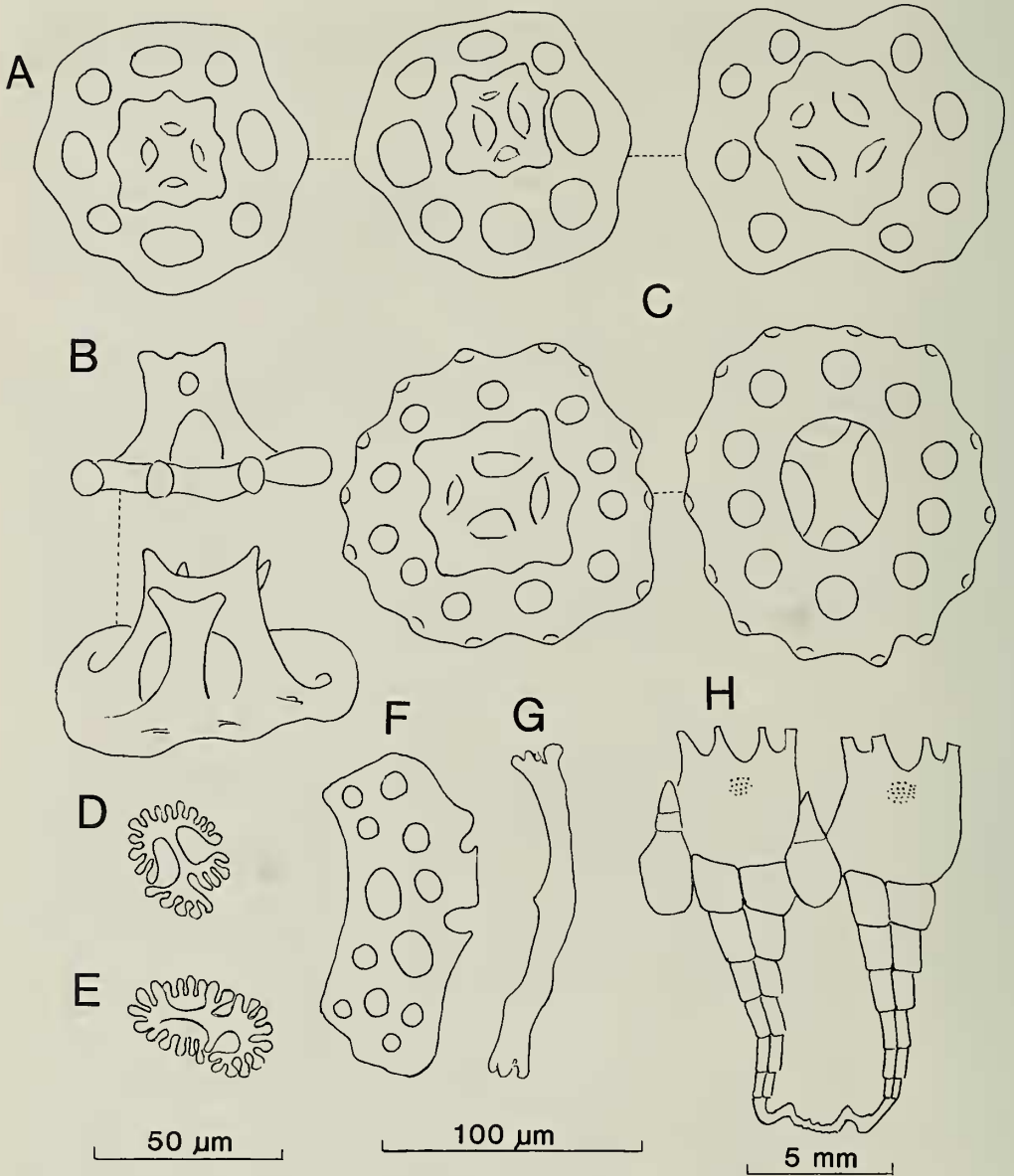


Fig. 2. *Anthochirus loui* Chang. A, tables from body wall; B, lateral view of tables from body wall; C, tables from posterior end; D, rosette from tentacles; E, rosette from introvert; F, perforated plate from tube feet; G, rod from tentacles; H, radial and interradial pieces of calcareous ring.

brown. Body wall ossicles irregular perforated plates and rods.

Description.—Total length 25 mm, diameter 15 mm. Body barrel-shaped, rounded anteriorly and posteriorly. Tentacles 20, of unequal size, in a single ring. Large tubefeet arranged in five double rows in radii;

feet absent from interradial. Anus surrounded by five minute papillae. Calcareous ring simple, without posterior projections (Fig. 1E). Single Polian vesicle and stone canal. Body wall thin, soft, with numerous ossicles of diverse forms, usually as perforated plates and rods. Plates very numerous, 50–

170 μm long and 35–100 μm wide, very variable in shape and number of perforations (Fig. 1A). Rods (precursors of plates, probably) 40–110 μm long, variable in shape, often X-shaped (Fig. 1B). Plates and rods often bear a knob on their surface. Tubefeet with well-developed end plates and no other ossicles. Tentacles with rosettes and supporting rods of variable size (Fig. 1C). Introvert with rosettes (Fig. 1D).

Remarks.—The combination of characters—number of tentacles, simple calcareous ring and arrangement of tube feet place this specimen in the genus *Actinocucumis* Ludwig. In their monograph of the Phyllophoridae as it was then characterized, Heding and Panning (1954) noted that *Actinocucumis* was monotypic, containing the single species *A. typicus* Ludwig. The new species differs from *A. typicus* in the structure of its ossicles; those of *A. typicus* are figure-eight shaped fenestrated ellipsoids and irregular tables with a strong four-pillared spire (Clark & Rowe 1971). Further investigation of a wider range of material may require that these two species be referred to separate genera, but for the present it is preferred that they remain within the genus *Actinocucumis*.

Family Phyllophoridae Östergren, 1907

Subfamily Phyllophorinae Östergren, 1907

Anthochirus loui Chang

Figs. 2, 20F, G

Anthochirus loui Chang, 1948:79–80, text fig. 21, pl. 10 figs. 6–8; Chang et al., 1964:29.

Material examined.—Yellow Sea, 33°30'N, 122°30'E, 36 m, 4 specimen; Yellow Sea, 33°N, 123°E, 57 m, 2 specimens; Yellow Sea, 33°N, 123°15'E, 1 specimen.

Diagnosis.—Medium-sized form, about 50 mm in total length. Body slender, tubefeet numerous, scattered on body wall. Tentacles 30, of variable size, in two rings, outer ring with 20 tentacles, inner ring with 10. Calcareous ring compact; radials with well-developed posterior projections composed of 5–8 pieces;

interradials much smaller than radials, more or less pentagonal, anterior end often composed of one or two small pieces. Ossicles in body wall sparsely scattered four-pillared and low-spired tables (Fig. 2A, B).

Remarks.—This remarkable holothurian was described by Chang in 1948 on the basis of four fragmentary specimens taken in the vicinity of Qingdao in about 20–30 m. It was a great pleasure to study seven entire specimens from the Yellow Sea, collected at depths between 33 and 57 meters. In his original description, Chang (1948:79) noted that “no deposits can be detected in body wall”. Our material has sparsely scattered ossicles (Fig. 2A, B) in the form of tables with low four-pillared spires, and re-examination of Chang’s type-material showed that he had overlooked the scattered ossicles. Tables in mid-body have smooth discs; those from the posterior end (Fig. 2C) have some small marginal knobs. Introvert with rosettes (Fig. 2E). Tube feet have perforated plates (Fig. 2F). Tentacles with rods (Fig. 2G) and rosettes (Fig. 2D). Details of the calcareous ring are illustrated here (Fig. 2H); posterior projections of present material are more delicate than those illustrated by Chang (1948).

In the structure of the ossicles, *Anthochirus* resembles *Selenkiella* Heding & Panning (1954), but *Anthochirus* differs in having more numerous tentacles and a more compact calcareous ring with single rather than bifurcated “tails” on the radial pieces.

Phyllophorus (Phyllophorella) dubius

Cherbonnier

Figs. 3, 20A

Phyllophorus (Phyllophorella) dubius Cherbonnier, 1960:434, fig. 5c–k, fig. 6a–b; Clark & Rowe, 1971:184.

Phyllophorus (Phyllophorella) kohkutiensis (in part).—Liao & Clark, 1995:508, fig. 309. Non: *Phyllophorus (Phyllophorella) kohkutiensis* Heding & Panning, 1954.

Material examined.—Gulf of Tonkin, 20°15'N, 108°E, 50 m, 1 specimen; Gulf of Tonkin, 20°15'N, 108°30'E, 57 m, 1 speci-

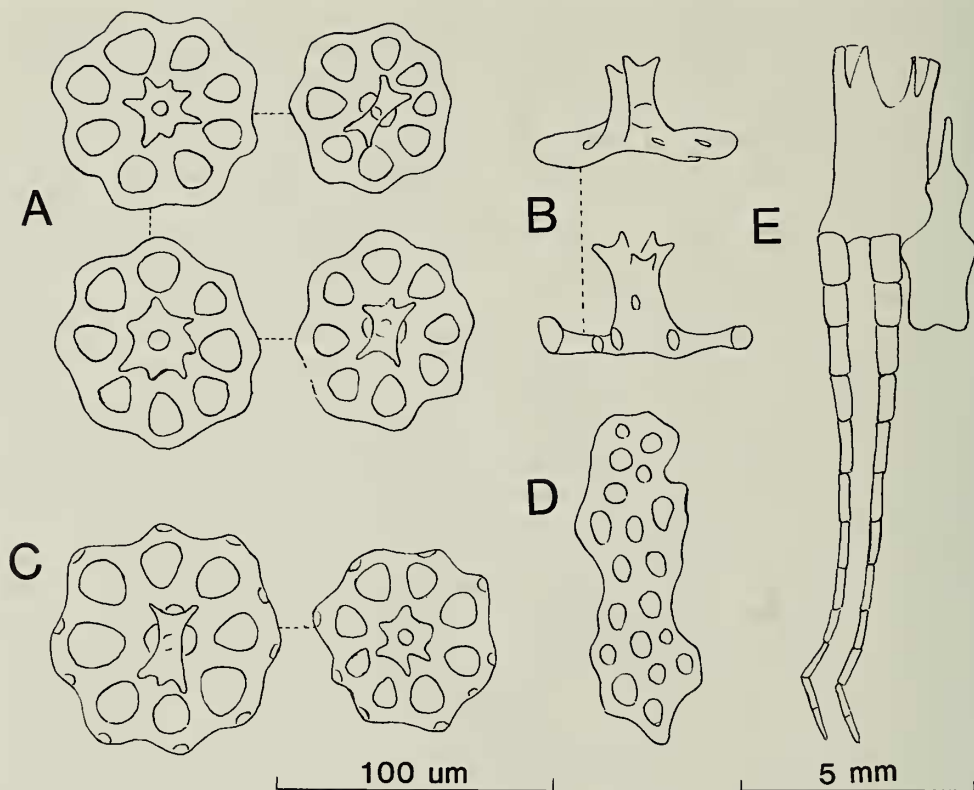


Fig. 3. *Phyllophorus* (*Phyllophorella*) *dubius* Cherbonnier. A, tables from body wall; B, tables from body wall, lateral view; C, body wall tables with marginal knobs; D, perforated plate from tube feet; E, radial and interradial pieces of calcareous ring.

men; Gulf of Tonkin, 18°N, 107°E, 63 m, 1 specimen; Gulf of Tonkin, 19°45'N, 108°30'E, 62 m, 1 specimen; Gulf of Tonkin, 19°45'N, 108°E, 63 m, 2 specimens; off Hainan Island, 19°45'N, 111°15'E, 106 m, 1 specimen; off southern end of Hainan Island, 17°30'N, 110°E, 125 m, 1 specimen; off Shanchuan Island, 21°15'N, 113°E, 43 m, 1 specimen; off Macao, 21°15'N, 113°30'E, 51 m, 1 specimen; off Macao, 21°30'N, 113°45'E, 43 m, 1 specimen; Taiwan Strait, 24°30'N, 119°45'E, 50 m, 6 specimens.

Diagnosis.—Small form, total length up to 50 mm, with spindle-shaped body. Tentacles 20, of varying size. Fine tube feet scattered on body wall. Calcareous ring with very long posterior projections on radials, each column composed of about 10 small pieces. Ossicles in body wall tables

with circular disc perforated by eight holes (Fig. 3A–C); margin often knobbed; low four-pillared spire crowned by eight sharp teeth. Tube feet with flat plates (Fig. 3D).

Remarks.—These are undoubtedly representatives of the species originally described by Cherbonnier (1960) on the basis of a small and incomplete specimen from Vietnam. Our material ranged in length from 6–45 mm, and in diameter from 9–12 mm. Chinese specimens were previously confused with *Phyllophorus* (*Phyllophorella*) *kohkutiensis* Heding & Panning, 1954 (see Liao & Clark 1995, p. 508), but the calcareous rings (Fig. 3E, 4E) of the two species are quite different. The body wall ossicles of *P.* (*P.*) *kohkutiensis* are similar to those of the present species, but the posterior projections on the radials of the cal-

careous ring are decidedly shorter and broader. The localities given here extend the known distribution area, and it is likely that this species will prove to be more widespread in the Indo-west-Pacific region.

Phyllophorus (Phyllophorella)
kohkutiensis Heding & Panning
Figs. 4, 20B

(?) *Thyonidium cebuense*. Theel, 1886:95, pl. 9 fig. 4 (Non *T. cebuense* Semper, 1868)

Phyllophorus (Phyllophorella) kohkutiensis Heding & Panning, 1954:156, fig. 69; Liao & Clark, 1995:508, fig. 309 (in part).

Phyllophorus (Phyllophorella) cebuense.—Cherbonnier, 1960:431, fig. 4b–i, fig. 5a–b (Non *T. cebuense* Semper, 1868).

Material examined.—Gulf of Tonkin, 20°30'N, 108°30'E, 46 m, 1 specimen; Gulf of Tonkin, 19°N, 108°30'E, 36 m, 1 specimen; Gulf of Tonkin, 20°15'N, 108°E, 45 m, 2 specimens; Gulf of Tonkin, 20°N, 108°E, 53 m, 1 specimen; Gulf of Tonkin, 20°15'N, 108°E, 42 m, 1 specimen; Gulf of Tonkin, 20°30'N, 107°30'E, 32 m, 1 specimen.

Diagnosis.—Small form, 20 mm in length, body crescent-shaped, often stout. Tentacles 20, in three circles 10 + 5 + 5. Calcareous ring compact, radials with short posterior projections, composed of about five pieces (Fig. 4E). Ossicles in body wall exclusively tables, sparsely scattered, with smooth disc with one central and eight peripheral holes; spire low, slender, with several blunt apical teeth (Fig. 4A–C). Tube feet with flat plates (Fig. 4D).

Remarks.—Some confusion has surrounded this species. On account of tables with high spires and several crossbars, Heding & Panning (1954) referred *cebuense* to their new subgenus *Phyllothuria* Heding & Panning, 1954. Cherbonnier (1960) referred a specimen from Vietnam with a single crossbar on spires of the tables to the subgenus *Phyllophorella*. Heding & Panning

were correct in referring specimens with high spires and several crossbars to *cebuense*, while specimens with low spires and a single crossbar on the tables are actually *kohkutiensis*. Cherbonnier's (1960) specimen is conspecific with *kohkutiensis* from Thailand. The seven specimens from the Gulf of Tonkin agree completely with the description and figures of *kohkutiensis* (Heding & Panning, 1954). Thus the species is now known from Vietnam, Thailand, and the Gulf of Tonkin.

Phyllophorus (Phyllothuria) cebuensis
(Semper)
Fig. 5

Thyonidium cebuense Semper, 1868:67, Pl. 12 fig. 5, pl. 13 fig. 25, pl. 15 fig. 8; Lampert, 1885:173.

Phyllophorus cebuensis.—Ludwig, 1892:347; Sluiter, 1901:112; Pearson, 1903:144, pl. 2 fig. 22–24; Clark, 1946:409.

Phyllophorus (Phyllothuria) cebuensis.—Heding & Panning, 1954:147, fig. 62; Liao, 1997:210, fig. 125.

(Non *Thyonidium cebuensis* Théel, 1886:95, 146, pl. 9 fig. 4; Sluiter, 1914:15, fig. 10; Clark, 1938:487; Cherbonnier, 1960:431, fig. 4b–i, fig. 5a–b).

Material examined.—off Hong Kong, 21°30'N, 113°30'E, 42 m, 1 specimen; off Hainan Island, 18°15'N, 110°30'E, 125 m, 1 specimen.

Diagnosis.—Small form, approximately 30 mm in length, with scattered tube feet. Tentacles 20, varying in size, in two rings, outer ring with 15, inner ring with five tentacles. Calcareous ring with posterior projections on radials, each column consisting of four pieces (Fig. 5E). Ossicles in body wall exclusively four-pillared tables with circular disc perforated by large central and eight peripheral holes (Fig. 5A); spire high, with 2–5 crossbars (Fig. 5B), crowned by numerous closely crowded teeth. Tube feet with plates (Fig. 5D), and tables (Fig. 5C).

Remarks.—Material consists of two small specimens 25 and 16 mm in length.

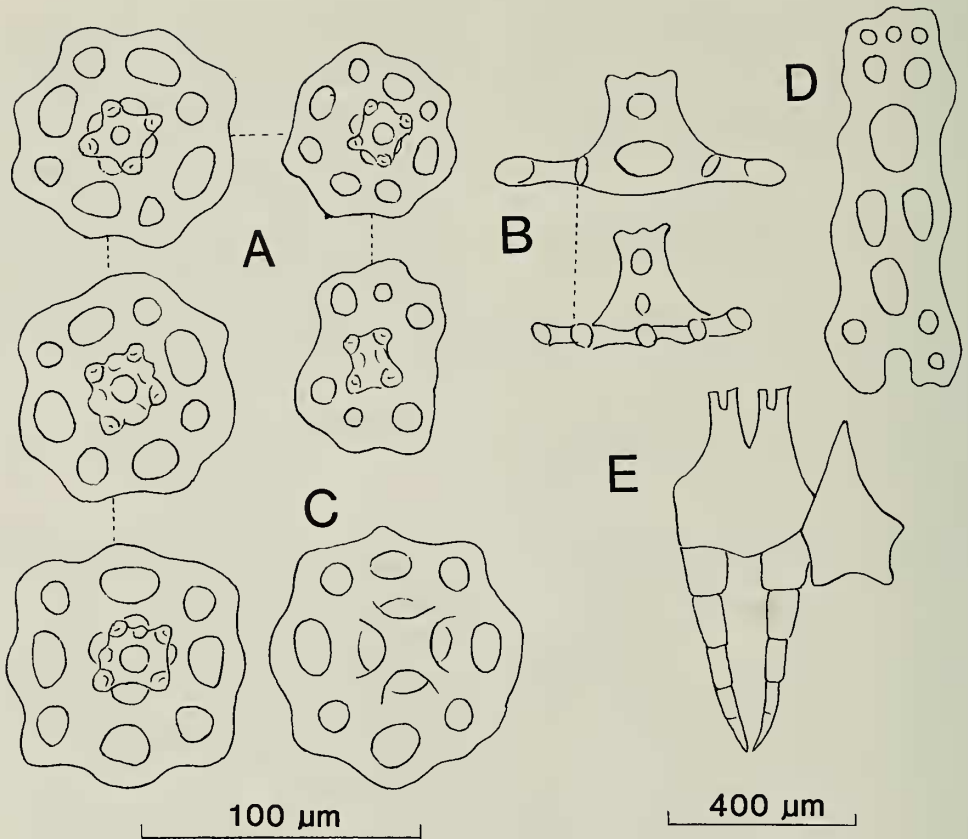


Fig. 4. *Phyllophorus (Phyllophorella) kohkutiensis* Heding & Panning A, tables from body wall; B, tables from body wall, lateral view; C, inner surface of body wall table; D, perforated plate from tube feet; E, radial and interradial pieces of calcareous ring.

They agree perfectly with the specimens recorded by Heding & Panning (1954) from Thailand and the Kei Islands. The species is now known from the Philippines, Sri Lanka, Thailand, Indonesia and China.

Phyllophorus (Phyllothuria) donghaiensis,
new species
Figs. 6, 20C

Material examined.—Holotype IOAS E1075, East China Sea, 30°30'N, 127°E, 1 Jul 1978, 100 m, sand and broken shell bottom.

Diagnosis.—Medium-sized form, 45 mm in total length, with spindle-shaped body. Body wall rigid, filled with ossicles. Tube

feet numerous, conical, papilliform and scattered on body wall. Calcareous ring small, radials with short posterior projections, each made up of four pieces. Ossicles in body wall four-pillared tables with 18–30 perforations. Tube feet ossicles tables with disc forming two to five lobes.

Description.—Body spindle-shaped, slightly curved, gently tapering towards ends. Length along dorsal surface 45 mm, along ventral surface 56 mm; diameter at middle 20 mm. Tentacles 20 in two rings, outer ring with 15, inner with 5. Tube feet numerous, conical, papilliform, and scattered all over body. Anus surrounded by five groups of small papillae. Body wall

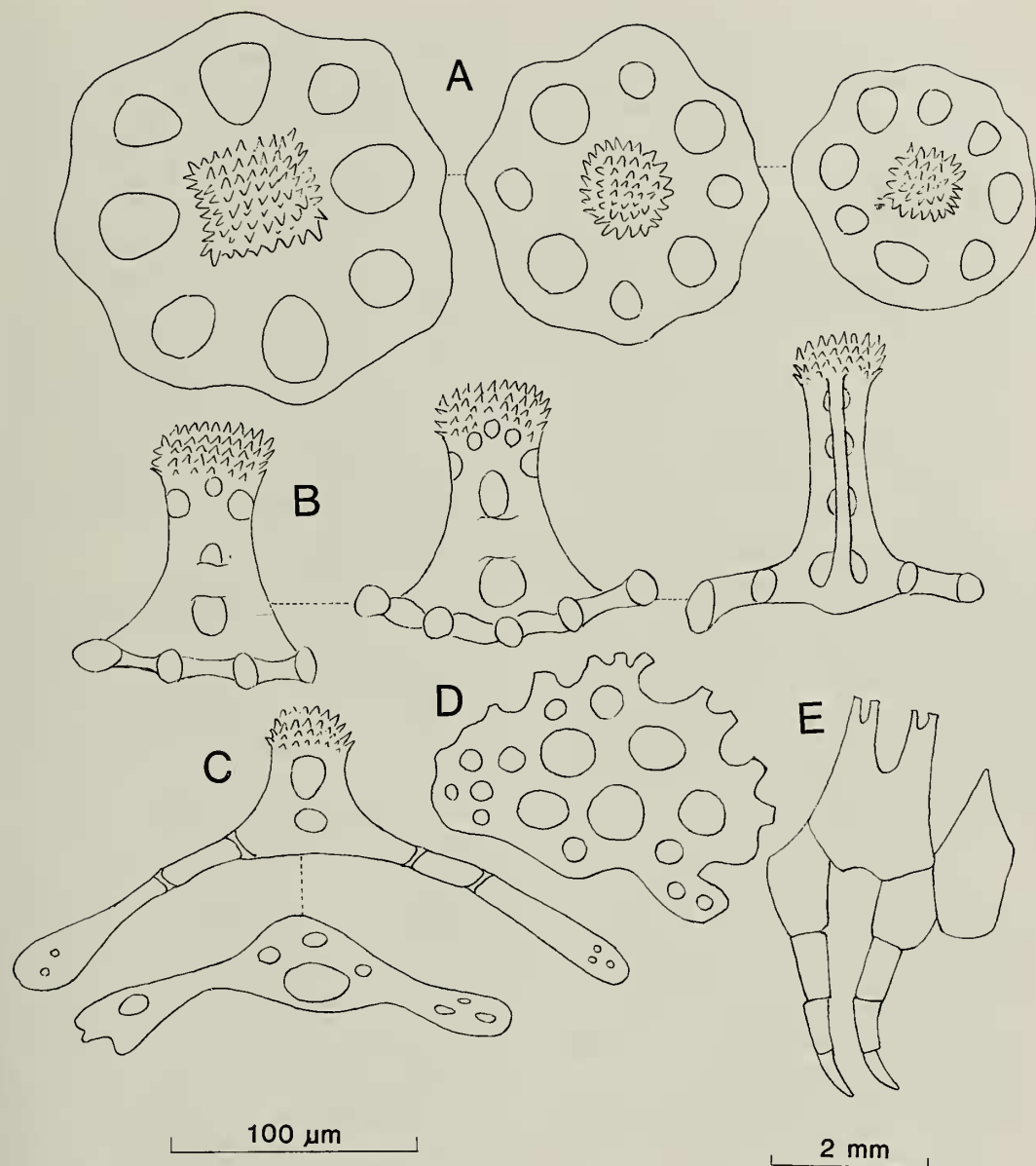


Fig. 5. *Phyllophorus (Phyllothuria) cebuensis* (Semper). A, tables from body wall; B, tables from body wall, lateral view; C, tables from tube feet; D, perforated plate from tube feet; E, radial and interradial pieces of calcareous ring.

rigid, rough. Calcareous ring small, total height 5 mm, radials with short posterior projections, each composed of four pieces; interradials pentagonal, anteriorly tapering to a point (Fig. 6H). One Polian vesicle; no stone canal detected. Ossicles abundant in body wall, four-pillared tables (Fig. 6A)

with circular discs perforated by 18–30 holes; spire high with two crossbars, crowned by about eight teeth (Fig. 6B). Ossicles in tube feet irregular tables with disc forming two to five lobes; spire high with two to five crossbars, crowned by about eight teeth (Fig. 6C, D). Disc diameter

100–200 μm , height of spire 60–80 μm . Introvert with numerous rosettes (Fig. 6G). Tentacles with large supporting rods (Fig. 6E) and less common minute rods (Fig. 6F). Color in alcohol grayish, more or less whitish ventrally.

Remarks.—This is one of the most distinctive species in the family. Its ossicles are unique. The lobed extensions of the discs in the tube feet ossicles are reminiscent of species in the genus *Thorsonia* (Thyoninae).

Subfamily Phyllophorinae Heding & Panning, 1954

Genus *Phyllophorus* Grube, 1840

Remarks.—In their revision of the Phyllophoridae, Heding & Panning (1954) referred three genera to the Subfamily Phyllophorinae, and the genus *Phyllophorus* Grube, 1840 was diagnosed as having 20 tentacles (15 + 5), and towers or rosettes in the body wall. We wish to expand the concept of the genus to include a new subgenus, which has 20 tentacles in a single ring.

Isophyllophorus, new subgenus

Diagnosis.—Tentacles 20, subequal, arranged in single circle. Ossicles in body wall four-pillared tables with high spire; disc irregular, with marginal knobs.

Type species.—*Phyllophorus (Isophyllophorus) orientalis* new species.

Remarks.—See under description of *Phyllophorus (Isophyllophorus) orientalis* new species.

Phyllophorus (Isophyllophorus) orientalis,
new species
Figs. 7, 20D, E

Material examined.—Holotype IOAS E1058, Yellow Sea, 33°N, 123°30'E, 4 Jul 1959, 41 m, sandy mud, grab sample.

Diagnosis.—Medium-sized form, total length about 40 mm. Tentacles 20, subequal, in single circle. Color in alcohol grayish-white, tube feet brownish. Calcareous ring

small, low, posterior projections on radials composed of five small pieces. Ossicles in body wall four-pillared tables; disc irregular with numerous perforations and with few marginal knobs; spire high with three crossbeams, crowned by numerous teeth.

Description.—Body nearly cylindrical, 38 mm long, 12 mm in diameter, tapering towards posterior end. Tentacles 20, fully expanded, subequal, arranged in single circle. Tube feet numerous, contracted, scattered over body. Calcareous ring small, low, total height 4.5 mm; radials with posterior projections composed of five small pieces (Fig. 7F); interradials relatively large, pentagonal. Anus surrounded by five groups of papillae. Body wall thick, transversely wrinkled, rough to touch, with numerous ossicles.

Ossicles in body wall numerous tables with large disc 120–300 μm across, highly variable in shape and in number of perforations; all have few marginal knobs (Fig. 7A, B). Spire high, 70–120 μm , with four pillars, three crossbars and numerous apical teeth (Fig. 7C). In tube feet ossicles similar to those in body wall; no obvious endplate. Few rosettes in introvert (Fig. 7D). Tentacles with robust supporting rods (Fig. 7E).

Remarks.—The unique specimen differs from all other phyllophorus-like holothurians, and must be placed in a distinct subgenus as defined above. In most phyllophorids with 20 tentacles the tentacles are arranged in two circles. Only Pawson (1970) reported *Neothyonidium* species from New Zealand as having 20 tentacles in a single ring, but in that case the ossicles had two-pillared spires.

Subfamily Semperiellinae Heding & Panning, 1954

Neothyonidium inflatum (Sluiter)
Fig. 8

Phyllophorus inflatus Sluiter, 1901:114, pl. 2 fig. 10, pl 6 fig. 16.

Neothyonidium inflatum.—Heding & Panning, 1954:1293, fig. 95.

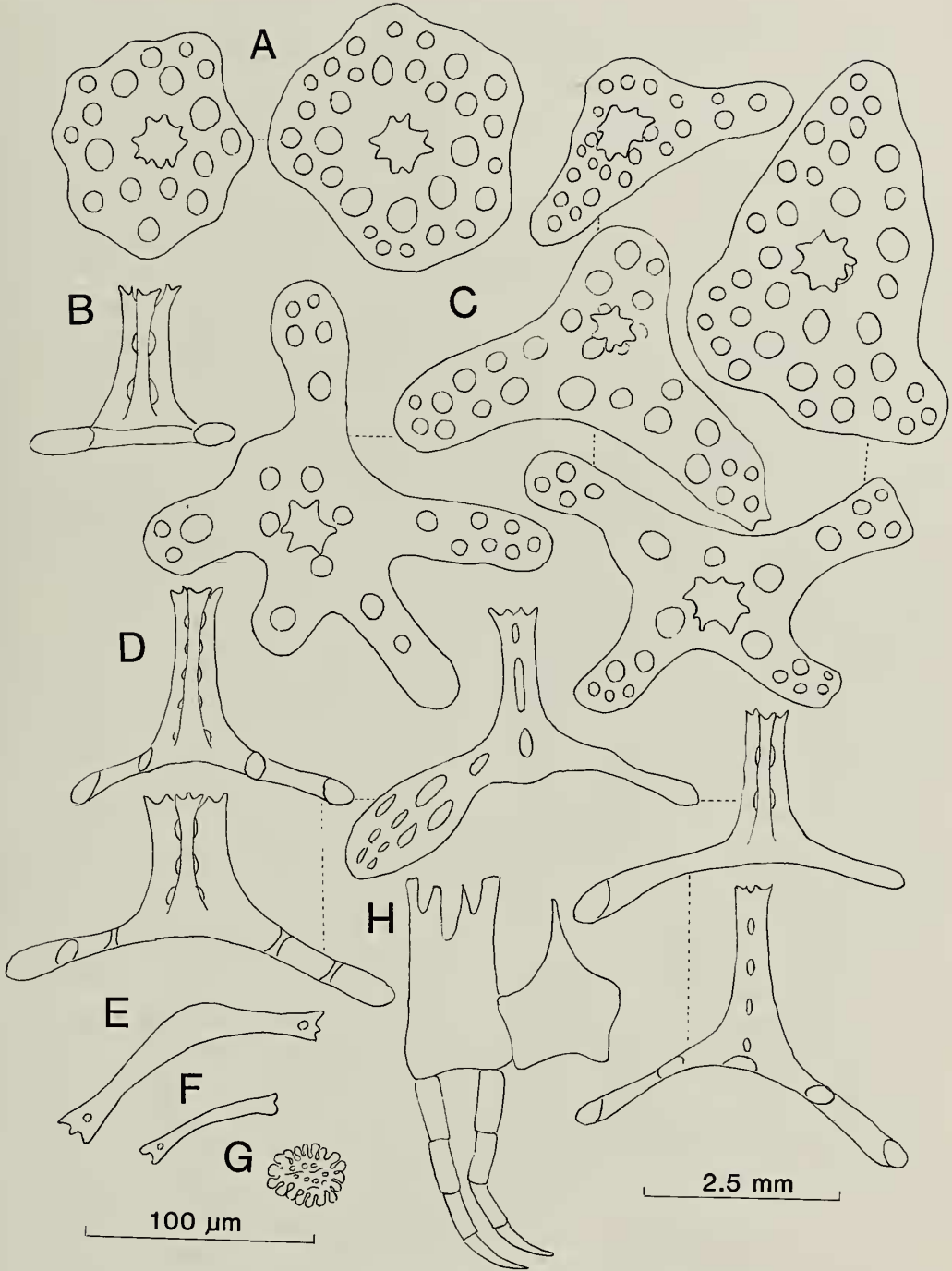


Fig. 6. *Phyllophorus (Phyllothuria) donghaiensis* new species. A, Tables from body wall; B, tables from body wall, lateral view; C, tables from tube feet; D, tables from tube feet, lateral view; E, rod from tentacles; F, minute rod from tentacles; G, rosette from introvert; H, radial and interradial pieces of calcareous ring.

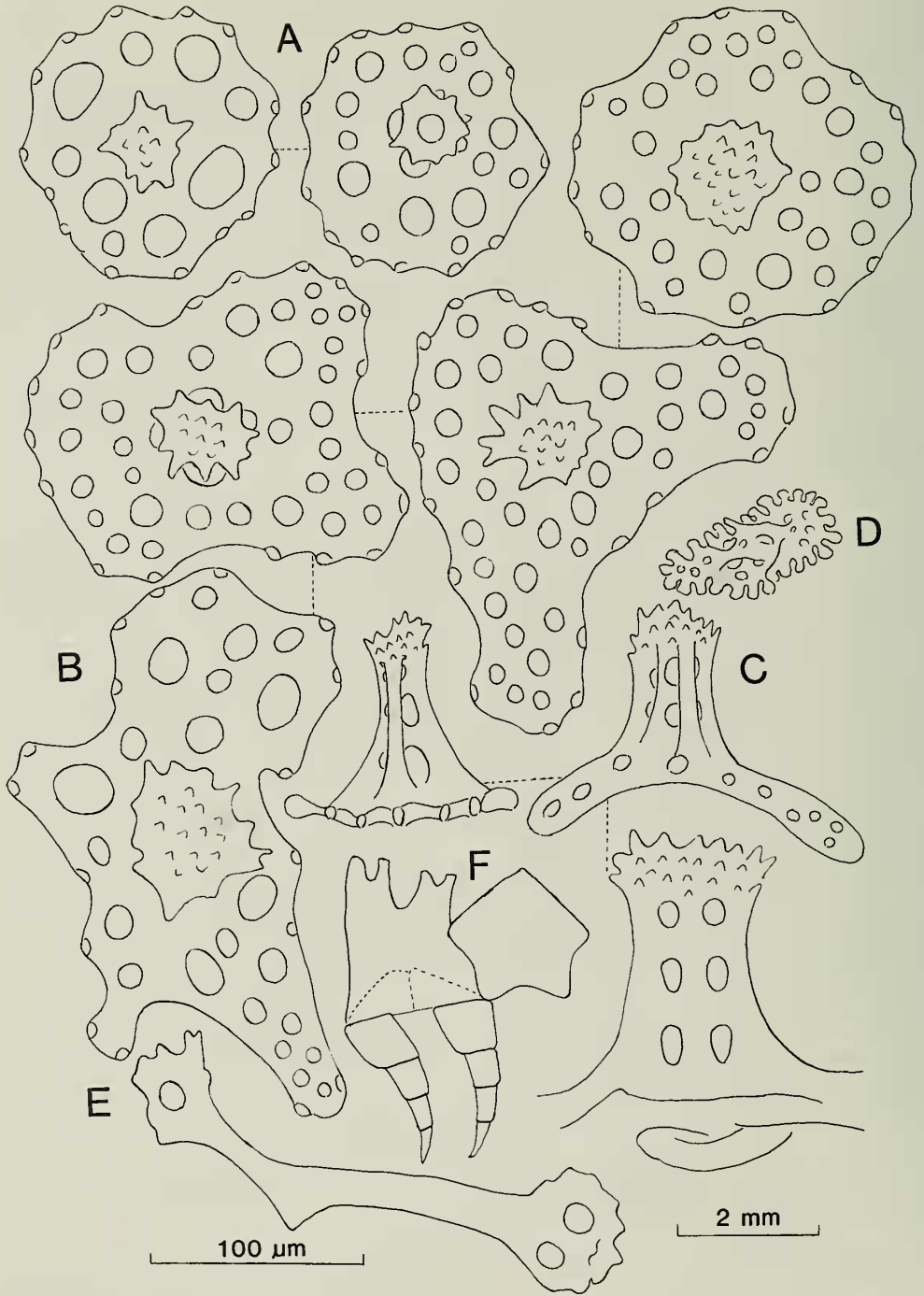


Fig. 7. *Phylloporus (Isophylloporus) orientalis* new subgenus, new species. A, tables from body wall; B, larger tables from body wall; C, tables from body wall, lateral view; D, rosette from introvert; E, rod from tentacles; F, radial and interradial pieces of calcareous ring.

Material examined.—Off Shantou, 23°30'N, 117°30'E, 37 m, 1 specimen; off Macao, 21°N, 117°30'E, 37 m, 1 specimen; off Guangdong Province, 20°30'N, 112°30'E, 74 m, 1 specimen. Diagnosis: Small to medium-sized form, up to 60 mm in length, body ovoid. Tentacles 20, arranged in two circles. Body wall thin, transparent. Tube feet thinly scattered over the body wall, more numerous ventrally than elsewhere. Calcareous ring very high, tubular, composed of a mosaic of small pieces; posterior projections on radials short, indistinct (Fig. 8D). Ossicles in body wall two-pillared tables (Fig. 8A, B) with low spire crowned with four diverging teeth; disc regular in outline, generally with eight perforations. Tube feet with well-developed end plates (Fig. 8C).

Remarks.—This species was previously known only from the unique holotype collected from Indonesia (Sluiter 1901). The current material is smaller (largest 20 mm in length). Coloration is striking—light yellow and transparent. The present record considerably extends the known range of the species.

Neothyonidium minutum (Ohshima)

Phyllophorus minutus Ohshima 1915:279, pl. 11 fig. 31a–b.

Neothyonidium minutum.—Heding & Pan-ning, 1954: 194, fig. 96; Rho & Won, 1993:129, pl. 5 fig. 1–4.

Material examined.—East China Sea, 28°30'N, 126°E, 116 m, 1 specimen.

Diagnosis.—Small form, about 15 mm in length, with slender body. Tentacles 20, in two circles of 10 + 10. Calcareous ring composed of a mosaic of small pieces; radials fused with interradians. Ossicles in body wall two-pillared tables with low spires crowned with four to eight teeth; disc regular with four or eight holes.

Remarks.—The type locality for this species is the east China Sea, off Goto Islands, Japan (Ohshima 1915); other records are from the Sagami Sea and South Korea. Our specimen is 15 mm long and slender, and it

is decalcified; we hesitantly refer it to this species, but we note that it was collected near the type locality of the species.

Neothyonidium spiniferum, new species
Figs. 9, 20H

Material examined.—Holotype IOAS E1061, Spratly Islands, South China Sea, 4°02'N, 109°59'E, 16 May 1987, 99 m, muddy sand bottom. Paratypes: IOAS E1083 Gulf of Tonkin, 18°15'N, 107°E, 8 Jan 1962, 69 m, 1 specimen; IOAS E1084, Gulf of Tonkin, 19°45'N, 108°45'E, 5 Jul 1960, 56 m, 1 specimen; IOAS E1085, Gulf of Tonkin, 19°N, 107°30'E, 9 Jul 1960, 66 m, 1 specimen; IOAS E1086, Gulf of Tonkin, 18°30'N, 107°E, 10 Dec 1969, 62 m, 1 specimen; IOAS E1087, Gulf of Tonkin, 18°N, 107°E, 14 Feb 1960, 63 m, 1 specimen; IOAS E1088, Gulf of Tonkin, 20°45'N, 107°30'E, 15 Feb 1960, 31 m, 1 specimen; IOAS E1089, Gulf of Tonkin, 19°N, 107°30'E, 9 Jul 1960, 66 m, 1 specimen; IOAS E1090, Gulf of Tonkin, 20°30'N, 108°30'E, 27 Aug 1962, 45 m, 1 specimen. Additional 8 specimens from Gulf of Tonkin, 31–91 m.

Diagnosis.—Small to medium-sized form, 40 mm in length, body ovoid, more or less upcurved with mouth and anus dorsal. Tentacles 20 in two circles (10 + 10). Tube feet papilliform, sparsely scattered over body. Calcareous ring high, tubular, composed of mosaic of small pieces; radials fused with interradians, radials carrying short posterior projections. Three types of ossicles in body wall: tables characteristic, with high excentric solid spire ending in a point; button-like plates spiny, with distinct spines on margin and surface; smooth perforated plates with varying number of small holes.

Description.—Body ovoid, length 40 mm, diameter 25 mm at middle of body. Extremities upturned, mouth and anus therefore dorsally oriented. Tentacles 20 in two rings of 10. Body wall thin, soft, more or less transparent. Tube feet papilliform, sparsely scattered over body, more numer-

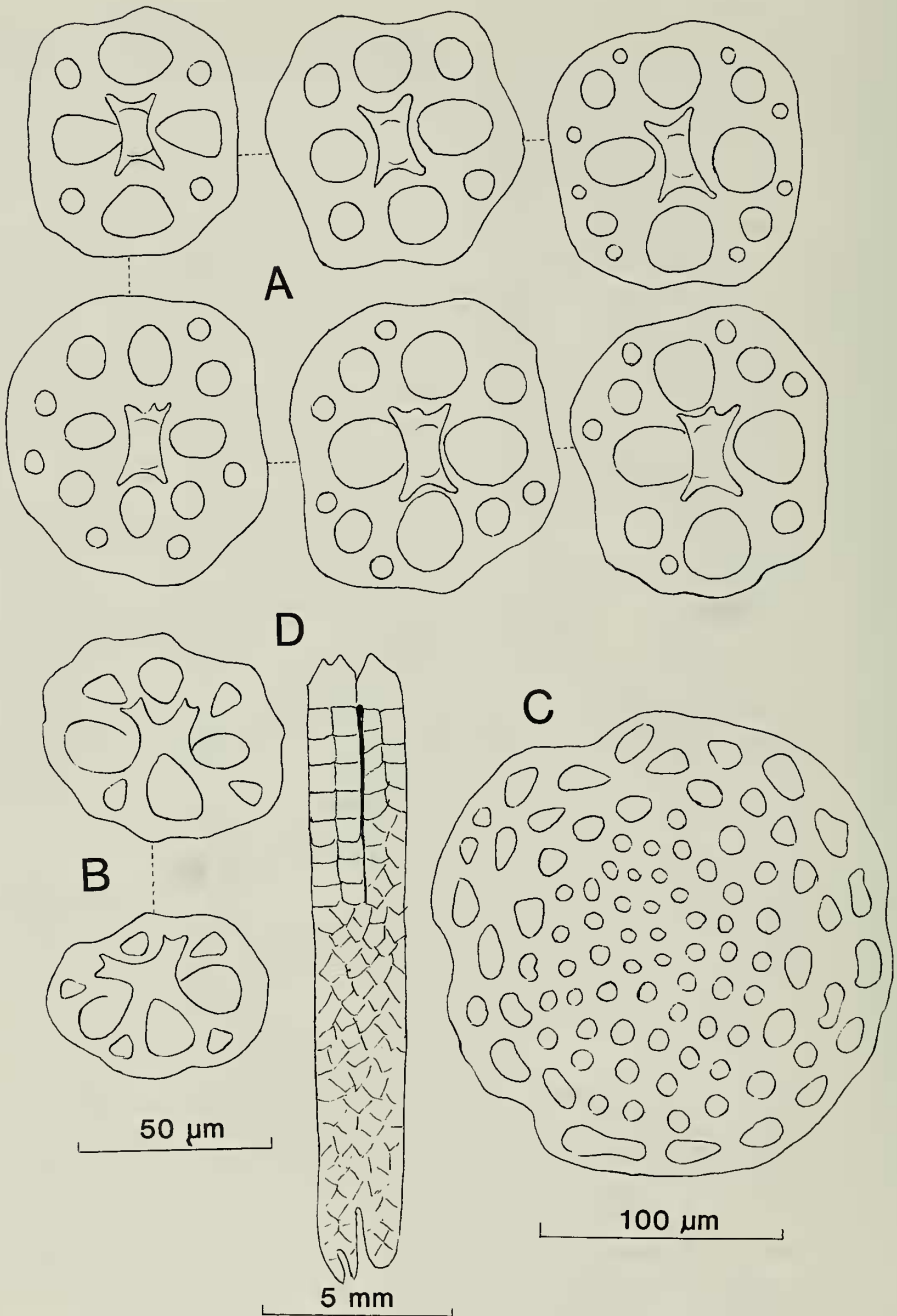


Fig. 8. *Neothyonidium inflatum* (Sluiter). A, tables from body wall; B, tables from body wall, oblique view; C, endplate from tube foot; D, radial and interradial pieces of calcareous ring.

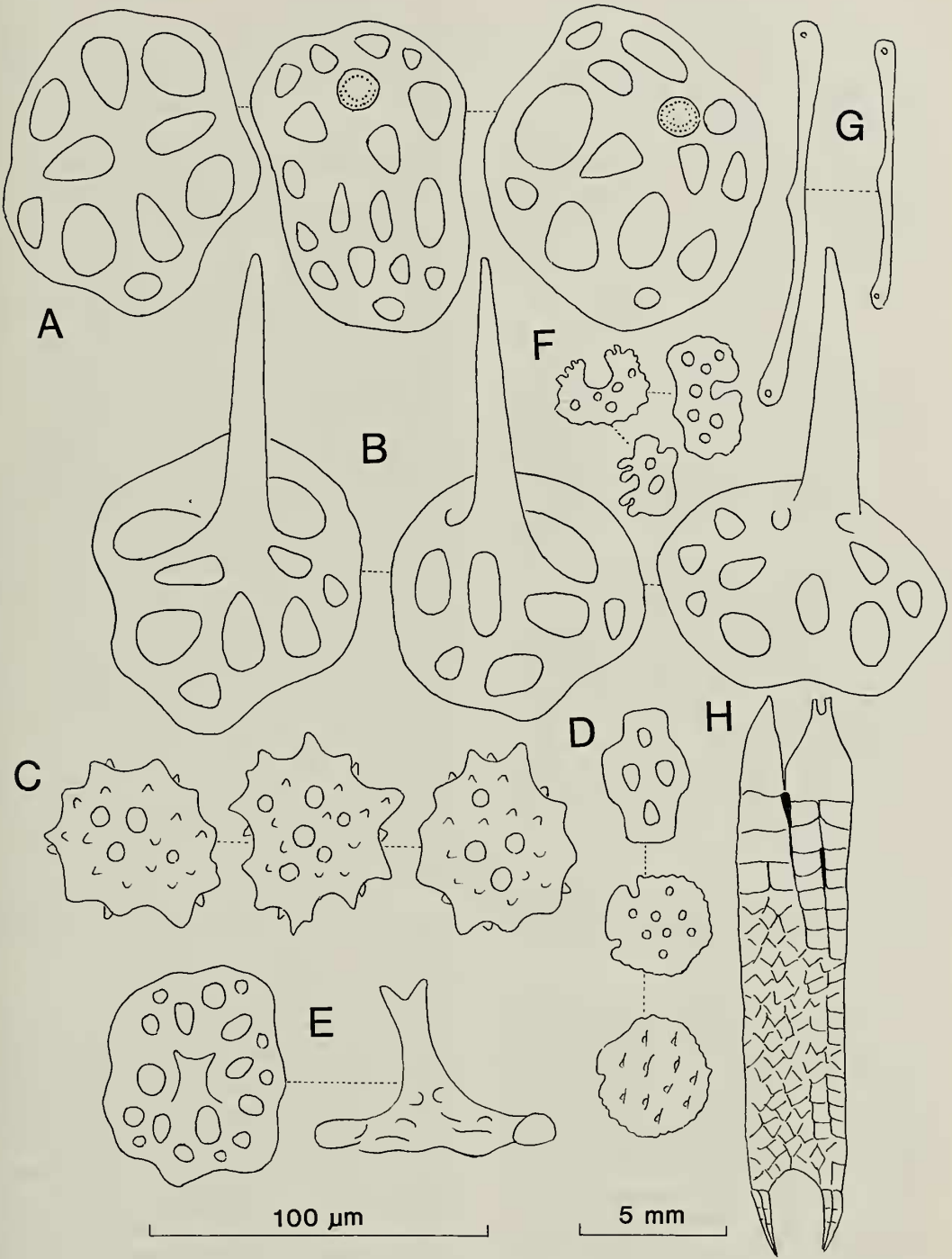


Fig. 9. *Neothyonidium spiniferum* new species. A, tables from body wall; B, tables from body wall, lateral view; C, spiny buttons from body wall; D, smooth plates from body wall; E, tables from introvert; F, rosettes from introvert; G, rods from tentacles; H, radial and interradial pieces of calcareous ring.

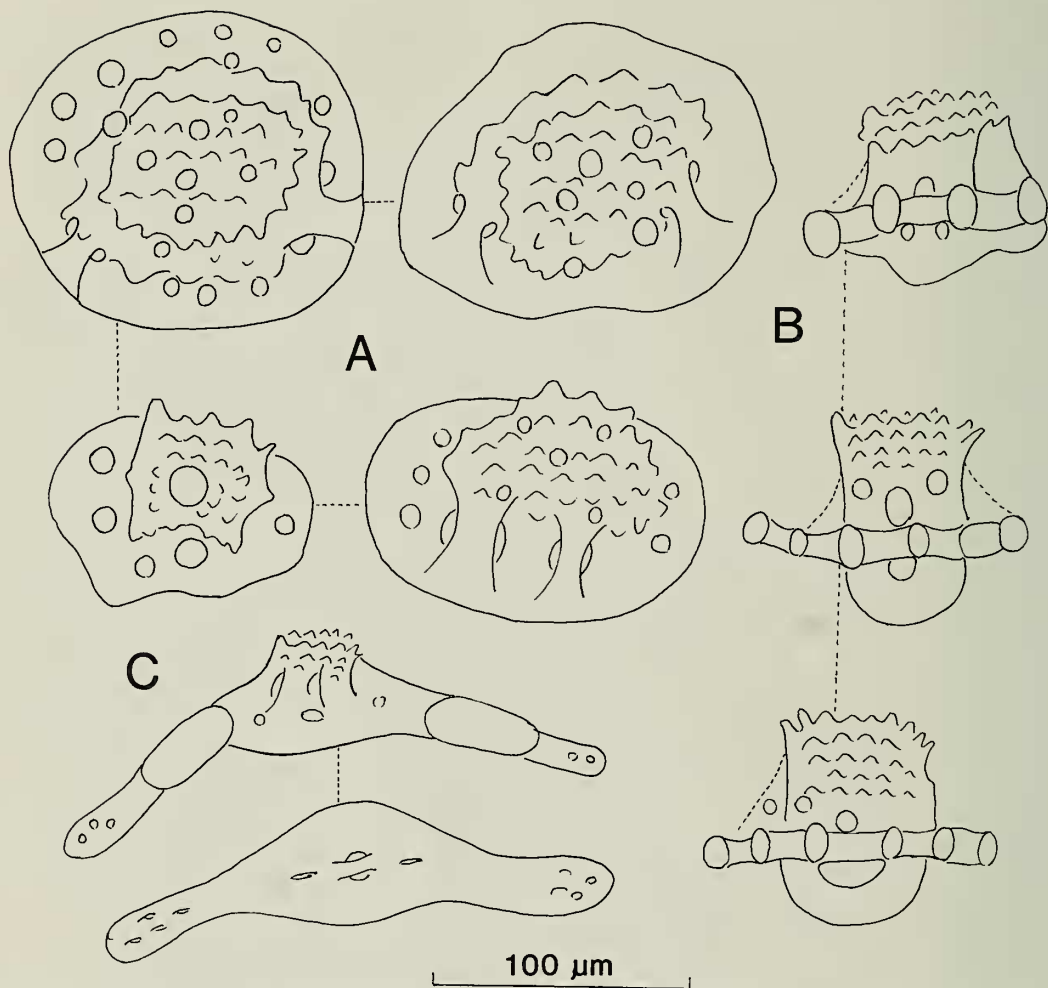


Fig. 10. *Allothyone longicauda* (Östergren). A, tables from body wall; B, tables from body wall, lateral view; C, tables from tube feet.

ous ventrally than dorsally. Anus surrounded by small papillae. Color in alcohol whitish. Calcareous ring tubular, high (20 mm long), entirely composed of mosaic of small pieces; radials fused with interradials; posterior projections on radials short (Fig. 9H). Polian vesicle and stone canal single.

Body wall ossicles of three kinds: tables, button-like plates and smooth perforated plates. Tables scarce in the body wall, but occur in numbers at bases of tube feet; discs smooth, circular 80–100 μm in diameter, with varying number of perforations. Spires excentric, solid, high (70–90 μm), termi-

nating in a single point (Fig. 9A, B). Button-like plates very numerous, spiny, 40–70 μm long, 30–60 μm wide, very variable in shape and in number of perforations, usually with distinct projections on margins and on surface (Fig. 9C). Smooth perforated plates of average diameter 30 μm , roundish or oblong with varying number of holes (Fig. 9D). In introvert tables (Fig. 9E) and rosettes (Fig. 9F). In tentacles delicate supporting rods of variable size (Fig. 9G).

Remarks.—The number of tentacles and shape of the calcareous ring require that this species be placed in *Neothyonidium* Deich-

mann, 1938. The species is distinctive in that no other known species in this genus possess the three kinds of body wall ossicles described here.

Subfamily Thyoninae Panning, 1949

Allothyone longicauda (Östergren)

Figs. 10, 20I

Cucumaria longicauda Östergren, 1898: 108–109, fig. 1.

Allothyone longicauda.—Panning, 1949: 466.

Cucumaria chronhjelmii.—Chang & Woo, 1954: 137–138, text fig. 6, pl. 2 fig. 3–4; Chang et al., 1964:23.

(Non *Cucumaria chronhjelmii* Théel, 1886).

Material examined.—Off Dalian, 26 Jul, 1957, 47.5 m, 1 specimen; Xiaopingdao, Dalian, intertidal zone, 1953, 1 specimen.

Diagnosis.—Medium-sized form, up to 60 mm in length, body barrel-shaped, posteriorly tapering into a caudal portion. Tube feet restricted to radii, in double rows. Ossicles in body wall tables with circular discs; spire low, four-pillared, with numerous crowded apical teeth; spire pillars sometimes connected to margin of disc thus forming complex fenestrated bodies; on inner surface of disc a distinct half-ring or handle is present.

Remarks.—The occurrence of this remarkable holothurian on the northern coast of China is of great interest, as it was hitherto known only from the holotype, collected from “Japan or China” (Östergren 1898). There are two specimens in the collection of the IOAS. A specimen 18 mm in length had been identified by Chang & Woo (1954) and by Chang and Liao (1964) as *Cucumaria chronhjelmii* Théel, 1886. Another specimen is larger, 59 mm in length and 10 mm in diameter with a distinctly narrowed posterior end. In both specimens tentacles and introvert are missing. The body wall is moderately thick but not hard. Color in alcohol is yellowish. Ossicles are numerous in the body wall; they are exclu-

sively tables with circular disc and many obscured perforations; the low four-pillared spires tend to fuse with the outer edge of the table disc producing a complex fenestrated body (Fig. 10A). On the inner surface of the table disc is a half-ring or “handle” (Fig. 10B). Tube feet with supporting tables. This material belongs to Östergren’s distinctive species *Cucumaria longicauda*.

Allothyone mucronata (Sluiter)

Fig. 11

Cucumaria mucronata Sluiter, 1901:88, pl. 7 fig. 7.

Allothyone mucronata.—Panning, 1949: 466; Liao, 1997:189, fig. 111.

Material examined.—Many specimens from the Gulf of Tonkin, 30–60 m. Depth.

Diagnosis.—Small form up to 30 mm in length, body slender, curved, tapering anteriorly and posteriorly, more or less pentagonal in cross section. Tube feet delicate, confined to radii, most numerous and larger on the ventral surface. Calcareous ring (Fig. 11D) with long posterior projections on radials, each column composed of many small pieces. Ossicles in body wall exclusively tables with rounded disc with numerous perforations; spires heavy, four-pillared, with numerous apical teeth. Supporting tables in tube feet distinctive, with very slender high spire.

Remarks.—This species, originally described by Sluiter on the basis of two specimens taken by the *Siboga* Expedition in Indonesia, has proved to be common in the Gulf of Tonkin. Numerous specimens are in the collections of IOAS. Body size is small, total length 10–30 mm, diameter 3–6 mm. Ossicles of body wall (Fig. 11A, B) and tube feet (Fig. 11C) are distinctive and comply well with Sluiter’s (1901) description. The range extension for this species implies that it may occur in many areas of the Indo-west-Pacific.

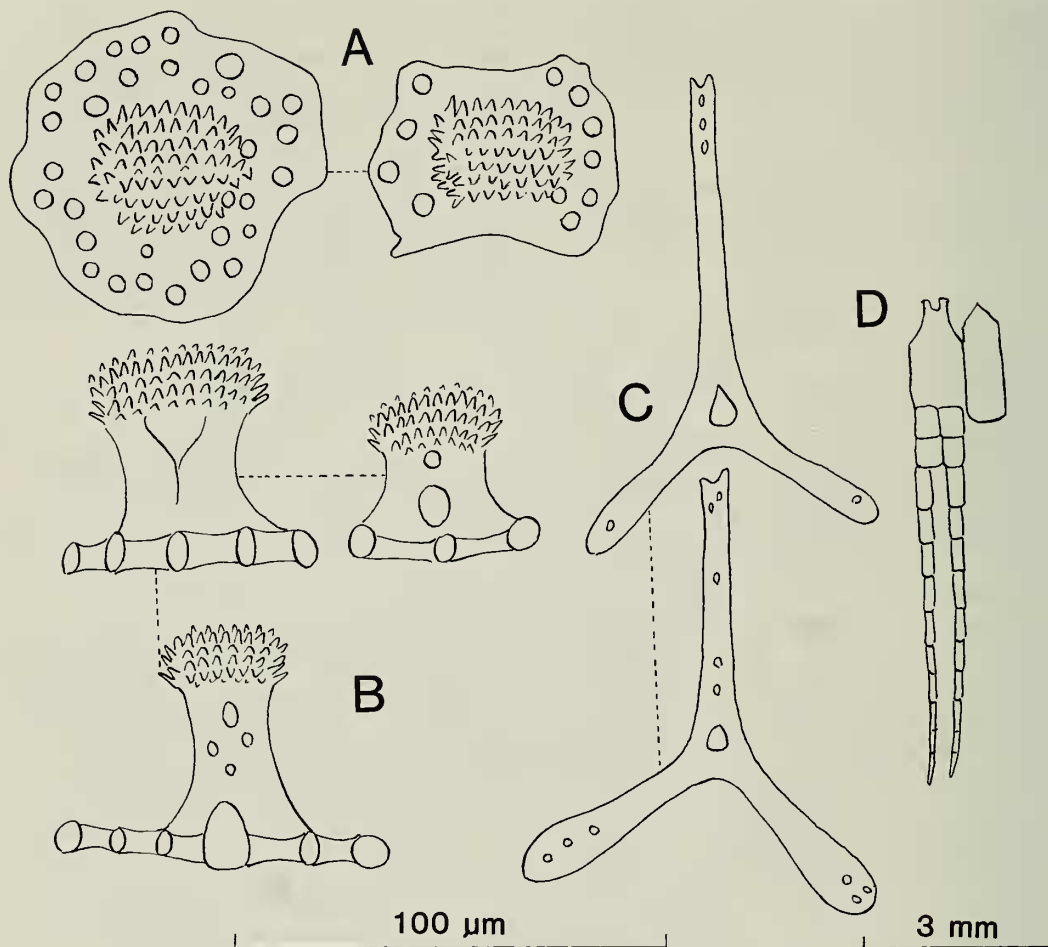


Fig. 11. *Allothyste mucronata* (Sluiter). A, tables from body wall; B, tables from body wall, lateral view; C, tables from tube feet; D, radial and interradial pieces of calcareous ring.

Pentamera constricta (Ohshima)

Fig. 12

Cucumaria constricta Ohshima, 1915:263, pl. 10 fig. 22a-b; 1916-19:277, pl. 6 fig. 40, text-fig. 63.

Pentamera constricta.—Panning, 1949: 465.

Material examined.—East China Sea, 26°30'N, 124°30'E, 150 m, 1 specimen; East China Sea, 29°30'N, 126°30'E, 100 m, 1 specimen; East China Sea, 31°30'N, 123°40'E, 55 m, 2 specimens.

Diagnosis.—Small form, approximately 25 mm in length, body slender, curved.

Tube feet confined to radii in double rows. Tentacles 10, ventral pair smaller. Calcareous ring with two long posterior projections on radials (Fig. 12E). Ossicles in body wall two-pillared tables (Fig. 12A) and perforated plates (Fig. 12C), discs of tables with smooth edge and varying number of perforations, spires moderately high, with 6-8 apical teeth (Fig. 12B). Tube feet with supporting tables.

Remarks.—This species was hitherto known only from off southern Japan; its range now extends to the East China Sea. The four specimens are all small, largest 15 × 6 mm, the smallest 9 × 7 mm. They

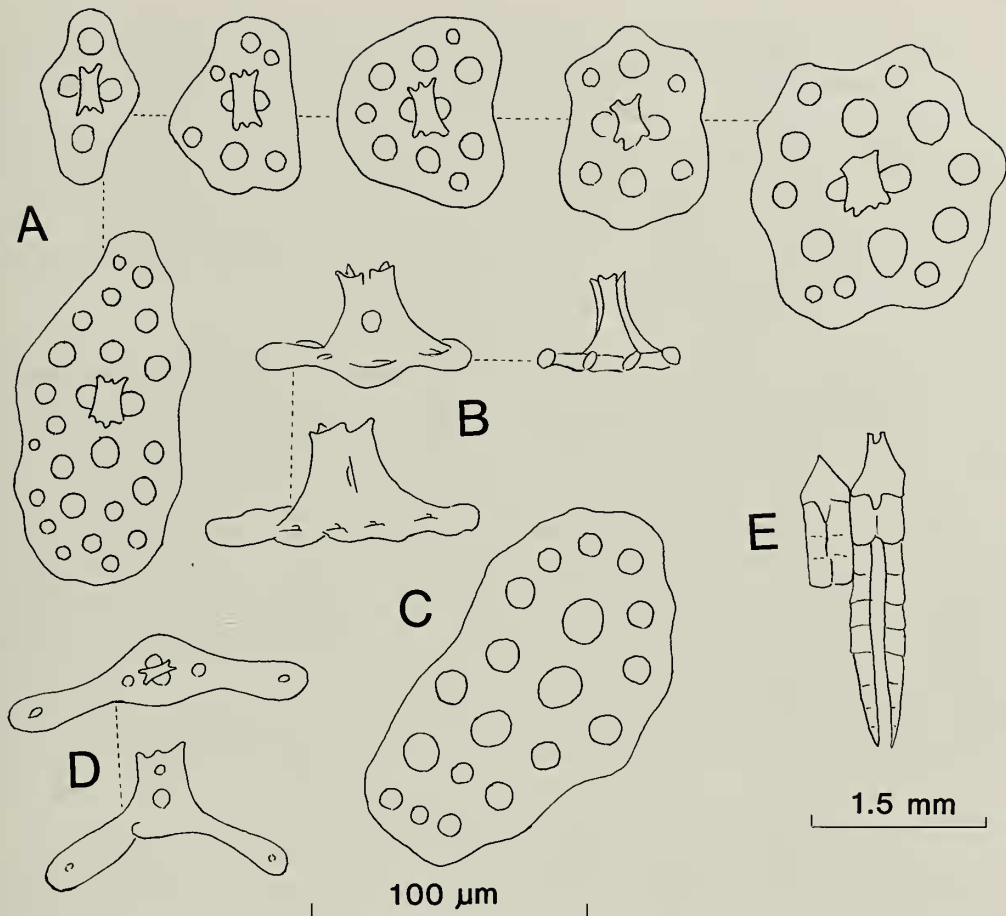


Fig. 12. *Pentamera constricta* (Ohshima). A, tables from body wall; B, tables from body wall, lateral view; C, perforated plate from body wall; D, supporting table from tube feet; E, radial and interradial pieces of calcareous ring.

agree in all essential features with the description and measurements given by Ohshima (1915), except that the diameter of the table ossicles in the Chinese specimens (about 100 μm) is smaller than in Ohshima's (1915) material (160 μm).

Stolus crassus, new species

Figs. 13, 20J

Material examined.—Holotype IOAS E1060, off Hong Kong, 21°N, 113°30'E, 14 Jul 1959, 74 m, muddy sand bottom. Paratype IOAS E1076, same locality as Holotype, 7 Feb 1960, 1 specimen.

Diagnosis.—Large form, total length ex-

ceeding 100 mm, body spindle-shaped. Tentacles 10, 2 ventral smaller. Tube feet not numerous, papilliform, sparsely scattered on body wall. Calcareous ring long, tubular, composed of a mosaic of small pieces, with short posterior projections on radials. Body wall thick and hard, with crowded large knobbed button-like tables.

Description.—Total length of single specimen approximately 130 mm, diameter at middle 30 mm. Body spindle-shaped, moderately curved, tapering anteriorly and posteriorly. Papilliform tube feet scattered on body, slightly more numerous ventrally than dorsally. Body wall thick, rough to

touch due to abundant ossicles. Tentacles 10, ventral pair markedly smaller. Anus surrounded by minute papillae. Color in alcohol whitish. Calcareous ring 20 mm long, tubular, all pieces composed of a mosaic of small elements; radials with short posterior projections; interradials well-developed, wider than radials; radials with membranous space in middle of anterior part (Fig. 13J). Stone canal and Polian vesicle single.

Ossicles in body wall large, knobbed button-like tables; discs rounded or triangular in outline, averaging about 100 μm in diameter, strongly knobbed, with 6 small perforations (Fig. 13A), two-pillared spires low, about 90 μm high, with 2–3 apical teeth (Fig. 13B). Inner surface of disc with a handle or half ring with large central perforation (Fig. 13B). Tube feet with numerous supporting tables (Fig. 13C, D) and perforated plates (Fig. 13E). In introvert, delicate tables with oblong disc, knobbed margin, and low spires (Fig. 13F, G). In tentacles rosettes (Fig. 13H) and rods of various sizes (Fig. 13I).

Remarks.—This new species is distinctive in the genus *Stolus* in having peculiar button-like tables with knobbed margins, and a calcareous ring with some unusual features.

Stolus micronodosus, new species

Fig. 14

Material examined.—Holotype IOAS E1063, South-China Sea, 20°30'N, 113°E, 20 Oct 1959, 92 m, sandy mud bottom.

Diagnosis.—Medium-sized form, total length 50 mm, body spindle-shaped, more or less pentagonal in cross-section. Extremities attenuate. Tentacles 10, ventral pair smaller. Tube feet delicate, numerous, often in indistinct bands on radii but also scattered in interradia. Calcareous ring very high, composed of a mosaic of small pieces; interradials almost as long as radials; radials with short posterior projections. Ossicles in body wall small knobbed buttons, usually with 4 holes and minute knobs.

Description.—Length 50 mm, diameter at mid-body 35 mm. Body spindle-shaped, tapering markedly anteriorly and posteriorly; ends pentagonal in cross-section. Tube feet numerous, delicate, often in indistinct rows, but also scattered in interradia. Tentacles 10, ventral pair markedly smaller. Anus closed by 5 valves. Color in alcohol whitish, with numerous grayish spots. Body wall thin, soft.

Calcareous ring exceedingly long, 25 mm, tubular, pentagonal in cross-section. Radials only slightly shorter than radials, all composed of mosaic of small pieces, radials with short posterior projections (Fig. 14G). Polian vesicle and stone canal single.

Ossicles in body wall delicate buttons, 30–65 μm long, 30–50 μm wide, with 4 or more holes, with about 8 knobs on margin and 2 at center (Fig. 14A, B). Few buttons smooth, without knobs (Fig. 14C). Ossicles in tube feet elongate buttons (Fig. 14D). Introvert with tables (Fig. 14E) with knobbed disc, 8–20 perforations in disc, low two-pillared spire with about 8 apical teeth. Tentacles with small, simple rods (Fig. 14F).

Remarks.—*Stolus micronodosus* is unique in the genus in having a pentagonal body in cross-section, an exceedingly long calcareous ring, and ossicles in the form of delicate buttons with small knobs.

Thyone crebrapodia Cherbonnier

Figs. 15, 20K

Thyone crebrapodia Cherbonnier, 1988: 197, fig. 84A–I.

Thyone cf. *villosa* Liao, 1997:206.

Non: *Thyone villosa* Semper, 1868.

Material examined.—Off eastern Guangdong Province, 22°30'N, 116°30'E, 43 m, 2 specimens; off Hong Kong, 21°15'N, 113°30'E, 52 m, 1 specimen; off Shantou, 23°30'N, 117°E, 47 m, 1 specimen; East China Sea, 29°N, 124°E, 73 m, 1 specimen.

Diagnosis.—Small form, approximately 30 mm in length. Tube feet numerous, closely crowded. Calcareous ring long, tubular, radials and interradials composed of

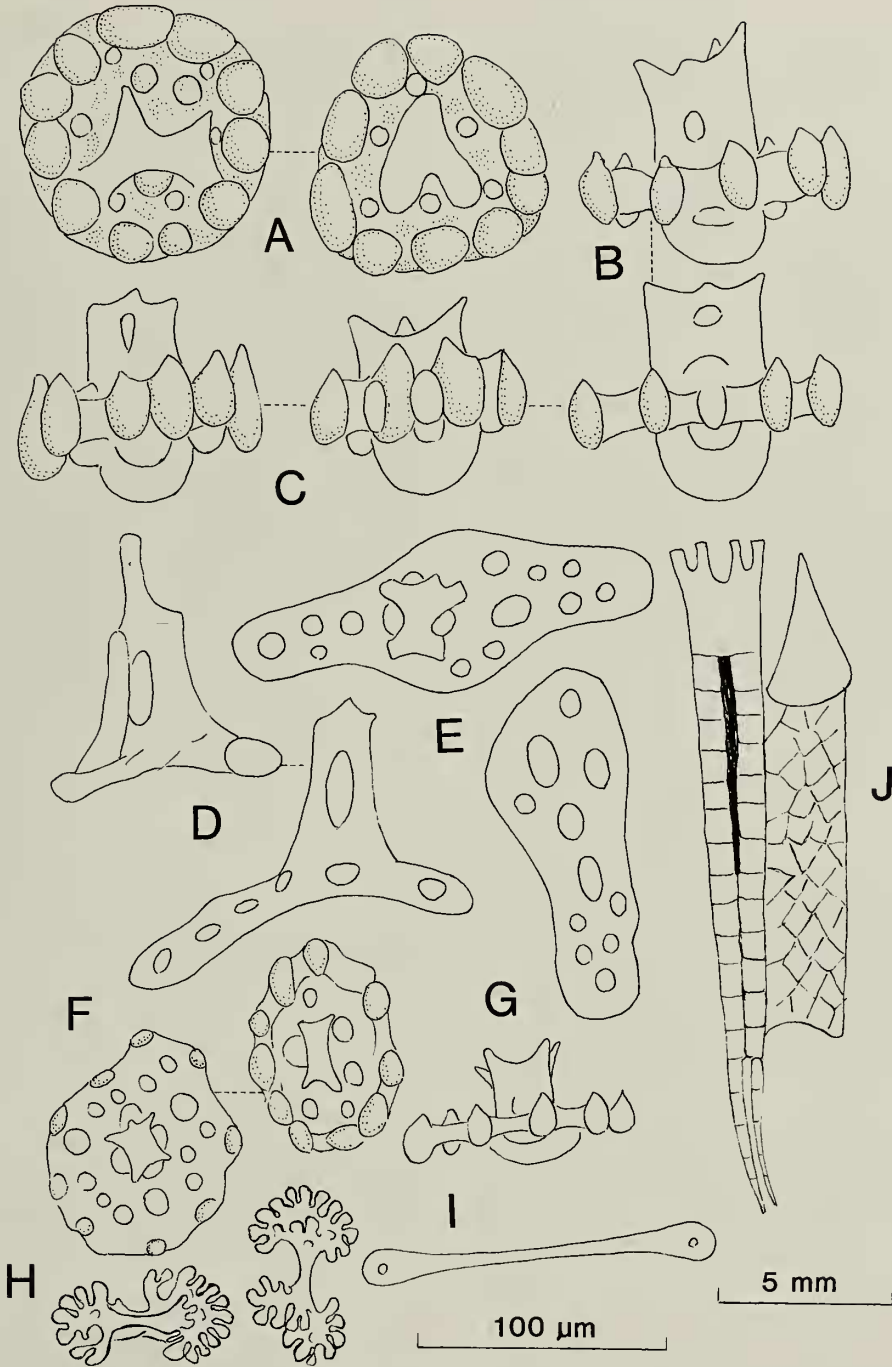


Fig. 13. *Stolus crassus* new species. A, table-like buttons from body wall; B, table-like buttons from body wall, lateral view; C, table from tube feet; D, tables from tube feet, lateral view; E, perforated plate from tube feet; F, tables from introvert; G, tables from introvert, lateral view; H, rosettes from tentacles; I, rod from tentacles; J, radial and interradial pieces of calcareous ring.

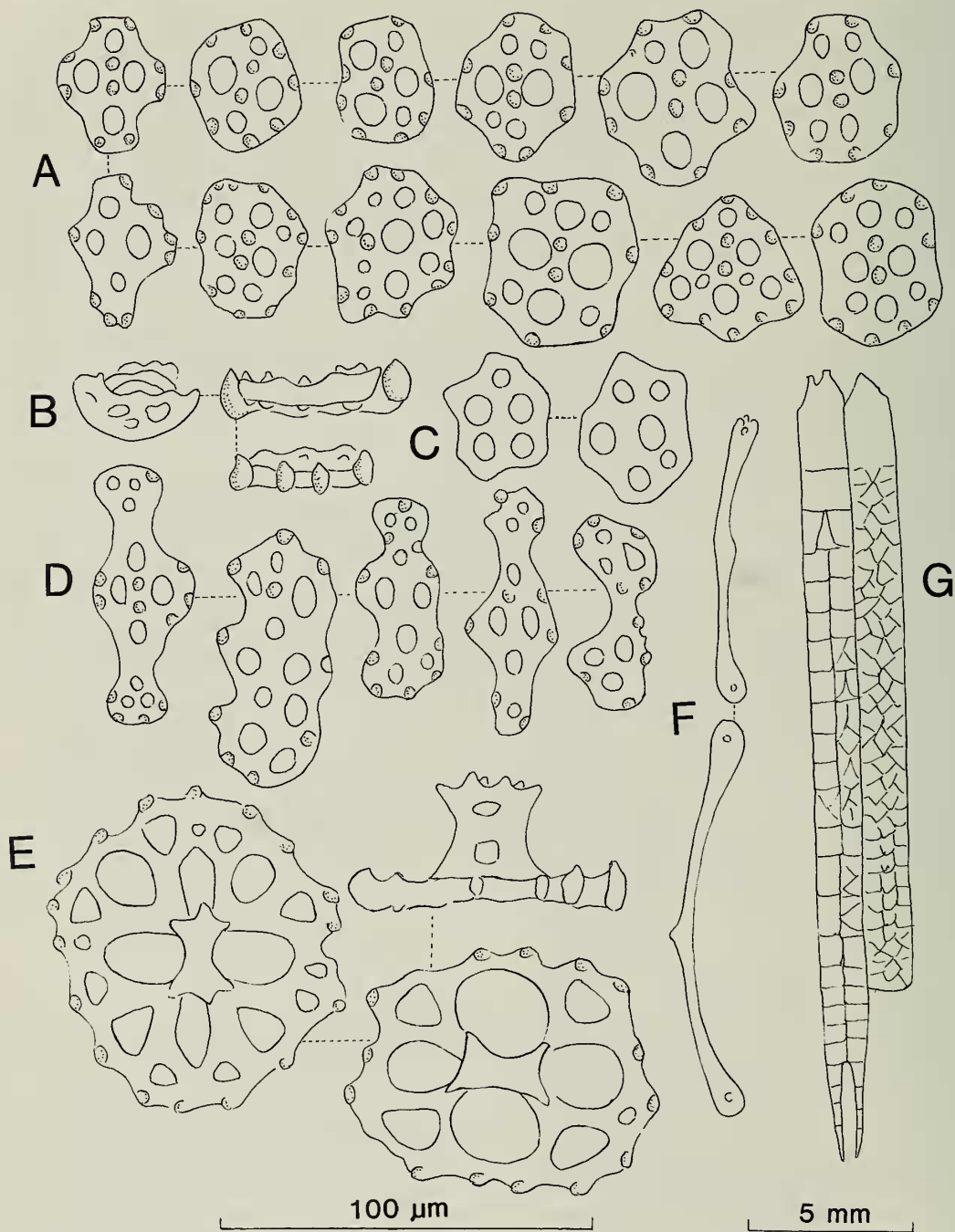


Fig. 14. *Stulus micronodosus* new species. A, knobbed buttons from body wall; B, knobbed buttons from body wall, lateral view; C, smooth buttons from body wall; D, buttons from tube feet; E, tables from introvert; F, rods from tentacles; G, radial and interradial pieces of calcareous ring.

a small number of pieces (Fig. 15E). Ossicles in body wall numerous two-pillared tables (Fig. 15A, B), disc oblong with 4–8 holes, spire low or moderately high with four apical teeth. Tube feet with supporting tables (Fig. 15C, D).

Remarks.—Of the five specimens the largest is 24×13 mm, the smallest 7×3.5 mm. They strongly resemble the Philippines species *Thyone villosa* Semper, 1868, and were referred to that species by Liao (1997). During a visit to the Hamburg Museum in Germany in 1993, YL examined the type of *T. villosa*, and decided that the Chinese material was not conspecific with that species. The characters of the calcareous ring and ossicles argue for referral of the specimens to *T. crebrapodia*, recently described by Cherbonnier (1988) from Madagascar.

Thyone papuensis Théel

Fig. 16

Holothuria dietrichii Ludwig, 1875:105, fig. 31.

Thyone fusus var. *papuensis* Théel, 1886: 92, pl. 17 fig. 1.

Thyone papuensis.—H. L. Clark, 1921:167; H. L. Clark, 1932:221; Clark & Rowe, 1971:182; A. M. Clark, 1982:489, 495, fig. 2; Cannon & Silver, 1987:32, fig. 9g; Rowe & Gates, 1995:316; Liao, 1997: 203, fig. 119.

Material examined.—Gulf of Tonkin, $20^{\circ}15'N$, $108^{\circ}30'E$, 58 m, 1 specimen; off Qingdao (Jiaozhou Bay), 25 m, 1 specimen; Yellow Sea, $33^{\circ}30'N$, $123^{\circ}E$, 14 m, 1 specimen; Yellow Sea, $33^{\circ}15'N$, $123^{\circ}30'E$, 46 m, 3 specimens.

Diagnosis.—Small to medium-sized form, up to 50 mm in length. Body spindle-shaped with numerous tube feet scattered all over body wall. Calcareous ring complex, both radials and interradials composed of mosaic of small pieces; radials with long posterior projections (Fig. 16G). Ossicles in body wall sparsely scattered small two-pillared tables with oblong disc, 4 large and 4

small perforations, low spire with 2 apical teeth (Fig. 16A, C). Feet with large endplates and curved supporting tables (Fig. 16D). Introvert with rosettes (Fig. 16E) and tables with numerous holes (Fig. 16B). Tentacles with rods (Fig. 16F).

Remarks.—There are six specimens of this species in the collections of IOAS. Total length 30–50 mm, diameter near mid-body 6–10 mm. Color in alcohol uniformly light yellowish. There is no doubt that the specimens from the Gulf of Tonkin are identical with those from the Yellow Sea, even though these two areas do not have many species in common. Clark's (1982) specimen from Hong Kong had tube feet that tended to be aligned in longitudinal series, especially in the radii, and tables in the dorsal body wall had a low spire of two separate columns. It is with some trepidation that we refer this Hong Kong specimen to this species.

Thyone purpureopunctata, new species

Figs. 17, 20L

Material examined.—Holotype IOAS E1059, off Sanya, Hainan Island, 21 Mar 1992, 32–37 m, muddy bottom. Paratypes IOAS E1080 Gulf of Tonkin, $20^{\circ}30'N$, $107^{\circ}30'E$, 20 Apr 1960, 34 m, 1 specimen; IOAS F1081, Gulf of Tonkin, $20^{\circ}N$, $109^{\circ}E$, 11 Jul 1960, 30.5 m, 1 specimen; IOAS E1082, Gulf of Tonkin, $19^{\circ}30'N$, $108^{\circ}E$, 60 m, 1 specimen.

Diagnosis.—Medium-sized form, up to 60 mm in length, body spindle-shaped, more tapered posteriorly than anteriorly. Tentacles 10, ventral pair smaller. Tube feet delicate, numerous, scattered all over body wall. Calcareous ring tubular, composed of mosaic of small pieces, radials with short posterior projections (Fig. 17I). Ossicles in body wall two-pillared tables with irregularly elongated discs, low arched spires terminating in conical solid point (Fig. 17C). Supporting tables in tube feet with elongate discs and high solid spires (Fig. 17E).

Description.—Length 60 mm, diameter

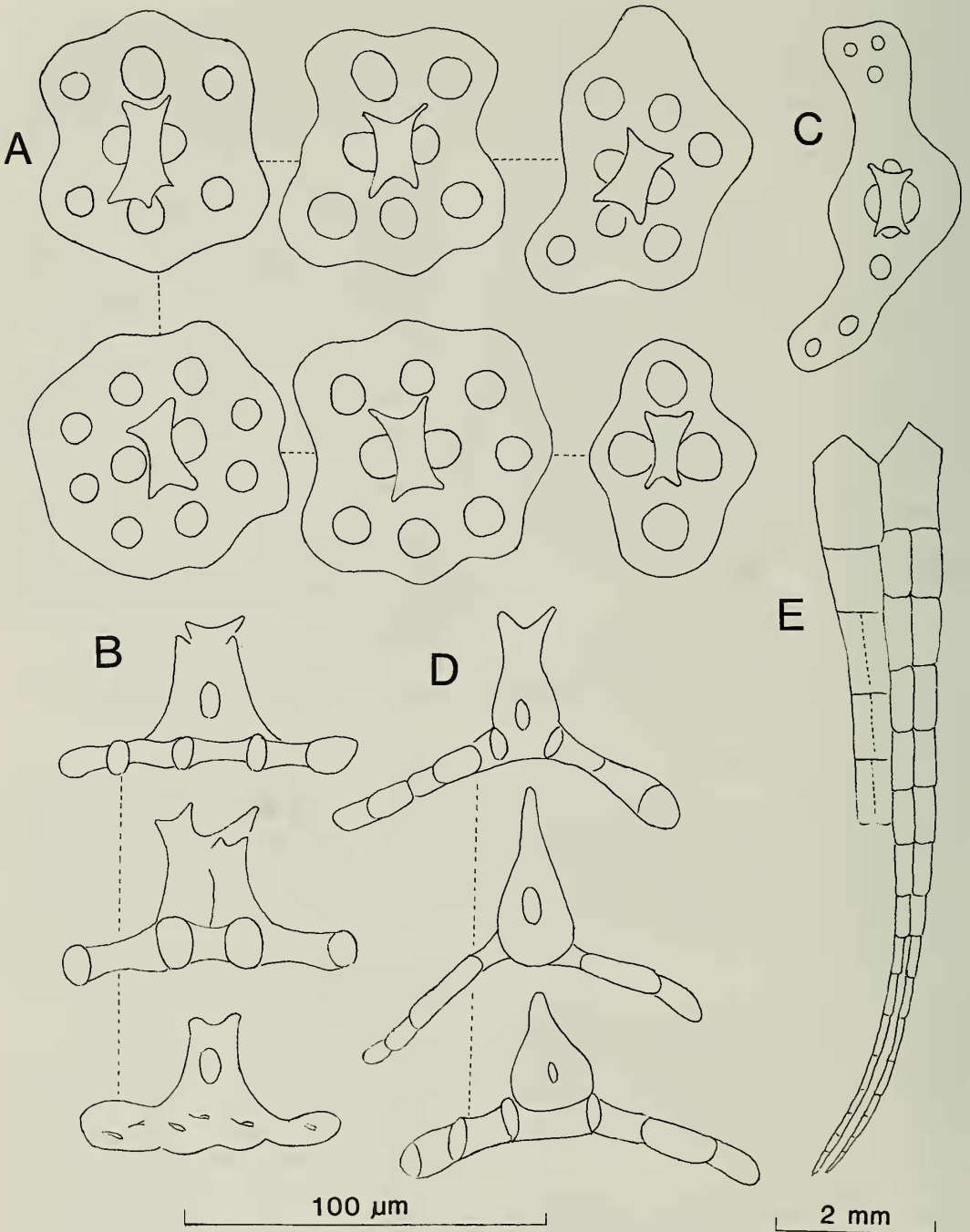


Fig. 15. *Thyone crebrapodia* Cherbomnier. A, tables from body wall; B, tables from body wall, lateral view; C, tables from tube feet; D, tables from tube feet, lateral view; E, radial and interradial pieces of calcarous ring.

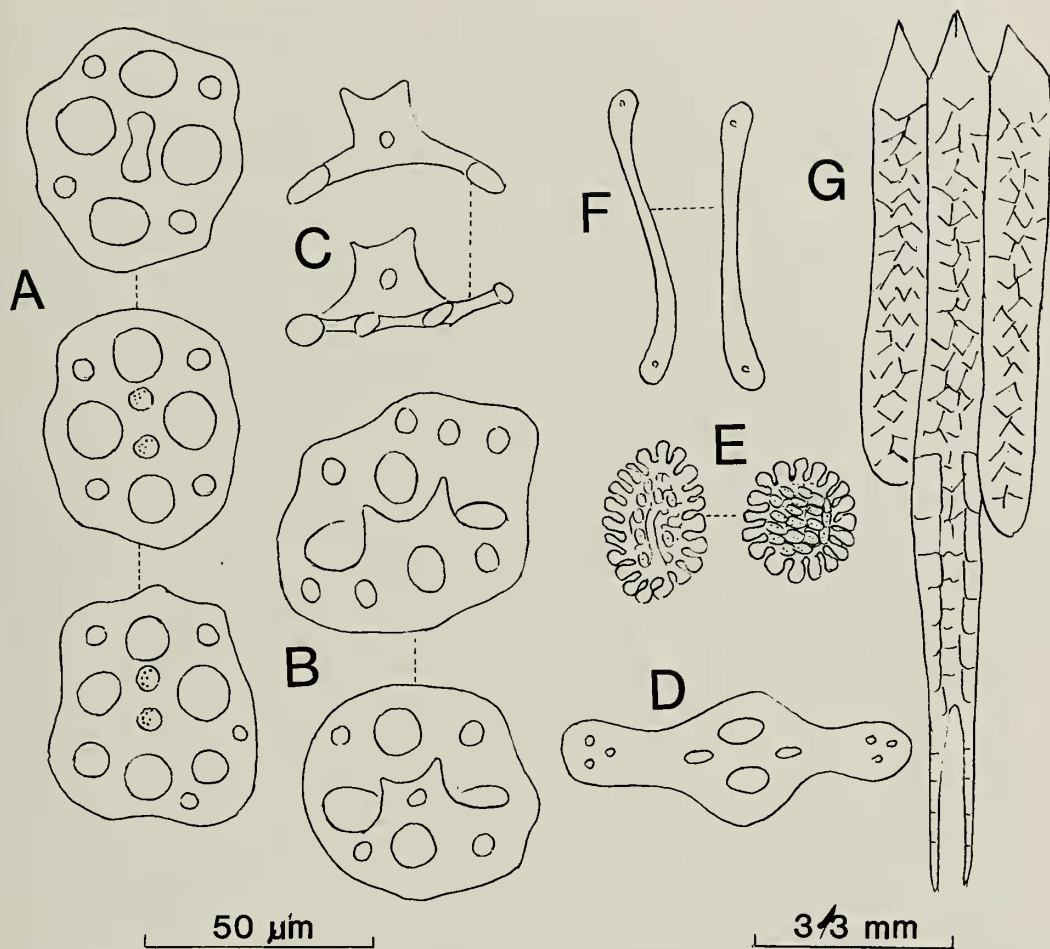


Fig. 16. *Thyone papuensis* Théel. A, tables from body wall; B, tables from body wall, oblique view; C, tables from body wall, lateral view; D, tables from body wall, oblique view; E, rosettes from introvert; F, rods from tentacles; G, radial and interradial pieces of calcareous ring.

about 16 mm near mid-body. Body spindle-shaped, more tapered posteriorly than anteriorly. Tentacles 10, ventral pair smaller. Tube feet delicate, numerous, scattered all over body, slightly more numerous ventrally than dorsally. Calcareous ring tubular, 10 mm long, composed of mosaic of small pieces; radials with short posterior projections (Fig. 17I). No obvious anal papillae. Color in alcohol grayish white, with numerous scattered purple spots. Body wall thick but not hard, with numerous ossicles. Polian vesicle and stone canal single.

Ossicles in body wall two-pillared tables (Fig. 17A-C), discs of variable outline with

varying number of perforations, 60–170 μm long, 40–90 μm wide; spires 20–30 μm high, arched, ending in conical solid point (Fig. 17C). In tube feet endplate present, supporting tables (Fig. 17D, E) with elongated curved discs and high spires ending in solid point. Introvert with rosettes (Fig. 17G) and tables (Fig. 17F). Tentacles with rosettes and supporting rods of various sizes (Fig. 17H).

Remarks.—This species is distinctive in its color and in the form of the ossicles. It may be distinguished from *Thyone villosa* Semper from the Philippines, to which it bears some resemblance, in having fewer

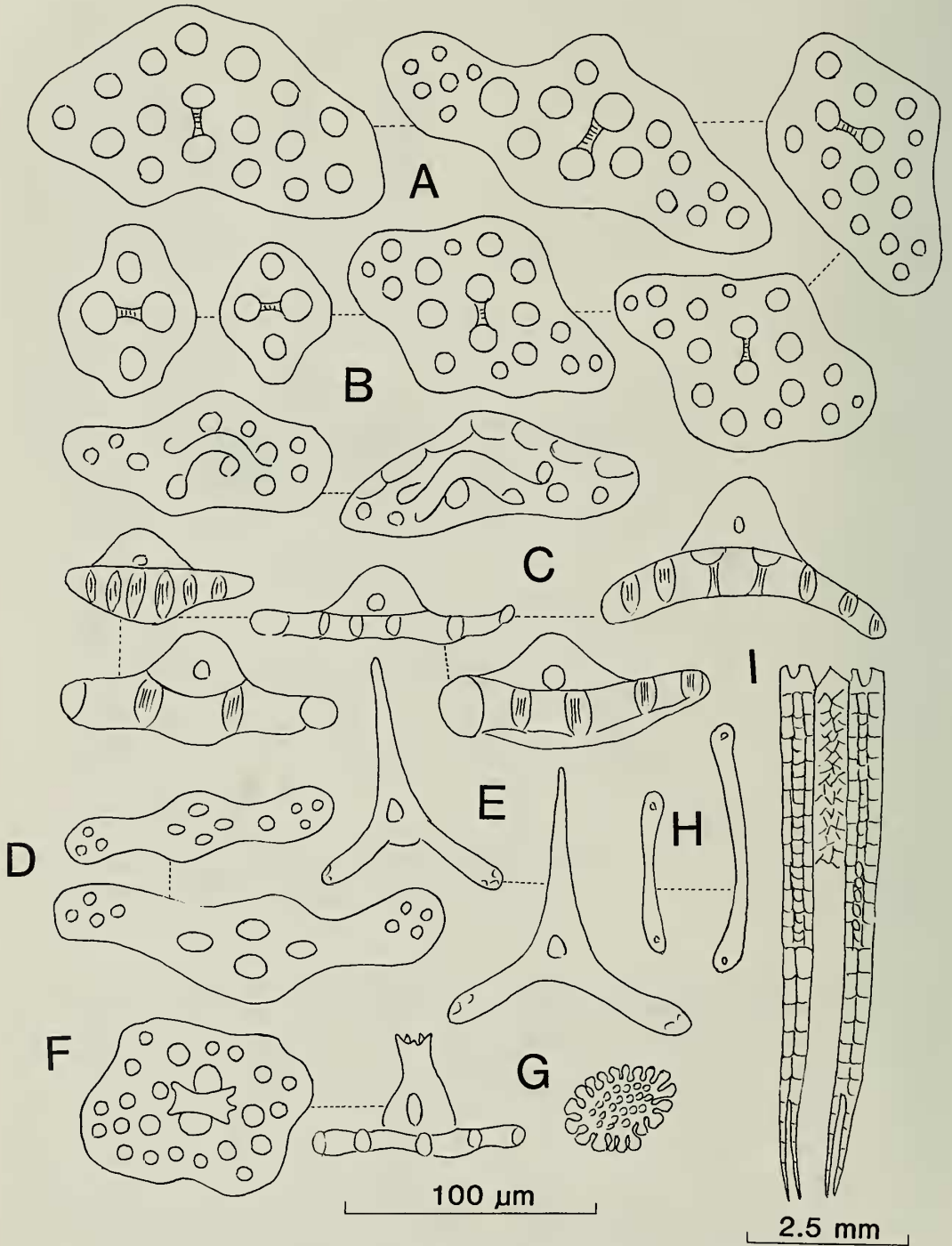


Fig. 17. *Thyone purpureopunctata* new species. A, tables from body wall; B, body wall tables, oblique view; C, tables from body wall, lateral view; D, discs of tables from tube feet; E, tables from tube feet, lateral view; F, tables from introvert; G, rosette from introvert; H, rods from tentacles; I, radial and interradial pieces of calcareous ring.

tube feet and tables with low arched spires ending in a single conical point.

Thyone sinensis, new species
Figs. 18, 20M

Material examined.—Holotype IOAS E1065, Dongshan, Fujian Province, 19 Dec 1981, 3.5 m, muddy bottom. Paratypes USNM E53143, same locality as holotype, 1 specimen; IOAS E1066, same locality as holotype, 2 specimens; IOAS E1078, Dongshan, Fujian province, 7 Mar 1963, 2 m, 2 specimens; IOAS E1079, Dongshan, Fujian province, 3 Jul 1981, 4 m, 2 specimens; IOAS E1079, Guangdong Province, 11 Dec 1954, intertidal zone, 1 specimen.

Diagnosis.—Small form, U-shaped, total length approximately 50 mm. Tentacles 10, ventral pair smaller. Body wall with numerous apparently nonretractile delicate tube feet, more numerous ventrally, with tendency to be arranged in bands on radii. Calcareous ring tubular, composed of relatively large pieces, with short posterior prolongations on radials. Ossicles in body wall two-pillared tables with irregular disc and low spire. Supporting tables in tube feet with high spires with 3–4 crossbeams.

Description.—Small species, body U-shaped, mouth and anus bent upwards. Largest dimension along ventral surface 50 mm, diameter at mid-body 15 mm. Ten tentacles, ventral pair smaller. Tubefeet numerous, delicate, nonretractile, more numerous ventrally, with tendency to be arranged in rows on radii. Anus surrounded by five groups of small papillae. Body wall thin, soft, with numerous ossicles. Color in alcohol white with yellowish tinge, especially ventrally, tube feet often orange in contrast. Calcareous ring tubular, 6 mm long, radials and interradials composed of large pieces; radials with short posterior projections; interradials about $\frac{2}{3}$ length of radials (Fig. 18J). Polian vesicle and stone canal single.

Ossicles in body wall two-pillared tables with irregular disc and low spire with four

apical teeth (Fig. 18A, B); disc diameter 65–100 μm , height of spire 30–50 μm . In tube feet supporting tables with elongate disc (Fig. 18C, D), 4 central perforations and usually single perforation at each end; spire high with 3–4 crossbeams, ending in 6 apical teeth; tables 100–130 μm long, 50–70 μm high (Fig. 18D). Tube feet with well-developed end plates (Fig. 18E). In introvert tables (Fig. 18G, H) and rosettes (Fig. 18I). Tentacles with supporting perforated plates of varying size (Fig. 18F).

Remarks.—A distinctive species, with tubular calcareous ring made up of large pieces, and tables with several holes. In most other species of *Thyone*, the discs of the tables have eight or fewer perforations. The discs of the tables in this new species resemble those of *T. pedata* Semper (Liao & Clark, 1995:505), but in this latter species the spires are much higher than those of the new species.

Family Placothuriidae Pawson & Fell,
1965

Placothuria Pawson & Fell, 1965
Placothuria molpadioides (Semper)

Ocnus molpadioides Semper, 1868:55, pl. 15 fig. 3; Théel, 1886:118.

Stolus molpadioides.—Panning, 1949:463; Clark & Rowe, 1971:182; Liao & Clark, 1995:497, fig. 302, pl. 23 fig. 2.

Placothuria molpadioides.—Liao, 1997: 224, fig. 134.

Material examined.—Off the Gulf of Tonkin to eastern Guangdong, 17–57 m, 78 specimens.

Diagnosis.—Body large, up to 135 mm in length, U-shaped, rigid. Ossicles in body wall overlapping thick plates usually exceeding 1 mm in diameter. Tube feet with table-like ossicles. Tentacles with delicate rods and rosettes.

Remarks.—This species has now been well characterized by Liao & Clark (1995) and Liao (1995). It differs from all other *Placothuria* species in having table-like supporting rods in the tube feet.

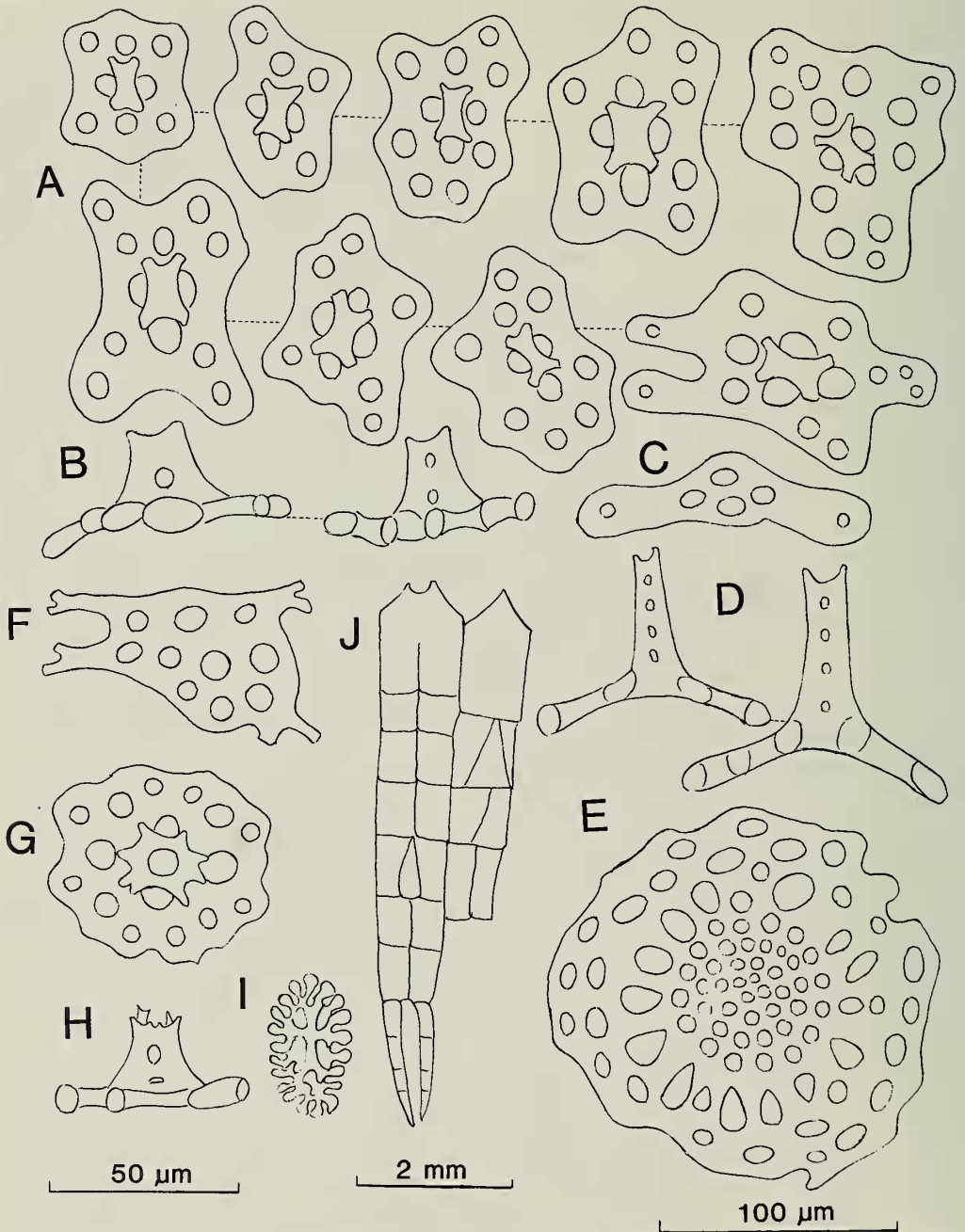


Fig. 18. *Thyone sinensis* new species. A, tables from body wall; B, tables from body wall, lateral view; C, disc of tables from tube feet; D, tables from tube feet, lateral view; E, endplate from tube foot; F, plate from tentacles; G, tables from introvert, lateral view; H, introvert table, lateral view; I, rosette from introvert; J, radial and interradial pieces of calcareous ring.

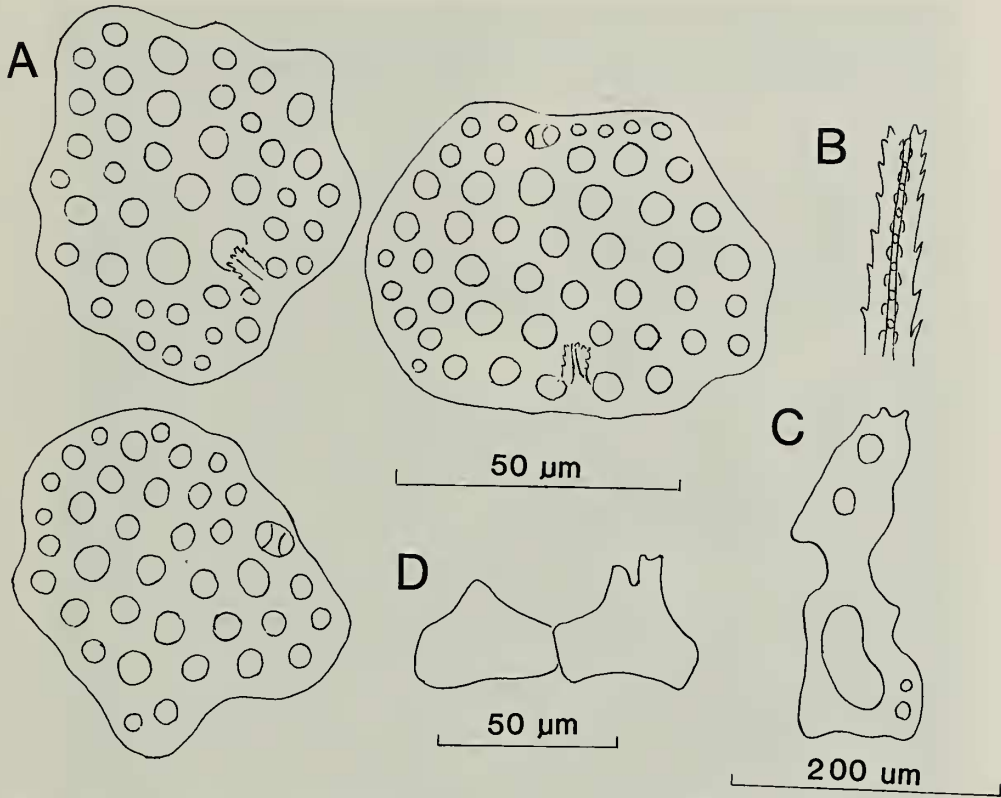


Fig. 19. *Vaneyella dactylica* (Ohshima). A, scales from body wall; B, lateral view of spire from body wall scale; C, perforated plate from tentacle; D, radial and interradial pieces of calcareous ring.

Placothuria ohshimai Liao

Cucumaria mosaica Ohshima, 1915:265; 1916:279, fig. 5, 6. (Objective junior homonym of *Cucumaria mosaica* Koehler & Vaney, 1910)

Pentamera mosaica Panning, 1949:465.

Placothuria ohshimai Liao, 1997:225, fig. 135.

Mitsukuriella squamulosa.—Liao, 1997: 229 (Non *Cucumaria squamulosa* Mitsukuri, 1912) Non: *Cucumaria mosaica* Koehler & Vaney, 1910

Material examined.—Off Yellow Sea, 33°N, 124°30'E, 64 m, 1 specimen; East China Sea, 30°30'N, 125°E, 65 m, 2 specimens.

Diagnosis.—Body medium-sized, up to 45 mm in length, U-shaped, rigid. Ossicles in body wall scales up to 0.5 mm diameter,

associated with numerous knobbed tables and derivatives therefrom. Tube feet with tables; tentacles with rods.

Remarks.—A distinctive species, differing from the three other known species in this genus (*P. molpadioides* (Semper), *P. huttoni* (Dendy), *P. squamata* Pawson) in having knobbed tables in the body wall along with the scales. When Ohshima described and named this species in 1915, the species name was an objective junior homonym of *Cucumaria mosaica* Koehler & Vaney, 1910, and thus the name was not available, despite Panning's (1949) attempt to transfer the species to another genus. A new and very appropriate name was finally provided by Liao (1997, p. 225). The record of *Mitsukuriella squamulosa* (Mitsukuri) in Liao (1997) and in Lane et al. (2000) should be cancelled. Re-examination shows

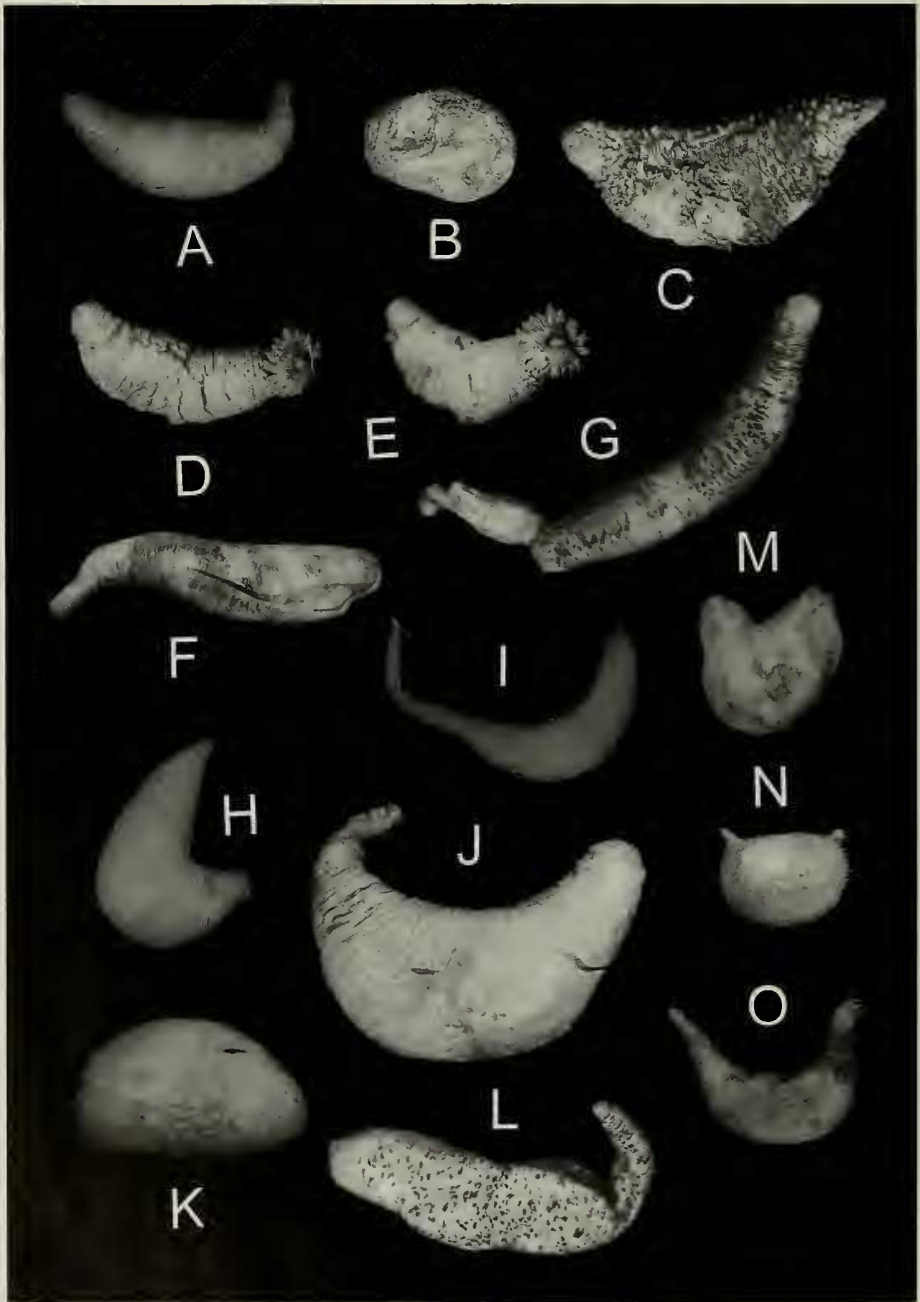


Fig. 20. A, *Phyllophorus (Phyllophorella) dubius* Cherbonnier; B, *Phyllophorus (Phyllophorella) kohkutien-sis* Heding & Panning; C, *Phyllophorus (Phyllothuria) donghaiensis* new species, Holotype; D, *Phyllophorus (Isophyllophorus) orientalis* new subgenus, new species, Holotype; E, The same, from anterior, showing 20 subequal tentacles; F, *Anthochirus loui* Chang; G, *Anthochirus loui* Chang; H, *Neothyonidium spiniferum* new species, Paratype; I, *Allothyone longicauda* (Östergren); J, *Stolus crassus* new species, Holotype; K, *Thyone crebrapodia* Cherbonnier; L, *Thyone purpureopunctata* new species. Holotype; M, *Thyone sinensis* new species, Paratype; N, *Ypsilothuria bitentaculata* (Ludwig); O, *Vaneyella dactylica* (Ohshima). All figures are approximately natural size; figure K is enlarged about 1.5 times.

that the two specimens previously referred to *Mitsukuriella squamulosa* are certainly *Placothuria ohshimai*.

Order Dactylochirotida

Family Vaneyellidae Pawson & Fell, 1965

Vaneyella dactylica (Ohshima)

Figs. 19, 200

Pseudocucumis dactylicus Ohshima, 1915:
272; 1916–19:395, fig. 76.

Vaneyella dactylica.—Heding & Panning,
1954:45.

Material examined.—East China Sea,
29°45'N, 128°30'E, 850 m, 5 specimens;
East China Sea, 27°45'N, 128°E, 900 m, 5
specimens.

Diagnosis.—Small form, up to 4 cm in
length with spindle-shaped body, mouth
and anus distinctly upturned. Tentacles 15,
7 larger and 8 smaller, digitiform. Calcare-
ous ring simple, no posterior prolongations
on radials (Fig. 19A). Ossicles in body wall
imbricating scales, single-layered, with num-
erous perforations and excentric spiny
spire near margin of scale (Fig. 19A, B).
Tentacles with perforated plates.

Remarks.—This very interesting dactyl-
ochirote does not seem to have been col-
lected since the *Albatross* obtained a single
specimen in the East China Sea, off Koshiki
Islands, Japan (31°9'N, 129°22'E), at a
depth of 715 m. Our ten specimens were
taken near the type locality. They are un-
doubtedly identical with the specimen orig-
inally described by Ohshima (1915).

Checklist of Dendrochirote and Dactylochirote Holothurians of China

New taxa are in bold. Species marked
with an asterisk (*) are discussed in the
text. Scientific names, authors and dates are
followed by known distribution in China
seas, and known depth ranges. Abbrevia-
tions: Y, Yellow Sea; E, East China Sea; S,
South China Sea; m, metres.

Order Dendrochirotida

Family Cucumariidae

Subfamily Colochirinae

Cercodemas anceps (Selenka, 1867). E, S,
0–10 m.

Colochirus quadrangularis Troschel, 1846.
E, S, 0–100 m.

Leptopentacta imbricata (Semper, 1868). E,
S, 0–54 m.

Plesiocolochirus inornatus (Marenzeller,
1881). Y, E, 0–30 m.

Plesiocolochirus nipponensis (Clark, 1938).
E, 0–30 m.

Pseudocolochirus violaceus (Théel, 1886).
S, 20–67 m.

Subfamily Cucumariinae

Pseudocnus echinatus (Marenzeller, 1881).
E, S, 0–50 m.

Subfamily Thyonidiinae

**Actinocucumis chinensis*, new species S,
45 m.

Actinocucumis typicus Ludwig, 1875. E, S,
0–50 m.

Mensamaria intercedens (Lampert, 1885).
E, S, 0–67 m.

Family Phyllophoridae

Subfamily Phyllophorinae

**Anthochirus loui* Chang, 1948. Y, 15–67 m.

**Phyllophorus (Phyllophorella) dubius*
Cherbonnier, 1960. E, S, 43–125 m.

**Phyllophorus (Phyllophorella) kohkutien-
sis* Heding & Panning, 1954. S, 36–53 m.

Phyllophorus (Phyllophorella) liuwutiensis
Yang, 1937. E, S, 0 m.

Phyllophorus (Phyllophorella) spiculata
Chang, 1935. E, S, 0–30 m.

**Phyllophorus (Phyllothuria) cebuensis*
(Semper, 1868). S, 42–125 m.

**Phyllophorus (Phyllothuria) donghaien-
sis*, new species. E, 100 m.

Phyllophorus (Phyllothuria) hypsipyriga
(Marenzeller, 1881). Y, E, 30–100 m.

Phyllophorus (Phyllothuria) ordinatus
Chang, 1935. Y, 0 m.

**Phyllophorus (Isophyllophorus) oriental-
is*, new subgenus, new species. Y, 41 m.

Subfamily Semperiellinae

**Neothyonidium inflatum* (Sluiter, 1901). S,
37–74 m.

- **Neothyonidium minutum* (Ohshima, 1915). E, 116 m.
- **Neothyonidium spiniferum*, new species. S, 31–99 m.
- Pentadactyla japonica* (Marenzeller, 1881). E, 60–103 m.
- Phyrella fragilis* (Ohshima, 1912). S, 0 m.
Subfamily Thyoninae
- **Allothyone longicauda* (Östergren, 1898). Y, 0–47 m.
- **Allothyone mucronata* (Sluiter, 1901). S, 20–89 m.
- Havelockia versicolor* (Semper, 1868). S, 0–59 m.
- **Pentamera constricta* (Ohshima, 1915). E, 55–150 m.
- Stolus albescens* Liao, 1995. S, 20–109 m.
- Stolus buccalis* (Stimpson, 1855). E, S, 0–54 m.
- Stolus canescens* (Semper, 1868). S, 74–89 m.
- **Stolus crassus*, new species. S, 74 m.
- **Stolus micronodosus*, new species. S, 92 m.
- Thorsonia adversaria* (Semper, 1868). E, S, 16–50 m.
- Thyone anomala* (Östergren, 1898). E, S, 0–103 m.
- Thyone bicornis* Ohshima, 1915. S, 23–61 m.
- **Thyone crebrapodia* Cherbonnier, 1988. E, S, 47–73 m.
- Thyone fusus chinensis* Yang, 1937. E, 0 m.
- **Thyone papuensis* Théel, 1886. Y, 25–58 m.
- Thyone pedata* Semper, 1868. S, 55 m.
- Thyone pohaiensis* Liao, 1986. Y, 0–8 m.
- **Thyone purpureopunctata*, new species. S, 30–60 m.
- **Thyone sinensis*, new species. E, S, 0–4 m.
- Thyone spinifera* Liao, 1995. S, 15–115 m.
Family Placothuriidae
- **Placothuria molpadioides* (Semper, 1868). S, 17–57 m.
- **Placothuria ohshimai* Liao, 1997. Y, E, 60–65 m.
Family Sclerodactylidae
Subfamily Cladolabinae
- Afrocucumis africana* (Semper, 1868). S, 0 m.
- Cladolabes aciculus* (Semper, 1868). S, 0 m.
- Cladolabes crassus* (Clark, 1938). S, ? m.
- Cladolabes schmeltzii* (Ludwig, 1875). S, 0 m.
- Euthyonidiella tungshanensis* (Yang, 1937). E, 0–80 m.
- Ohshimella ehrenbergi* (Selenka, 1867). S, 0 m.
Subfamily Sclerodaetylinae
- Sclerodactyla multipes* (Théel, 1886). Y, 0–50 m.
Order Dactylochirotida
Family Ypsilothuriidae
- Ypsilothuria bitentaculata* (Ludwig, 1894). E, S, 510–580 m.
Family Vaneyellidae
- **Vaneyella dactylica* (Ohshima, 1915). E, 850–900 m.

Distribution Patterns of Dendrochirotes and Dactylochirotes of China

Of the 56 dendrochirote and dactylochirote holothurian species now known from China seas, approximately 40 species (71%) are more widely distributed, in the Indo-west-Pacific area generally, or in the China-Japan area. One species, *Ypsilothuria bitentaculata* (Ludwig), is more or less cosmopolitan. Sixteen species (28%), including the eight new species described here, are known only from China seas. In a detailed analysis of the echinoderm fauna of the South China Sea, Lane et al. (2000) found that when echinoderms as a whole are considered, endemism is lower (12%), while endemism in holothurians is 16%. For further discussion of distribution patterns, see Lane et al. (2000).

Literature Cited

- Cannon, L. R. G., & H. Silver, 1987. Sea cucumbers of Northern Australia. Queensland Museum, Brisbane, 60 pp.
- Chang, F. Y. 1934. Report on the holothurians collected from the coast of China.—Contributions from the Institute of Zoology, National Academy of Peiping 2(1):1–52.
- . 1935. Additions to the holothurians of the

- Chinese coast.—Contributions from the Institute of Zoology, National Academy of Peiping 2(3):1–18.
- . 1943. Notes on some echinoderms from Chengshan, Chowshan Archipelago.—Journal of the National Normal University, Peiping, 1943:1–8.
- . 1948. Echinoderms of Tsingtao.—Contributions from the Institute of Zoology, National Academy of Peiping 4:33–104.
- , & Y. Liao. 1964. Echinodermata. Illustrated Fauna of China. Science Press, Beijing, 142 pp.
- , & P. L. Woo. 1954. On the echinoderms of Dalian and its vicinity.—Acta Zoologica Sinica 6(2):123–145.
- Cherbonnier, G. 1960. Holothuries récoltées par A. Gallardo dans la Baie de Nha-trang (Sud Vietnam).—Bulletin du Muséum National d'Histoire Naturelle 2^e Série 32(5):425–435; 33(1):132–136.
- . 1988. Echinodermes: Holothurides. Faune de Madagascar 70. O.R.S.T.O.M., Paris, 292 pp.
- Clark, A. M. 1982. Echinoderms of Hong Kong. Pp. 485–501 in B. S. Morton and C. K. Tseng, eds., The marine flora and fauna of Hong Kong and Southern China. Hong Kong University Press, Hong Kong, 350 pp.
- , & F. W. E. Rowe. 1971. Monograph of shallow-water Indo-West-Pacific echinoderms. British Museum (Natural History), London, 238 pp.
- Clark, H. L. 1921. The echinoderm fauna of Torres Strait: its composition and origin.—Carnegie Institution of Washington Publication 214, Department of Marine Biology 10, 224 pp.
- . 1932. Echinodermata (other than Asteroidea) of the Great Barrier Reef Expedition, 1928–1929.—Scientific Reports of the Great Barrier Reef Expedition 1928–1929, 4(7):197–239.
- . 1938. Echinoderms from Australia.—Memoirs of the Museum of Comparative Zoology at Harvard College 55:1–596.
- . 1946. The echinoderm fauna of Australia.—Carnegie Institution of Washington Publication 566:1–567.
- Ekman, S. 1918. Holothurioidea. Results of Dr. E. Mjöberg's Swedish scientific expeditions to Australia 1910–1913. XIX.—Kongliga Svenska Vetenskapsakademiens Handlingar 58(6):1–70.
- , & A. Panning. 1954. Phyllophoridae.—Spolia Zoologica Musei Hauniensis 13:1–209.
- Koehler, R., & C. Vaney. 1908. Holothuries recueillies par l'investigateur dans l'Océan Indien. II. Les Holothuries Littorales. Indian Museum, Calcutta, 54 pp.
- Lampert, K. 1885. Die Seewalzen. Pp. 1–312 in C. Semper, Reisen im Archipel der Philippinen. 4(3). Weisbaden.
- Lane, D. J. W., L. M. Marsh, D. VandenSpiegel, & W. E. Rowe. 2000. Echinoderm fauna of the South China Sea: inventory and analysis of distribution patterns.—The Raffles Bulletin of Zoology 2000 Supplement No. 8:459–493.
- Liao, Y. 1986. *Thyone pohaiensis*, a new sea cucumber from the Bohai Sea, China.—China Journal of Oceanography and Limnology 4(3):313–317.
- . 1997. Fauna Sinica. Phylum Echinodermata, Class Holothuroidea. Science Press, Beijing, 334 pp.
- , & A. M. Clark. 1995. The echinoderms of Southern China. Science Press, Beijing, 614 pp.
- Ludwig, H. 1875. Beiträge zur Kenntniss der Holothurien.—Arbeiten aus dem Zoologisch-Zoatomisches Institut in Würzburg 2(2):77–120.
- . 1892. Die Seewalzen. In H. G. Bronn, ed., Klassen und Ordnungen der Thierreichs 2(3):1–447.
- . 1894. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross," during 1891, Lieut. Commander Z. L. Tanner, U.S.N., commanding. XII. The Holothurioidea.—Memoirs of the museum of Comparative Zoology 17(3):5–183.
- Marenzeller, E. 1881. Neue Holothurien von Japan und China.—Verhandlungen der Zoologisch-Botanischen Gesellschaft in Österreich 31:121–140.
- Mitsukuri, K. 1912. Studies on actinopodous Holothurioidea.—Journal of the College of Science, Imperial University of Tokyo 29(2):1–284.
- Östergren, H. 1898. Zur Anatomie der Dendrochiroten, nebst beschreibungen neuer Arten.—Zoologischer Anzeiger 20:102–110, 133–136.
- Ohshima, H. 1912. On the system of Phyllophorinae with description of the species found in Japan.—Annotationes Zoologicae Japonensis 8(1):53–96.
- . 1915. Report on the holothurians collected by the United States steamer Albatross in the northwestern Pacific during the summer of 1906.—Proceedings of the United States National Museum 48:213–291.
- . 1916–1919. Northwestern Pacific holothurians collected by the Albatross.—Zoological Magazine, Tokyo, articles in vols. 28–31.
- Panning, A. 1949. Versuch einer Neuordnung der Familie Cucumariidae.—Zoologischer Jahrbucher Abteilung für Systematik, Ökologie und Geographie der Tiere 78:404–470.
- Pawson, D. L. 1970. The marine fauna of New Zealand. Sea cucumbers (Echinodermata: Holothuroidea).—Memoirs of the New Zealand Oceanographic Institute 52:1–69.
- , & H. B. Fell. 1965. A revised classification of the dendrochirote holothurians.—Breviora 214:1–7.

- Pearson, J. 1903. Holothurioidea. Pp. 181–208 in W. A. Herdman, ed., Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Manaar. Supplementary report 5, Royal Society of London.
- Rho, B. J., & J. H. Won 1993. A systematic study on *Dendrochirota* (Echinodermata: Holothurioidea) in Korea.—The Korean Journal of Systematic Zoology 9(2):123–149.
- Rowe, F. W. E., & J. Gates. 1995. Echinodermata. Zoological Catalogue of Australia, 33. C.S.I.R.O., Australia. 510 pp.
- Selenka, E. 1867. Beiträge zur Anatomie und Systematik der Holothurien.—Z Wiss Zool 17:291–374.
- Semper, C. 1868. Holothurien. Reisen im Archipel der Philippinen 2, Wissenschaftliche Resultate. Wilhelm Engelmann, Leipzig, 288 pp.
- Sluiter, C. P. 1901. Die Holothurien der Siboga-Expedition.—Siboga Expeditie 44:1–142.
- . 1914. Die von Dr. P. N. van Kampen, Während seiner Fahrten mit dem Regierungsdampfer Gier 1906–09 im Indischen Archipel Gesammelten Holothurien.—Contributions a la Faune des Indes Néerlandaises 1(1):1–28.
- Stimpson, W. 1855. Descriptions of some new marine Invertebrata.—Proceedings of the Academy of Natural Sciences, Philadelphia 7:385–394.
- Théel, H. 1886. Report on the Holothurioidea. 2.—Report on the Scientific results of the Voyage of H.M.S. Challenger 1873–76, Zoology 4(39): 1–290.
- Troschel, F. H. 1846. Neue Holothurien-Gattungen.—Archiv für Naturgeschichte 1:60–66.
- Yang, P. F. 1937. Report on the holothurians from the Fukien coast.—Amoy Marine Biological Bulletin 2(1–2):1–46.