

The Sponges of Micronesia, Part I

The Palau Archipelago

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ALTHOUGH potentially interesting from a zoogeographic standpoint, the marine fauna of the Palau Islands and of the islands and atolls to the eastward, with the exception of Hawaii, have received scant attention from expeditions and individual collectors. It was to repair this gap in our knowledge that the "Project Coral Fish" expeditions to the western and central Pacific were undertaken. The first of these expeditions visited the Palau Islands in 1955 and made extensive marine collections, of which the sponges described below were a part.

Previous work relating to the Demospongiae of the Palau Islands is restricted to de Laubenfels' (1954) "Sponges of the West Central Pacific." This monograph was based upon the author's own collections in the Caroline Islands, Marshall Islands, and the Marianas; and it contains, in addition to descriptions of many new species, significant field observations which have facilitated identification of the present collection. There are 33 species common to the two collections and the identification of these has necessitated considerable revision of portions of de Laubenfels' monograph.

The Palau Islands belong to the Western Caroline group and are situated on a submarine ridge running northeast from the Moluccas at 6° 53' N to 8° 06' N, 134° 29' E. Between the Palaus and the Philippines is the Philippine Trench, which acts as an effective natural barrier to the free migration of shallow-water invertebrates. Consequently, zoogeographic interest in the Palau area focuses on whether the fauna has remained similar to that of the Indo-Malayan region, through interchange of populations across the intervening 600 miles, or has diverged significantly, producing a high percentage of endemic species.

In order to generalize about the relationships of the Palau Islands sponge fauna it is necessary to know something of the faunas of contiguous areas. Two main regions have contributed to the Palauan fauna, the Indo-Malayan and the New Guinea-northern Australian. The sponge fauna of the Indo-Malayan region is known chiefly from the works of Thiele (1898, 1900, 1903), Lindgren (1897), Kieschnick (1898), Topsent (1897), Hentschel (1912), Wilson (1925), de Laubenfels (1935), and Lévi (1961).

Islands to the east of the Palaus are relatively unknown in respect to their sponge fauna. With the exception of Hawaii the literature is restricted to Kirkpatrick (1900) for Christmas Island; and de Laubenfels (1949) for Yap, (1955) for Onotoa, and (1954) for the Marshall Islands, Caroline Islands, and the Marianas.

Our knowledge of the New Guinea and northern Australian fauna stems from the work of Ridley (1884) and Burton (1934).

Many of the references cited above are very old and require extensive revision; this, added to the obvious incompleteness of the faunal picture they present of their respective areas, restricts the zoogeographic comparisons that can be made. In view of the unreliability of the literature, the statements made here with respect to the Palau Islands are based solely on the specimens examined in the course of this investigation, and draw on de Laubenfels' work only where this has been verified. It will be possible to give a more detailed analysis when collections from Ifaluk, Kapingamarangi, the Philippines, and Hawaii have been fully studied.

Fifty species are described in this report; of this number nine are new. A total of 14 species is endemic to the Palau Islands; seven species are known only from the Palaus eastward, in the case of *Xestospongia exigua* eastward to

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Christmas Island. Thirteen species are common to the Indo-Malayan and Palau areas, extending, in the case of *Iotrochota baculifera*, *Clathria fasciculata*, *Clathria cervicornis*, *Neofolitispa dianchora*, and *Asteropus sarasinorum*, eastward to the Marshall Islands. Eleven species have a wide Indo-Pacific distribution: *Heteronema erecta*, *Ircinia ramosa*, *Phyllospongia foliascens*, *Psammaphysilla purpurea*, *Dysidea herbacea*, *Coelocarteria singaporense*, *Myrmekioderma granulata*, *Spirastrella vagabunda*, *Placospongia melobesioides*, *Ancorina acervus*, and *Cinachyra australiensis*. Three species are known elsewhere only from Australia, in the case of *Jaspis coriacea* only from South Australia.

The sponge fauna of the Palau Islands is certainly richer and more varied than that of any of the more easterly islands thus far studied. It is not possible, however, to compare the quantity and variety of Demospongiae in Indo-Malayan localities with that of the Palau Islands without more data on both areas.

The broad system of classification used in this work is basically that propounded by Topsent (1928) and modified by de Laubenfels (1936). In several cases minor alterations in this system have been suggested. The Axinellidae are still treated as a family of the Halichondrida, although it is clear that they should be elevated to the level of a separate order. To reassign the genera involved is a long task, the material for which is not immediately available.

Throughout the text means are given in parentheses with the range of spicule dimensions.

All color notations are after Munsell's *Book of Color*.

ACKNOWLEDGMENTS

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STATION DATA

- Sta. 10. Madalai district, west end of Koror I., Abé's Traverse III. Sand bottom with *Enhalus* and *Halimeda*; depth 12 inches at low water. July 8, 1955.
- Sta. 12. Madalai district, west end of Koror I., Abé's Traverse II, at south end of Koror-Arakabesan Causeway. Mud and sand, with *Enhalus*, *Halimeda* and *Padina*; exposed at low water. July 9, 1955.
- Sta. 15. Madalai district, west end of Koror I. Shallow flat enclosed by retaining wall parallel to Malakal Causeway. Sand and silt, with *Enhalus*; depth 18-24 inches at low water. July 11, 1955.
- Sta. 25. Inner margin of barrier reef, 8 miles NW of Koror. Sand, coral, dead coral blocks; depth 3-7 ft. July 19, 1955.
- Sta. 35. Peleliu boat channel, between Ngargersal and Kongauru islands, ca. 1 mile east of north tip of Peleliu. Sand, silt, some coral; *Enhalus acoroides* and 2 other species of eelgrass; algae incl. *Caulerpa* spp. Depth 1-10 ft. July 24, 1955.
- Sta. 47. Iwayama Bay, shore of islands XXXIII and XXXIV, west side of Kogai-Hanto. Sand, live and dead coral; *Enhalus* in sand, *Padina* on rocky areas. July 28, 1955.
- Sta. 53. Ngaremdiu area, eastern Urukthapel; rocky cape west of sand beach Oiratel-ruul. Sand, coral, rock; small eel grass and *Halophila ovalis*; depth 0-7 ft. July 31, 1955.
- Sta. 59. Reef bordering eel grass flat east of Ebadul's dock, north shore of Koror. Living and dead coral, with sparse patches of sand. Aug. 4, 1955.
- Sta. 50. Sand and eel grass flat west of Ebadul's dock, north shore of Koror. Sand with occasional coral patches, *Enhalus* abundant, long streamers of sargassum attached to dead coral. August 5, 1955.
- Sta. 61. Seaward reef flat at south end of Nge-melis I., west side of Palau Archipelago. Coral and sand, some *Enhalus* and *Halimeda* in sand patches; depth 18 inches-6 ft. August 6, 1955.
- Sta. 64. Small bay at southern end of Eil Malk lagoon. Bottom limestone and sand, little coral; depth 6-20 ft. August 7, 1955.

- Sta. 67. Reef in pass west of Nghus ("Ankosu" on charts), southern tip of Urukthapel. Living and dead coral, sand, coral rubble; depth 5–7 ft. Aug. 7, 1955.
- Sta. 92. Iwayama Bay, south end of island XV; Abé's Traverse XIII. Bottom silty sand over rocky limestone platform, marginal living reef; *Enbalus*, *Padina*, *Halimeda*; depth 3–20 ft. August 14, 1955.
- Sta. 100. Iwayama Bay, Bay of the Dragon Palace, west side of Kogai-hanto. Bottom coral, sand in pockets; depth 5–15 ft. August 16, 1955.
- Sta. 104. Malakal Harbor. From sunken ship off north shore of Urukthapel; depth 40–50 ft. August 17, 1955.
- Sta. 106. Reef flat, Ngadarak reef north of mouth of Malakal Pass. Exposed coral rubble with residual tide pools. August 17, 1955.
- Sta. 111. Reef flat, Ngaremdiu reef, east side of Urukthapel. Exposed boulder flat. August 19, 1955.
- Sta. 124. Yoo Passage, west of Kasao Reef, 3¼ miles SSE of Ngaremdiu, east side of Urukthapel. August 24, 1955 [Gloria Maris Sta. 450, haul 2].
- Sta. 125. 1¾ miles NE of Ngabadangel (Cape "Gabadaguru" on charts). Sand with *Halimeda* and *Seriatopora*, 17 fms. August 24, 1955. [Gloria Maris Sta. 452, haul 1].
- Sta. 133. Iwayama Bay, south shore of island II. Reef flat between shore and deep reef pool; area of Abé's traverses VIII, IX, and X. Coral with sand pockets; depth 2–3 ft at m.l.w. August 28, 1955.
- Sta. 134. Iwayama Bay, south end of island XX. Reef shelf and slope; bottom entirely coral and rock; depth 3–20 ft. August 28, 1955.
- Sta. 135. Iwayama Bay, west side of island XXII. Reef shelf and slope; bottom entirely coral and rock; depth 3–40 ft. August 28, 1955.
- Sta. 136. Reef flat outside of large cave at SE end of Koror, east entrance of Iwayama Bay. Sand, branched coral (*Montipora*, *Seriatopora*), and vegetation (*Enbalus*, *Halimeda*, *Padina*); depth 4–6 ft. August 28, 1955.
- Sta. 140. Iwayama Bay, in Ngerchelngael ("Geruherugairu" on charts) Pass, between Kogai Peninsula and Kaibakku I. *Montipora*-flat with *Enbalus*, *Halimeda*, *Padina*, and some rocks of foreign origin; depth 4–5 ft. August 30, 1955.
- Sta. 219. Iwayama Bay (Abé's Division L), extreme eastern part. Marginal reef along coast of Koror called U'lamii' (or Uchlamiich). Living and dead coral, sand patches; depth 3–20 ft. October 12, 1955.
- Sta. 220. Iwayama Bay, east side of mouth of Kaki-suido (Oyster Pass) between islands XXIX and SE Koror. Limestone, live and dead coral; depth 3–20 ft. October 12, 1955.
- Sta. 220A. Same as 220 but collected Oct. 22, 1955.
- Sta. 220B. Same as 220 but collected Oct. 29, 1955.
- Sta. 236A. Same as 220 but 150 yds. north. Oct. 20, 1955.
- Sta. 245. West shore of Urukthapel, in small bay; 7° 16' 31" N, 134° 26' 13" E. Limestone shelf, coral, *Halimeda*, 3–10 ft. October 23, 1955.
- Sta. 252. Fringing reef of small island in west part of lagoon of Eil Malk Island. Limestone, coral, sand, 0–10 ft. October 27, 1955.
- Sta. 258. Small bay in north coast of Ngaremdiu region of Urukthapel, near Japanese stone pier. Sand, live and dead coral, limestone, with *Enbalus* and *Halimeda*, much stinging *Stephanoscyphus*; depth 2–4 ft. November 2, 1955.

SYSTEMATIC DESCRIPTION AND DISCUSSION
(Species included are listed in systematic order)

Order Keratosa Grant

Suborder Dictyoceratida Minchin

Family Spongiidae Gray

Genus *Spongia* Linné

Spongia officinalis Linné

Genus *Dactylospongia* n. gen.

Dactylospongia elegans (Thiele)

Genus *Heteronema* Keller

Heteronema erecta Keller

Genus *Ircinia* Nardo

Ircinia ramosa Keller

Genus *Phyllospongia*

Phyllospongia foliascens (Pallas)

Phyllospongia dendyi Lendenfeld

Genus *Fasciospongia* Burton

Fasciospongia chondrodes

(de Laubenfels)

- Genus *Psammaphysilla* Keller
Psammaphysilla purpurea Carter
 Family Dysideidae Gray
 Genus *Dysidea* Johnston
Dysidea herbacea (Keller)
Dysidea chlorea de Laubenfels
Dysidea granulosa n. sp.
Dysidea arenaria n. sp.
 Genus *Euryspongia*
Euryspongia lobata n. sp.
- Order Haplosclerida Topsent
 Family Haliclونidae de Laubenfels
 Genus *Haliclona* Grant
Haliclona velinea (de Laubenfels)
Haliclona koremella de Laubenfels
 Genus *Cibrochalina* Schmidt
Cibrochalina olemda de Laubenfels
 Genus *Xestospongia* de Laubenfels
Xestospongia exigua (Kirkpatrick)
 Family Callyspongiidae de Laubenfels
 Genus *Callyspongia* Duchassaing and Michelotti
Callyspongia subarmigera (Ridley)
Callyspongia ridleyi Burton
 Family Desmacidonidae Gray
 Genus *Gelliodes* Ridley
Gelliodes gracilis Hentschel
- Order Poecilosclerida Topsent
 Suborder Phorbasiformes de Laubenfels
 Family Adocidae de Laubenfels
 Genus *Adocia* Gray
Adocia turquosia de Laubenfels
 Genus *Toxadocia* de Laubenfels
Toxadocia violacea de Laubenfels
 Genus *Orina* Gray
Orina sagittaria Sollas
 Genus *Kallypilidion* de Laubenfels
Kallypilidion poseidon de Laubenfels
 Genus *Pellina* Schmidt
Pellina carbonaria (Lamarck)
 Genus *Siphonodictyon* n. gen.
Siphonodictyon mucosa n. sp.
 Family Coelosphaeridae Hentschel
 Genus *Coelocarteria* Burton
Coelocarteria singaporensis (Carter)
- Suborder Myxilliformes de Laubenfels
 Family Tedaniidae Ridley and Dendy
 Genus *Iotrochota* Ridley
Iotrochota baculifera Ridley
- Suborder Microcioniformes de Laubenfels
 Family Microcionidae Hentschel
 Genus *Microciona* Bowerbank
Microciona eurypa (de Laubenfels)
 Genus *Clathria* Schmidt
Clathria cervicornis (Thiele)
Clathria fasciculata Wilson
 Family Ophlitaspongiidae de Laubenfels
 Genus *Mycale* Gray
Mycale lissochela n. sp.
Mycale cavernosa n. sp.
 Genus *Neofolitiispa* nom. nov.
Neofolitiispa dianchora (de Laubenfels)
 Genus *Desmacella* Schmidt
Desmacella lampra de Laubenfels
- Order Halichondrida Topsent
 Family Axinellidae Ridley and Dendy
 Genus *Pseudaxymissa* Burton
Pseudaxymissa pitys de Laubenfels
 Genus *Phycopsis* Carter
Phycopsis sp. cf. *terpnis* de Laubenfels
 Family Desmoxyidae Hallmann
 Genus *Higginsia* Higgin
Higginsia mixta (Hentschel)
 Genus *Myrmekioderma* Ehlers
Myrmekioderma granulata (Esper)
- Order Hadromerida Topsent
 Family Spirastrellidae Hentschel
 Genus *Spirastrella* Schmidt
Spirastrella aurivilli Lindgren
Spirastrella vagabunda Ridley
 Genus *Timea* Gray
Timea granulata n. sp.
 Family Placospongiidae Gray
 Genus *Placospongia* Gray
Placospongia melobesioides Gray
- Order Epipolasida Sollas
 Family Jaspidae de Laubenfels
 Genus *Asteropus* Sollas
Asteropus sarasinorum (Thiele)
 Genus *Jaspis* Gray
Jaspis coriacea (Carter)
- Order Choristida Sollas
 Family Ancorinidae Gray
 Subfamily Ancorininae de Laubenfels
 Genus *Ancorina* Schmidt
Ancorina acervus (Bowerbank)

Subfamily Stellettinae Sollas

Genus *Stelletta* Schmidt*Stelletta durissima* n. sp.

Family Tetillidae Sollas

Genus *Tetilla* Schmidt*Tetilla microxea* n. sp.Genus *Paratetilla* Dendy*Paratetilla bacca* (Selenka)Genus *Cinachyra* Sollas*Cinachyra australiensis* (Carter)

(complex of species)

ORDER KERATOSA Grant

SUBORDER DICTYOCERATIDA Minchin

FAMILY SPONGIIDAE Gray

GENUS *Spongia* Linné*Spongia officinalis* Linné, 1759, p. 1348, pl. 1,

RESTRICTED SYNONYMY:

Spongia officinalis Linné, 1759, p. 1348, pl. 1, figs. 1 and 2.*Spongia officinalis* subspecies *matamata* de Laubenfels, 1954, p. 4.

OCCURRENCE: Sta. 60.

REMARKS: A single specimen of this sponge is in the present collection. It compares well with the type of de Laubenfels' *S. officinalis* subspecies *matamata*, USNM 23200, except that the primary fibres are stouter, up to 80μ in diameter, and more frequent than is inferred in de Laubenfels' (1954) description.

Embryos in all stages of segmentation are present in the specimen, and the older embryos are very darkly pigmented.

No attempt is made here to evaluate the previous records of *Spongia officinalis* from the Indo-Pacific region. It is evident that systematic relationships are confused in the entire genus and particularly in *S. officinalis* and *S. zimocca*. A careful study of more extensive collections than are presently available is necessary before affirming that all specimens referred to these species are correctly assigned.

DISTRIBUTION: Mediterranean, West Indies, Australia, Indian Ocean, Norway(?), South America, Marshall Islands.

GENUS *Dactylospongia* nov. gen.

Dictyoceratida with skeleton a relatively regular network of polygonal meshes without differentiation into ascending and connecting elements. Fibres lack foreign inclusions except for a few isolated spicule fragments, have a granulate surface texture and a faintly stratified structure. The sponge surface is free of detritus and is covered with irregular conules. The dermal membrane between rows of conules is stretched over deep subdermal channels which extend for a considerable vertical distance. Flagellate chambers are evenly distributed throughout the endosome, and are spherical and small, $24\text{--}30\mu$ in diameter. The genus is erected for the type species, *Luffariella elegans* Thiele, and is most closely allied to *Hippospongia*.

Dactylospongia elegans (Thiele)

Fig. 1a, b

Luffariella elegans Thiele, 1899, p. 25, pl. 3, fig. 4, pl. 5, fig. 20.

OCCURRENCE: Sta. 47. Palau Islands.

DESCRIPTION: Several pieces of this sponge were obtained, probably all from one large colony with long thin anastomosing branches diverging from a small poorly defined basal region. The branches are 0.5–1.5 cm wide, up to 32 cm long, and many have several anastomoses along their length.

COLOR: In alcohol, dark reddish-brown, between (rY-R2/2) and (rY-3/2).

TEXTURE: Extremely tough and elastic, almost rubbery.

SURFACE: Coarsely conulose, with the conules tending to be aligned in rows between which the dermal membrane is stretched. In parts of the sponge the dermal membrane of either surface is all that connects two adjacent branches. In the preserved sponge the membrane is sunken into deep subdermal cavities which may be up to 4.0 cm long and 0.5 cm wide. Conules are irregular, squarish, multituberculate, and up to 0.5 cm long, 0.2 cm high, and 0.2 cm wide. The oscules are distributed irregularly over the surface of the branches and are 0.08–0.2 mm in diameter. Pores are absent from the areas where the dermal membrane extends over



FIG. 1a. *Dactylospongia elegans* (Thiele). USNM 23707.

subdermal cavities, but abundant over most of the surface.

SKELETON: A compact irregular reticulation of clear yellow-brown fibres; many ascending fibres are distinguishable only immediately below the surface. Some stratification is shown in most fibres and a poorly demarcated pith occurs infrequently. Isolated spicule fragments occur randomly. A characteristic feature of the skeleton is the granulate surface of the fibres. Fibre diameter is $20\text{--}54\mu$ (38μ).

FLAGELLATE CHAMBERS: Small, spherical, $24\text{--}30\mu$ in diameter, and are regularly distributed throughout the body of the sponge except in the lacunar areas which surround the subdermal cavities. The endosome contains many darkly pigmented granules and abundant diatom skeletons.

DISCUSSION: Thiele (1899) described this sponge from the Celebes and established the genus *Luffariella* to receive *Luffaria variabilis* Poléjaeff and *Luffariella elegans*; the former was designated as the type of the genus by Thiele and later by de Laubenfels (1936).

Considerable confusion has centered around the correct generic position of *Luffaria variabilis*. The genus *Luffaria* was unrecognizably described by Duchassaing and Michelotti (1864). Schmidt (1870) redescribed the genus without adding any species, and Poléjaeff (1884) described *Luffaria variabilis*. Lendenfeld (1889) recognized that Poléjaeff's sponge was not a *Luffaria* as understood by Schmidt (= *Verongia*), and took the erroneous step of re-establishing *Luffaria* under Poléjaeff's name to receive *L. variabilis* and two new species. Topsent (1934) considered that both *Luffaria* and *Luffariella* should be abandoned and all species involved transferred to *Aplysinopsis* Lendenfeld. The difference between *Aplysinopsis* and *Thorecta* Lendenfeld is very slight, merely that *Thorecta* has a relatively smooth surface and more foreign material in the dermis (see de Laubenfels, 1948). These two genera are now considered synonymous.

The type specimen of *Luffaria variabilis* Poléjaeff should be established as BM 85.8.8.52. This sponge has been examined and in most features it is compatible with *Cacospongia*. It has, however, one distinguishing characteristic: an extremely fine and regular tertiary fibre network is present throughout the sponge. In view of this marked difference in the skeleton, it is proposed to retain *Luffariella* for *L. variabilis* and other sponges which have comparable skeletal structure. *Luffariella geometrica* Kirkpatrick may properly belong here.

It is clear that *Luffariella elegans* Thiele is generically distinct from *Luffariella variabilis*.

Examination of the Palau specimen of *L. elegans* and an undescribed specimen in the British Museum (1946.11.25.170) shows that the correct generic grouping for this sponge is not near *Cacospongia* but near *Hippospongia*, differing from some specimens of this genus only in form, the presence of long surface channels, and the lack of any cored primary fibres. These are the only features separating *L. elegans* and *Hippospongia metachromia*² (de Laubenfels), also from the Palau Islands.

² No cored ascending fibres were described for this sponge, but re-examination of the type has shown them to be present in the subdermal region.

Since the genus *Luffariella* is retained for *L. variabilis*, a new genus *Dactylospongia* is erected to receive *Luffariella elegans*.

DISTRIBUTION: Celebes (Thiele)

GENUS *Heteronema* Keller

Heteronema erecta Keller

Fig. 2

Heteronema erecta Keller, 1889, p. 339.

Heteronema erecta Row, 1911, p. 369.

Thorectopsamma mela de Laubenfels, 1954, p. 29, fig. 15, pl. 8, fig. 6.

Thorectopsamma mela de Laubenfels, 1955, p. 138.

OCCURRENCE: Sta. 10, 100, 140.

DESCRIPTION: De Laubenfels (1954) has given an excellent description of this sponge as it occurs in the Micronesian area and little can be added except to note that: (1) the primary fibres have a tendency to be fasciculated immediately below the surface; (2) The dermis is crowded with granules containing a black pigment; (3) The immediate subdermal region is cavernous, consequently the dermis is easily detachable; and (4) The pigment granules in the subdermal and deep layers of the body are extremely abundant and tend to obscure the chambers and canal system.

DISCUSSION: Comparison of Red Sea specimens of *Heteronema erecta* with de Laubenfels' Pacific sponges identified as *Thorectopsamma mela* reveals that the two species are identical. The extremely characteristic surface pattern of radiating ridges between conules is present in all specimens examined from both geographical areas. The texture of the sponge varies greatly: some of the Palau specimens are relatively compressible; others are extremely hard and thus compare with specimens described by Row (1911).

With the removal of *T. mela* to *Heteronema*, the genus *Thorectopsamma* Burton is reduced to three species. *T. irregularis*, the type species, was described from a single specimen; it had laminated fibres densely packed with debris and no special dermal skeleton. Burton made no mention of the soft tissues of his sponge. Re-examination of the type of *T. irregularis* (BM 30.8.13.217) shows that the flagellate chambers

are small and spherical, 20–30 μ in diameter; the subdermal region is extremely cavernous and darkly pigmented. This sponge is not easily distinguishable from *Heteronema*.

The second species described in *Thorectopsamma* is *T. chromogenia* de Laubenfels from Bermuda. This sponge is a dark red color and has far less debris in the fibres than *T. irregularis*. The flagellate chambers were undescribed and apparently much sand was incorporated in the body of the sponge. It is unlikely that this sponge belongs to *Thorectopsamma* but, in view of our incomplete knowledge of its anatomy, no suggestion can be made about its real affinities. *Thorectopsamma xana* de Laubenfels (1954) is referred to *Psammaphysilla purpurea*.

DISTRIBUTION: Red Sea (Keller, Topsent, Row); West Central Pacific; Hawaii (de Laubenfels).

GENUS *Ircinia* Nardo

Ircinia ramosa (Keller)

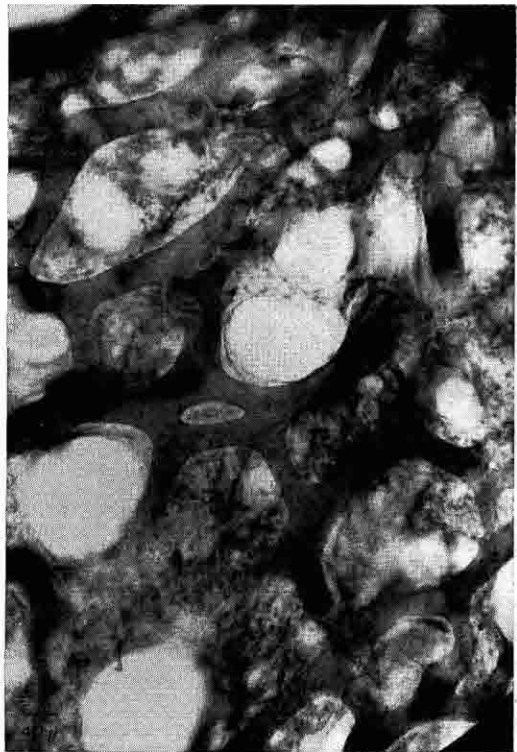


FIG. 1b. *Dactylospongia elegans* (Thiele). Portion of the fibre network.

RESTRICTED SYNONYMY:

Hircinia ramosa Keller, 1889, p. 345, pl. 20, fig. 5.

Ircinia ramosa de Laubenfels, 1948, p. 73.

Ircinia ramosa de Laubenfels, 1954, p. 23, fig. 11.

OCCURRENCE: Sta. 15, 60, 92.

REMARKS: De Laubenfels (1954) gives a relatively detailed description of this species and stresses the ramose form, the abundant fine filaments, and the presence of a second coarser type of filament containing refractile material as the characteristic features. The specimens in this collection agree in most details with the above. The fibres lacking granules have a greater range in diameter, $2.0-5.0\mu$, than either de Lau-

benfels', or Keller's specimens; the flagellate chambers range from $24-36\mu$ in diameter.

De Laubenfels (1950) differentiates *I. ramosa*, in the West Indies, from *I. fasciculata* by the form of the branch tips, rounded in *ramosa*, pointed in *fasciculata*. Hartman (1959) has emphasized the presence of a dermal reticulum of sand grains in *I. ramosa*. At present it is impossible to be sure that the Pacific sponges discussed above belong to the same species as West Indian sponges also named *I. ramosa*; the same problem applies to *I. fasciculata*. In the case of *ramosa*, however, the Pacific sponges seem closer to Keller's original description and, in the event some specific difference is found, the West Indian population would require a new

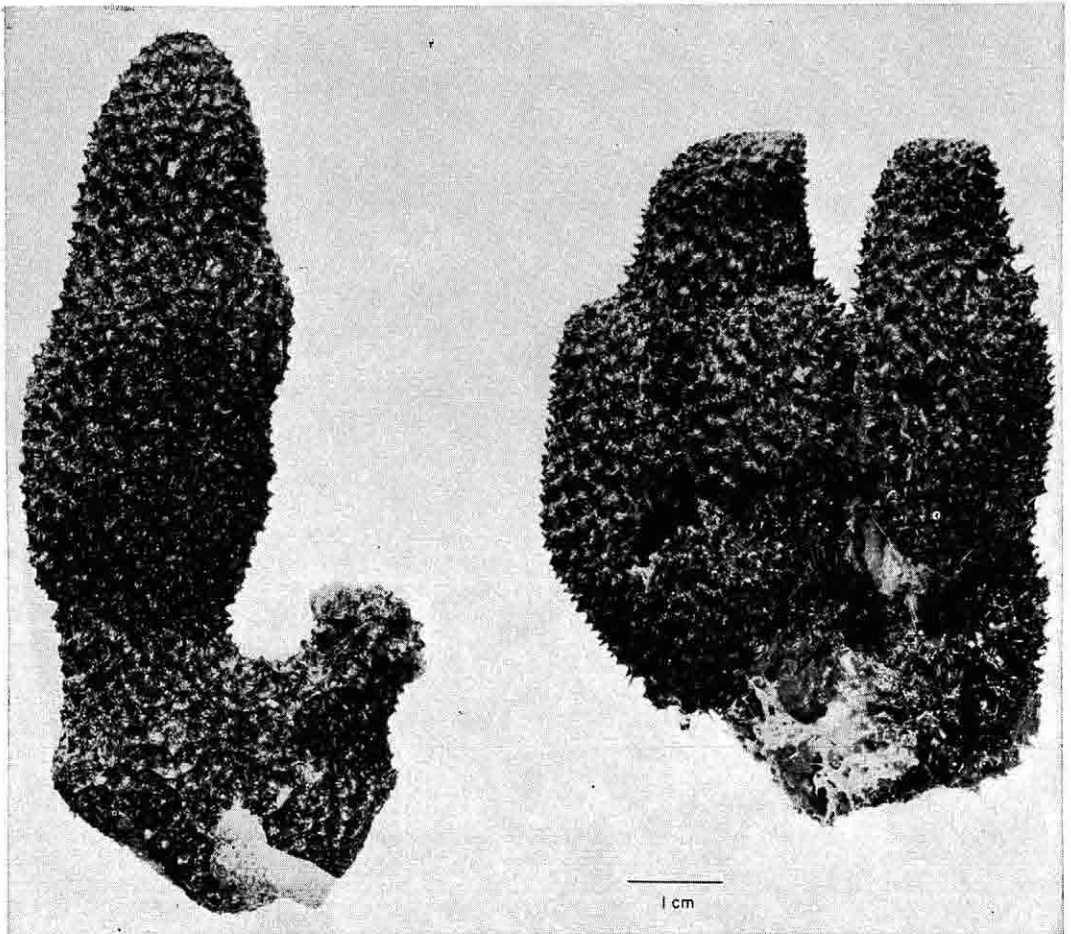


FIG. 2. *Heteronema erecta* Keller. Left, Sta. 10; right, Sta. 140.

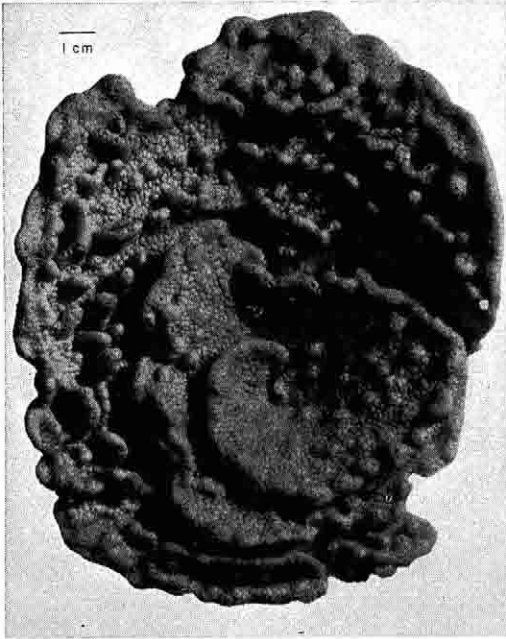


FIG. 3a. *Phyllospongia foliascens* (Pallas). Sta. 111.

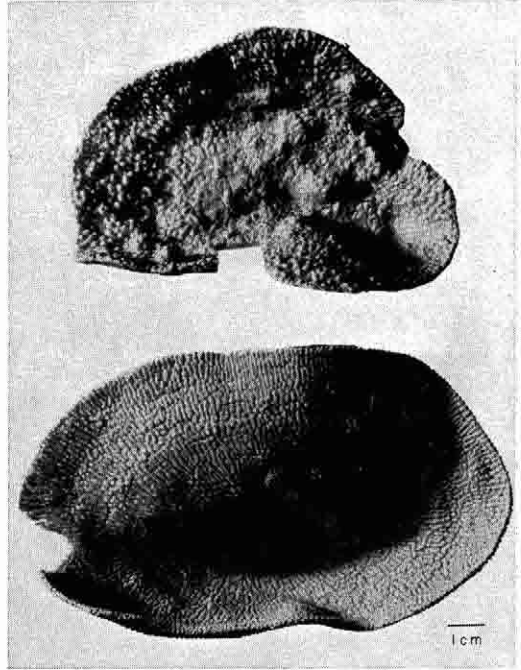


FIG. 3b. *Phyllospongia foliascens* (Pallas). Upper, Sta. 245; lower, Sta. 220A.

specific name. It is difficult to see what characters can be used to distinguish between such sponges as *I. ramosa*, *I. fasciculata*, and *I. dendroides* since the entire genus is extremely uniform in internal morphology and, seemingly, variable in habit and surface characteristics. Studies of the ecology and morphology of living populations are urgently required in this genus.

DISTRIBUTION: Red Sea, West Indies, Palau Islands, Ponape, Great Barrier Reef.

GENUS *Phyllospongia* Ehlers

Phyllospongia foliascens (Pallas)

Fig. 3a, b

RESTRICTED SYNONYMY:

Spongia foliascens Pallas, 1766, p. 395.

Phyllospongia foliascens Lendenfeld, 1889, p. 196, pl. v, fig. 3; pl. vi, figs. 1, 3, 4, 10; pl. vii, fig. 11; pl. xiv, fig. 2; pl. xxiv, fig. 6.

Carteriospongia foliascens Burton, 1934, p. 573.

Phyllospongia lekanis de Laubenfels, 1954, p. 15, fig. 7, pl. 111, fig. a.

OCCURRENCE: Sta. 111, 220A, 245.

DESCRIPTION: Three of the five specimens are similar in form to *P. foliascens* as illustrated by Lendenfeld (1889:pl. 5, fig. 3), one is almost identical to *P. lekanis* de Laubenfels (1954:pl. 111, fig. a), and one, of spiral shape, answers to de Laubenfels' description of large specimens of *P. lekanis* which he observed in the field. There is a great variation in the surface ornamentation, and in the distribution and abundance of oscules. In all specimens the skeleton is compact, with cored primary tracts and thick sand cortex on both surfaces. In this respect the present specimens contrast with the holotype of *P. lekanis* (USNM 23109), which has a loose skeleton mesh, lightly cored fibres, and a thin sand cortex on both surfaces.

Little note has been taken in the systematics of *Phyllospongia* of the amount of debris present in the cortex and the skeleton; this, in conjunction with the range of form exhibited by this sponge in the Palaus, is sufficient reason for relegating *P. lekanis* to *P. foliascens*.

DISCUSSION: It is with some hesitation that these specimens are described as *Phyllospongia*

rather than *Carteriospongia*. It seems that *Spongia foliascens* Pallas, which is the type species of *Carteriospongia* Hyatt by subsequent designation of Burton (1954), has abundant foreign material incorporated into the dermis and the primary fibres. *Spongia papyracea* Esper, the type species of *Phyllospongia* Ehlers, is understood by Burton to have no sandy inclusions in either the fibres or the cortex. Ehlers (1870) does not comment specifically on this feature. Many authors (Dendy, Ridley, Bowerbank, de Laubenfels) have described sponges with cored ascending fibres as *P. papyracea*. De Laubenfels (1948) suggests that the type specimen is one in which primary fibres are rare or absent and that the specimens described by later authors are congeneric with Esper's sponge even though they possess varying amounts of debris in both cortex and primary fibres. The commonly accepted view of *Phyllospongia* is of a sponge with a variable amount of debris in both fibres and cortex, and in keeping with this view the Palau specimens are assigned to *Phyllospongia*. A restudy of *Spongia papyracea* Esper is required to clarify this problem.

DISTRIBUTION: Red Sea, Indian Ocean, Malaya, Australia, New Zealand,³ West Central Pacific.

Phyllospongia dendyi Lendenfeld

Fig. 4a, b

Phyllospongia dendyi Lendenfeld, 1889, p. 177, pl. 14, fig. 5.

Phyllospongia dendyi var. *frondosa* Lendenfeld, 1889, p. 178, pl. 14, fig. 5.

Phyllospongia dendyi var. *digitata* Lendenfeld, 1889, p. 178.

Phyllospongia dendyi Burton, 1934, p. 573.

OCCURRENCE: Sta. 92.

DESCRIPTION: This sponge consists of somewhat inclined lamellae decreasing in height from the center to the margin and often bearing lobelike secondary lamellae on the outer surface. The lamellae arise from a spreading base and tend to intersect to form a series of pouches. The free margins of the lamellae are undulat-

³ This record is doubtful; Lendenfeld described several species and varieties of *Phyllospongia* from New Zealand, none of which has been verified.

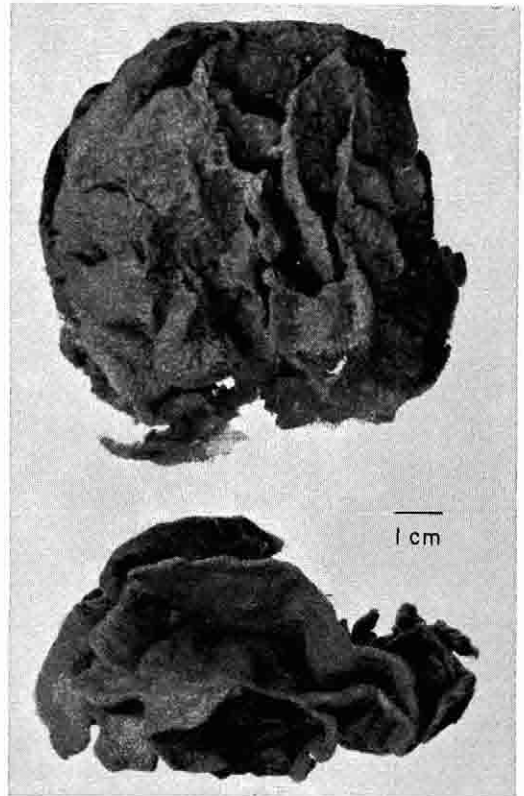


FIG. 4a. Lower, *Phyllospongia dendyi* Lendenfeld. Sta. 92. Upper, *Fasciospongia chondrodes* (de Laubenfels). Sta. 92A.

ing, particularly the outer series. The single specimen is 10 cm long, 5.0 cm wide and 6.0 cm high; lamellae are 2.0–3.2 mm thick.

COLOR: In alcohol, dark reddish-brown, between (rY-R 5/2) and (rY-R 5/3).

TEXTURE: Fleishy but sufficiently elastic for the sponge to regain its shape after being compressed.

SURFACE: Covered evenly with sharp fine conules up to 0.5 mm high. Oscules are scattered over the sides of the lamellae and range from 0.2–1.2 mm in diameter. Narrow subdermal channels are visible through the dermal membrane; these meander over the surface in certain areas and are absent near the edges of the lamellae.

SKELETON: Composed of primary fibres cored with spicule fragments and running diagonally through the lamellae. They are connected by a network of uncored secondary fibres.

Primary fibres are $63\text{--}100\mu$ in diameter; secondaries, $10\text{--}32\mu$. No cortex of foreign material is developed over either surface of the lamellae, but numerous spicule fragments occur throughout the body of the sponge and in patches on the surface. The major part of the surface is clear of debris.

CORTEX: A collenchymatous layer of variable thickness, rich in spongin A and containing many dark-staining cells with dendritic processes. The thickness of the cortex is comparable on both surfaces of the lamellae varying from $62\text{--}187\mu$.

ENDOSOME: A remarkable feature of the endosome is the presence of quantities of a blue-green alga filling all available space between flagellate chambers and canals. Flagellate chambers are slightly oval and are large for the Spongiidae, $37\text{--}65 \times 32\text{--}42\mu$ ($36 \times 47\mu$). De Laubenfels (1948) mentions in connection with the genus *Thorecta* that large flagellate chambers are common; Poléjaeff has described large flagellate chambers in his *Phyllospongia radiata*. I have found the chambers of *P. foliascens* and *Fasciospongia chondrodes* from the Palau Islands to be in excess of 40μ . In view of the frequency with which large flagellate

chambers occur in sponges which undoubtedly belong to the Spongiidae, it is suggested that this feature should not be used to distinguish between the Spongiidae and the Dysideidae. Emphasis should be laid on the structure of the chamber system rather than on the absolute dimensions of individual units.

DISCUSSION: No good description of *Phyllospongia dendyi* is available. Lendenfeld's descriptions were based on dry specimens and Burton (1934) did not give any morphological details. There are several important differences between the Palau specimens and Lendenfeld's description: (1) the Palau specimens lack fasciculate primary columns and special dermal fibres; (2) the primary fibres are up to 120μ wide in the Australian specimens, 99μ in the Palau specimen. Despite these differences, the habit of this sponge is distinctive and the broad features of its morphology are comparable with *P. dendyi*. On this basis the Palau sponge is referred to this species. De Laubenfels (1948) has referred *P. dendyi* to *P. papyracea* var. *macropora*. This view cannot be supported from Lendenfeld's descriptions. It is useful to retain this species until a restudy of type material can confirm the identification.

DISTRIBUTION: Australia (Lendenfeld, Burton).

GENUS *Fasciospongia* Burton

Fasciospongia chondrodes (de Laubenfels)

Figs. 4a, 5a, b

Spongionella chondrodes de Laubenfels, 1954, p. 26, fig. 13.

OCCURRENCE: Sta. 92, 92A.

DESCRIPTION: The type description (de Laubenfels, 1954) was based upon a fragment of a specimen distorted by the presence of numerous embryos and is therefore misleading in many details.

The sponge grows as a series of interconnected lamellae from a thin spreading basal plate. From both surfaces of the erect plates subsidiary phalanges arise sometimes forming small pouches, in other cases merely forming prominent ridges. There are three sponges described from the Palaus which have this dis-



FIG. 4b. *Phyllospongia dendyi* Lendenfeld. Portion of the fibre network at right angles to the surface.

tinctive habit, *Fasciospongia chondrodes*, *Dysidea herbacea*, and *Phyllospongia dendyi*.

COLOR: In alcohol, varies from pale pinkish-purple (RY-R 6/2), to yellowish-gray (rY 7/4), to pale creamy (rY 8/4), in the holotype.

TEXTURE: Stiff and rather cartilaginous.

SURFACE: In the holotype, almost smooth; in the other two specimens it is irregularly conulose in such a way as to give an over-all spined appearance and to render the edges of all lamellae crenulate. Some parts of the sponge are almost smooth where the dermal membrane is stretched between adjacent ridges. Conules are simple or multiple; sometimes the primary fibres are produced beyond the surface. A system of tangential dermal fibres is developed, being plainly visible in the Palau material and just discernible in the holotype. The dermal membrane is granular and skinlike and is not easily separable from the underlying cartilaginous cortex, the two layers together being 200–250 μ thick.

SKELETON: Composed of a compact reticulation of secondary fibres from which the primary fasciculated columns rise abruptly and extend through the collagenous cortex into the conules. All fibres are finely laminated and a pith is present, distributed sporadically in both primary and secondary fibres. Only the primary columns are cored by spicule fragments. There is no sand cortex.

The primary fibres range from 70–180 μ in diameter; the secondaries, from 25–160 μ .

De Laubenfels stated that there were no cored fibres in the type of *Spongionella chondrodes*, but this is an error. All primary fibres are fascicular, pithed, and cored with spicule fragments.

CORTEX: A dense layer, 180–800 μ deep, usually 250 μ , rich in spongin A. It contains abundant dendritic cells with granular cytoplasm which are possibly pigment-containing cells. A specimen of *Fasciospongia cavernosa* (Schmidt) from Marseilles has been examined



FIG. 5a. *Fasciospongia chondrodes* (de Laubenfels). Sta. 92. Section at right angles to the surface showing the fasciculate fibre system, the coring spicules in the ascending fibres, and (lower left) traces of pith and concentric lamination in the fibres.

and also has a dense collagenous cortex. The same feature is characteristic of the type species, *Fasciospongia fovea* (Lendenfeld), from Australia.

ENDOSOME: Cavernous and contains a dense, irregular network of fibres. Flagellate chambers tend to be localized, groups of chambers being separated by areas of collagenous tissue. Considerable variation in size and shape characterizes the chambers. They are somewhat oval in two specimens, $19.8 \times 16.5\mu$ to $30 \times 22\mu$ and $37 \times 23\mu$ to $50 \times 44\mu$ spherical, $26-49\mu$, in the other.

Vacelet (1959) commented upon the chamber size of *Spongionella chondrodes*, recorded as $25-30\mu$ by de Laubenfels, and concluded that this sponge did not belong in *Spongionella*. It is noteworthy that the type specimen of *S. chondrodes* has much larger chambers than de Laubenfels states and that they tend to be oval, but not eurypylous. It is impossible, however, to be sure that the above dimensions are accurate, for the chambers in almost all cases are not lying *in situ*. The collagenous ground substance in which they lie has contracted, leaving the groups of flagellate cells lying in spaces in the matrix. The two Palau specimens are in good condition and perhaps reflect more reliably the structure of this species.

DISCUSSION: A restudy of the holotype (USNM 23112) and the paratype (Bishop Museum 153) of *S. chondrodes* in conjunction with the two specimens included in this collection leaves little doubt that this sponge is a *Fasciospongia*. More information on the nature of the flagellate chambers in other species of *Fasciospongia* would be desirable, but unfortunately the type of *F. fovea* (Lendenfeld) cannot be located at present. It seems that variation in size and shape of the chambers in *F. chondrodes* is greater than is usual in the Spongiidae. In my specimen of *F. cavernosa* the chambers are often slightly oval, measuring $37 \times 30\mu$.

DISTRIBUTION: Palau Islands.

GENUS *Psammaphysilla* Keller

Psammaphysilla purpurea (Carter)

Fig. 6a, b, c, d

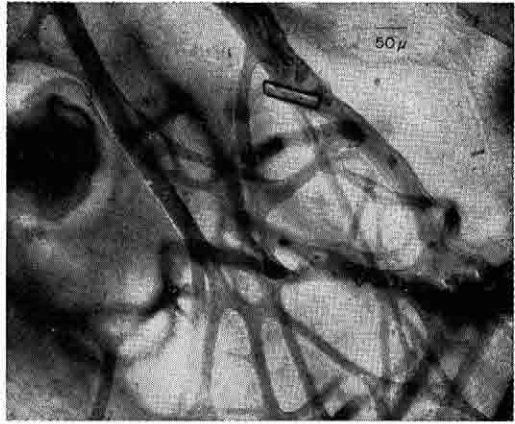


FIG. 5b. *Fasciospongia chondrodes* (de Laubenfels). Holotype, USNM 23112. Section showing fibre reticulum and an embryo.

Aplysina purpurea Carter, 1880, p. 36.

Aplysina purpurea Carter, 1881, p. 103, pl. IX, fig. 1, a-i, fig. 2, a-c.

Aplysina purpurea Dendy, 1889, p. 97.

Psammaphysilla arabica Keller, 1889, p. 358, pl. XXII, figs. 23-27.

Psammopemma fuliginosum Lendenfeld, 1889, pars. p. 636.

Druinella ramosa Thiele, 1899, p. 24, pl. 3, fig. 3, pl. 4, fig. 5.

Aplysina purpurea Dendy, 1905, p. 224.

Aplysina purpurea Row, 1911, p. 377.

Aplysina purpurea Hentschel, 1912, p. 437.

Psammaphysilla kelleri Wilson, 1925, p. 488, pl. 44, fig. 3.

Druinella purpurea Burton, 1934, p. 594.

non *Druinella ramosa* Burton, 1934, p. 595.

Aplysina purpurea Brøndsted, 1934, p. 26.

Cacospongia ramosa pars. de Laubenfels, 1948, p. 95.

Hexadella pleochromata de Laubenfels, 1950, p. 10.

Thorectopsamma xana de Laubenfels, 1954, p. 32, fig. 16.

Dendrilla verongiformis de Laubenfels, 1954, p. 45, fig. 25.

Druinella tyroëis de Laubenfels, 1954, p. 27, fig. 14.

non *Druinella ramosa* Burton, 1959, p. 269.

non *Psammaphysilla arabica* Burton, 1959, p. 271.

OCCURRENCE: Sta. 12, 60, 92, 100, 134.

DESCRIPTION: The six Palau specimens of this sponge range in habit from thin encrustations (Sta. 134) to massive with a single stout branch (Sta. 12), or are ramose (Sta. 12, 60, 92, 100) and repent. The branches of the ramose specimens anastomose frequently. In two cases the branches arise from a massive, spreading portion which incorporates much shell and sand (see also de Laubenfels, 1954: 33).

DIMENSIONS: The encrusting specimen is 0.8–1.0 mm thick, covering an area 6.5 cm ×

4.5 cm on the under surface of a *Fungia*. The ramose specimens have almost cylindrical branches which are up to 28 cm long and from 0.5–2.0 cm wide.

COLOR: In alcohol, dark reddish-brown both internally and externally; the exact shade varies with each specimen from (RY-R 2/2–RY-R 3/6–YR3/2–rY-R 2/2). In one specimen (Sta. 12) the tips of the branches, both inside and out are light pinkish-red (rY-R 5/2). The color in life is described as bright green; de Laubenfels has recorded it as yellow (in *Thorectopsamma xana*) and yellow tinged with green (in *Dendrilla verongiformis*).

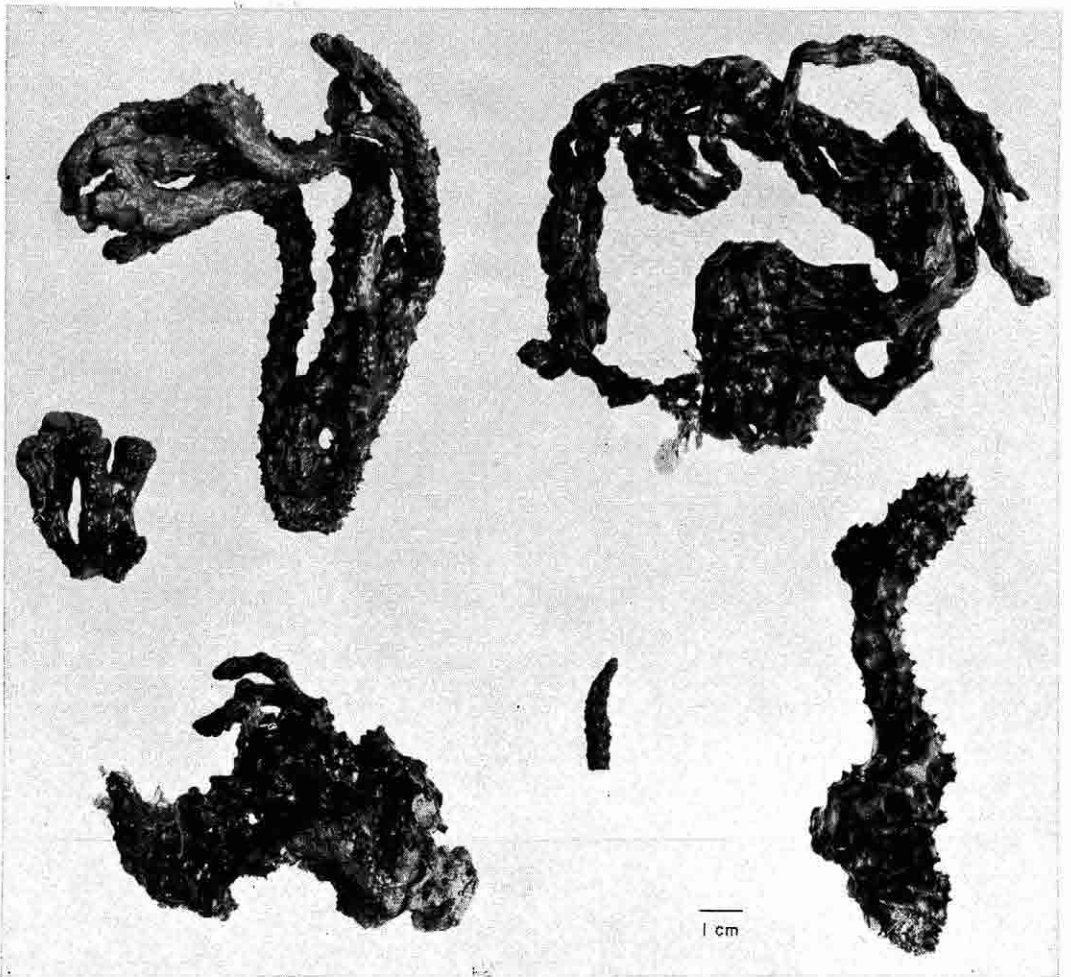


FIG. 6a. *Psammaphysilla purpurea* (Carter). Upper left, Sta. 12; upper right, Sta. 92. Center left, *Dendrilla verongiformis* de Laubenfels, holotype. Lower left, Sta. 92; lower center, *Thorectopsamma xana* de Laubenfels, holotype; lower right, Sta. 12.

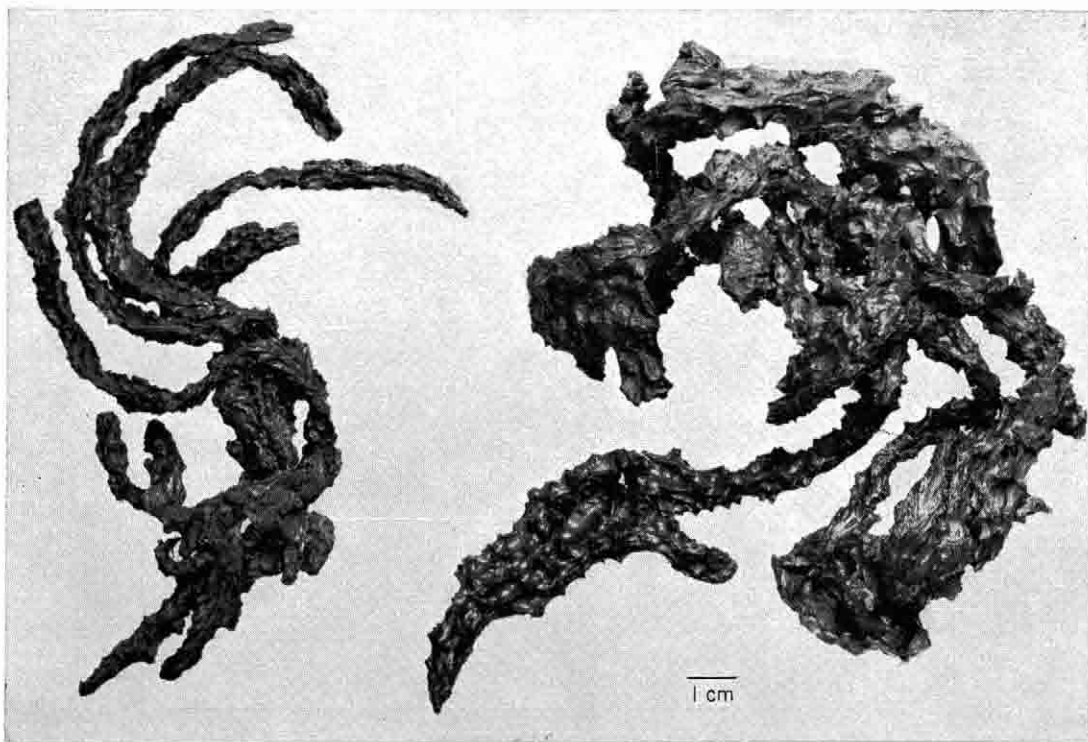


FIG. 6b. *Psammaphysilla purpurea* (Carter). Left, *Psammaphysilla kelleri* Wilson, holotype. Right, Sta. 60. USNM 23708.

TEXTURE: Firm, rather elastic in some cases, stiffer in others.

SURFACE: Always conulose, but the height and spacing of the conules differ with the specimen from few, low, rather rounded projections in the thinly encrusting specimen to blunt, tall, and abundant in the specimens from Sta. 60. In most specimens, conspicuous ridges connect adjacent conules. The dermis is thick, smooth, and with no apparent pores. Oscules are irregularly dispersed, oval and 2.5–7.0 mm in longest dimension.

The surface of the holotype of *Druinella tyroensis* is conspicuously reticulated between the ridges diverging from the conules. This type of structure was described by Carter (1881) for *A. purpurea*, but is not well shown in any of the Palau specimens.

SKELETON: A reticulation of irregular, concentrically stratified fibres which are themselves built up as a reticulum of extremely fine threads. In many places irregular lobes arise from the

fibres. Most authors have given recognizable descriptions of the skeleton of this species, none better than Keller (1889) and Wilson (1925). Inclusions in the form of sand grains vary in quantity from specimen to specimen. Some lack them entirely. Spicule fragments occur sporadically. There is a tendency toward the fusion of fibres at the base of the sponge, giving the appearance of a basal plate; this is, however, not well marked in most specimens. The fibres of this sponge are composed entirely of the reticulate substance which makes up the pith in other verongioid genera. The concentric structure is often more compact at the surface and gives the impression of an outer, more dense layer. The extreme irregularity of the fibres makes measurements of little value, but those quoted by Wilson (1925) are typical.

CORTEX: Of variable thickness and composed of dense spongin A, broken into patches by the numerous pore canals. In specimens where the branches are wider the endosome has a more



FIG. 6c. *Psammaphysilla purpurea* (Carter). Photomicrograph showing branching of fibres and structure of the flagellate chambers. One of the ellipsoid masses of dense tissue of unknown function is shown at lower center.

open structure and the cortical region is narrow (75–100 μ) [e.g., Sta. 60; *Dendrilla verongiformis* USNM 23104; *Druinella purpurea* (Burton, 1934)]. In those specimens where the over-all texture is rough and the branches are thinner, the cortex may be up to 350 μ thick [e.g., *Thorectopsamma xana* USNM 22994; *Psammaphysilla kelleri* USNM 21241; specimen from Sta. 92].

ENDOSOME: Earlier workers (Lendenfeld, 1889; de Laubenfels, 1954) have mentioned that the flagellate chambers tend to be concentrated around the excurrent canals and are lacking from large areas of the sponge. After examining several specimens, including the sponges which de Laubenfels described, it is apparent that this is not strictly the case. Chambers are aggregated around the excurrent canals but in all specimens groups of chambers are

more or less evenly dispersed throughout the endosome. In compact specimens (such as the type of *D. tyroensis*) the relatively great extent of the cortex gives the impression that the chambers are restricted in occurrence. The structure of the flagellate chambers is in no way remarkable. They do not have long fine prosodal canals, but long aphodal canals do occur and vary in length (up to 100 μ) and diameter from specimen to specimen. The chambers themselves are small and slightly ellipsoidal, 23 \times 12 to 46 \times 30 μ . A constant feature of the species is the occurrence throughout the endosome of ellipsoidal masses of relatively deep-staining cells. These are figured by Wilson (1925: pl. 44) but no comment is offered as to their possible function. They are always set off from the surrounding mesenchyme by a concentrated zone of spongin A which often extends inward as bands between the cells. It is possible that these structures represent developmental stages of the fibres.

DISCUSSION: In order to elucidate the systematic affinities of *Psammaphysilla purpurea* (Carter) it was necessary to investigate the sponges assigned to the genus *Druinella* Lendenfeld for, superficially at least, the two genera are closely similar.

Lendenfeld (1889) described *Druinella* to receive *D. rotunda* from Australia. This sponge was notable for the lobose knotty fibres and for the possession of long prosodal and aphodal canals. In all features except the possession of these canals, *D. rotunda* is inseparable from *Aplysina purpurea* Carter. Burton (1934) was the first worker to definitely associate *Aplysina purpurea* Carter with the genus *Druinella*. Wilson (1925) had tentatively suggested that *Psammaphysilla kelleri* and *P. arabica* belong to the same genus as *A. purpurea*, and likened all of these species to *Druinella* and *Thymosia* (Topsent).

No author since Lendenfeld's time has seen *Druinella rotunda* nor had similar canal structure been described from any other sponge⁴ until de Laubenfels (1948) referred *Cacospongia camera* de Laubenfels to *Druinella*. He

⁴ A similar pattern of short canals is well known from the work of Schulze (1878) on the Aplysiniidae.

claimed to have observed just such a chamber structure as Lendenfeld figured for *Druinella rotunda*. Examination of the type, and only, specimen of *C. camera* (USNM 22405) shows it to be a poorly preserved sponge containing quantities of filamentous blue-green algae and having normal spongin fibres. The cell structure of the sponge is largely dissociated. Those traces of flagellate chambers which remain indicate that the chambers were quite large (40–60 μ) and possibly eurypylous. *Cacospongia camera* does not belong in *Druinella*, and should be pronounced unrecognizable.

Thiele (1899) identified a sponge from the Celebes as *Druinella ramosa*. He stated that he had not been able to study the flagellate chambers and that the identification was based on similarity of habit and fibre structure. Burton (1934, 1959) has referred sponges to *D. ramosa*; preparations of both of these have been examined and clearly neither belongs to *Druinella*. The two sponges belong to different genera. One (BM 1930.8.13.201) is possibly a *Dactylospongia* but certainly belongs to the Spongiidae; the other (BM 1930.3.4.155) is probably a *Cacospongia*, but the fragments examined were too small to allow further identification.

Only one other sponge has been described in the genus *Druinella*, namely *tyroei* de Laubenfels. This sponge is identical with the specimens of *Psammaphysilla purpurea* from Palau except that it is more compact; the endosome is extremely compressed and full of Spongin A and the aphodal canals show clearly. No structure comparable with that described for *D. rotunda* can be found in the holotype (USNM 23052).

Burton (1934) referred *Aplysina purpurea* Carter to *Druinella* as *Druinella purpurea* and, presuming Carter's original specimen to be lost, named Dendy's specimen from the Gulf of Manaar as neotype. The reasons for referring this sponge to *Druinella* rather than *Psammaphysilla* were not given but were certainly not based on histological study of *Druinella rotunda*. In the text of the same work Burton refers *Aplysina purpurea* Carter (1881) from Ceylon and Australia to *Psammaphysilla* in contradiction to his reference in the synonymy, where it is placed in *Druinella purpurea*. Bur-

ton differentiates Carter's later specimens (1881) from the type specimen (Carter, 1880) and that described by Dendy (1905) by stressing the fasciculate fibre network in the former, a structure identical to that figured by Keller (1889) for *Psammaphysilla arabica*. There is nothing in Carter's original description or in Dendy's account of his specimen to give basis to the assumption that such a skeletal structure is absent. On the contrary, all accounts of the skeleton of this sponge agree remarkably, and Dendy specifically describes "compound fibres."

The type specimen of *Druinella rotunda* has been lost; it is not at the British Museum; the Australian Museum, Sydney; or the National Museum of Victoria, Melbourne. Since, first, the only specimen of the type species (*D. rotunda*) is lost; second, the type description is poor and could easily refer to *Psammaphysilla purpurea*; and third, all subsequent records of *Druinella* are referable to *Psammaphysilla*, it is suggested that the genus *Druinella* be considered unrecognizable and that the genus *Psam-*

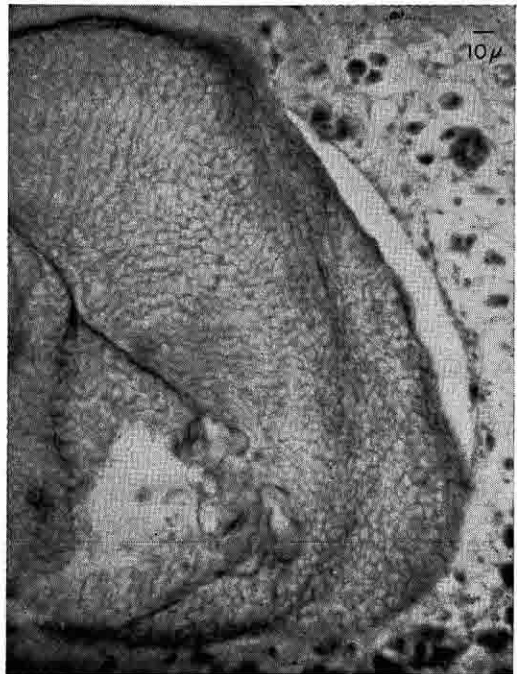


FIG. 6d. *Psammaphysilla purpurea* (Carter). Photomicrograph showing the reticulate structure of the fibres.

maplyssilla Keller be used for *Aplysina purpurea* Carter and its synonyms.

Psammaplysilla arabica was well described by Keller (1889) except for the canal system, and there can be little doubt that it is the same sponge as *A. purpurea* Carter. Certainly the two belong in the same genus, the affinities of which are with genera such as *Verongia* rather than with the Aplysillids (Dendy, 1905).

No significant difference can be found in the descriptions of *Psammaplysilla arabica* and *Psammaplysilla kelleri* Wilson. The type of the latter (USNM 21241) has been examined and its identity with the Palau specimens established. *P. kelleri* is from the Celebes, as is *Druinella ramosa* Thiele, and these are considered identical. *Druinella purpurea* (Burton, 1934, BM 1930.8.13.197) has also been examined and is identical with the above. Row (1911) considered that *P. arabica* and *A. purpurea* may belong to the same species, but he appended a query to his synonymy. Burton has not endorsed the synonymy and in 1959 recorded a specimen of *P. arabica* (BM 1936.3.4.574) from Suakin. This sponge has been examined and, while no opinion can yet be offered as to what it is, it certainly is not *P. arabica*.

De Laubenfels (1954) described *Thorectopsamma xana* (USNM 22994) and *Dendrilla verongiformis* (USNM 23104) from the Palau. The types and paratypes of these sponges have been examined and all specimens are referable to *P. purpurea*.

Hexadella pleochromata de Laubenfels, from Hawaii (USNM 22748) is an encrusting specimen of *P. purpurea*, and closely resembles the holotype of *Druinella tyroensis*.

All of the species listed in the synonymy above are identical in their possession of a unique type of fibre and in their color. Many of the early specimens were either dry or poorly preserved and thus, until the work of Wilson (1925), no reliable description of the flagellate chambers was available. In Wilson's specimen it is difficult to see the chambers because of the density of the spongin. A. Burton (1934) commented that too much emphasis on color and too little attention to the more important details of histology has led to confusion in this complex. This statement is perhaps true, but it

appears from the literature that, with the possible exception of Lendenfeld, no author up to the time Burton made the statement had satisfactory material for histological study. Burton, however, did not publish the desired histological details. De Laubenfels collected his own material, which is in an excellent state of preservation, but only in the small semiencrusting fragment described as *Druinella tyroensis* did he observe aphodal canals.

DISTRIBUTION: Gulf of Manaar (Carter, Dendy); Ceylon (Carter); S. W. Australia (Carter); Red Sea (Keller, Row); Celebes (Thiele, Wilson); Gt. Barrier Reef (Burton); East Indies (Brøndsted); Caroline Islands, Marshall Islands, Palau Islands, Hawaii (de Laubenfels).

FAMILY DYSIDEIDAE Gray

GENUS *Dysidea* Johnston

Dysidea herbacea (Keller)

Fig. 7a, b, c

RESTRICTED SYNONYMY:

Spongelia herbacea Keller, 1889, p. 336, pl. 20, fig. 1.

Dysideopsis palmata Topsent, 1897, p. 482, pl. XX, fig. 25.

Spongelia delicatula Row, 1911, p. 364.

Phyllospongia cordifolia Row, 1911, p. 378.

Dysideopsis topsenti Hentschel, 1912, p. 439.

Dysidea herbacea Burton, 1934, p. 593.

Phyllospongia complex de Laubenfels, 1954, p. 18, fig. 8, pl. 3, fig. 6.

non *Dysidea herbacea* de Laubenfels, 1954, p. 38.

OCCURRENCE: Sta. 10, 60.

DESCRIPTION: The habit of the sponge is well described and figured by de Laubenfels (1954: pl. III, fig. 6). Beyond this point, however, his description is completely unrelated to *Dysidea herbacea*. The following description is based upon the holotype (USNM 23110) and paratypes (USNM 23127 and Bishop Museum 148) of *Phyllospongia complex* de Laubenfels and two additional specimens from our Palau collections.

COLOR: In life, gray; in alcohol, yellowish-gray (between Y-R-Y 7/2 and rY 7/4) to

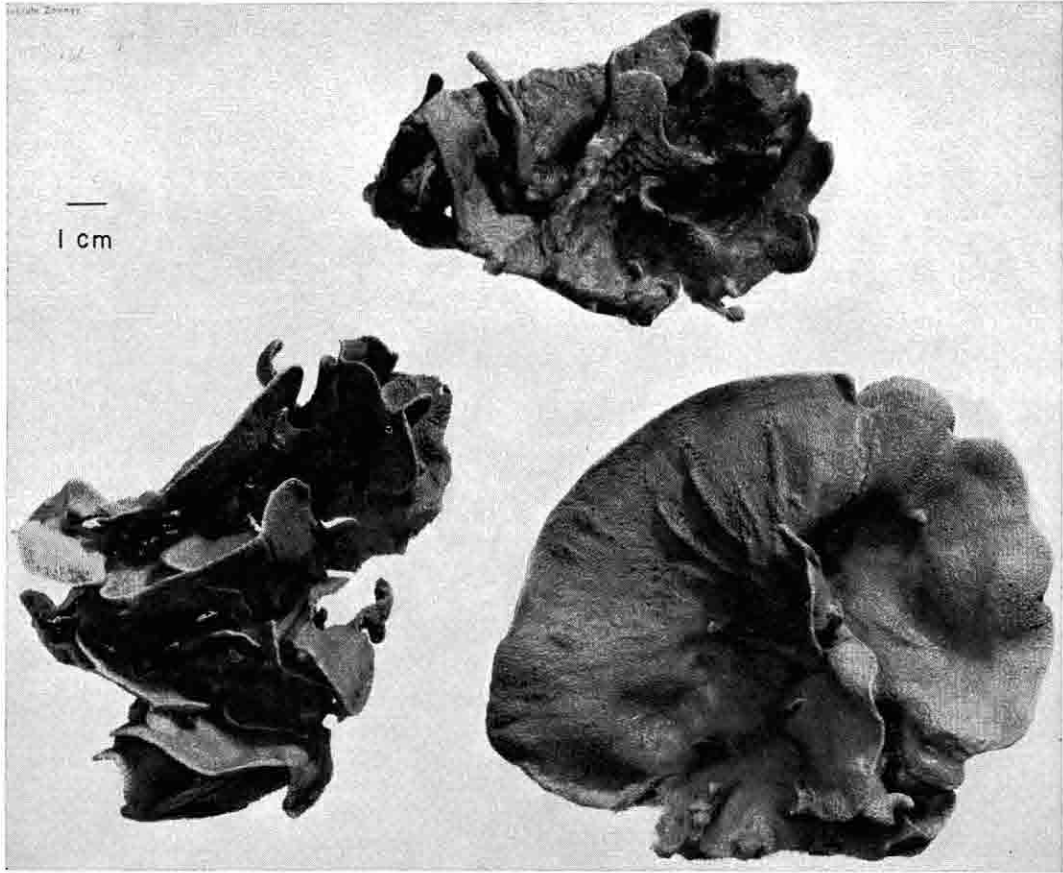


FIG. 7a. *Dysidea herbacea* (Keller). Lower left and right, Sta. 10; upper center, specimen from Tonga showing surface characteristics intermediate between Palau Is. specimens of *D. herbacea* and *D. chlorea*.

purplish pink (yR 4/2) in the specimen from Sta. 60. The color in life appears to vary from gray to greenish depending upon the amount of algae in the sponge tissue.

TEXTURE: Resembles that of soft leather. One specimen (Sta. 60) is tough and rigid; this sponge contains more and coarser detritus than any other examined.

SURFACE: Finely conulose; individual conules range up to 0.4 mm high, with a tendency to be aligned in vertical rows which give an over-all slightly striated appearance to the sponge surface. This feature is most noticeable in the specimen from Sta. 10, but is discernible in patches on all specimens.

SKELETON: An open network of fibres cored with sand grains of extremely irregular dimensions. There is no distinction between primary

and secondary fibres; the range in diameter is 50–153 μ . A layer of foreign material is present on both surfaces, 27–90 μ deep and essentially contained within the dermal membrane, only rarely extending into the cortical region. In the specimen from Sta. 60, inclusions in the fibres are coarser and more irregular and here the superficial debris often extends into the body of the sponge.

ENDOSOME: The skeleton is loose and the cortex relatively thin; consequently most of the thickness of the lamellae is endosome. Flagellate chambers are abundant, oval, 54–120 \times 28–82 μ and eurypylous; the collagenous endosomal matrix surrounding them is packed with blue-green algae.

DISCUSSION: All specimens making up the type series of *Phyllospongia complex* de Lau-

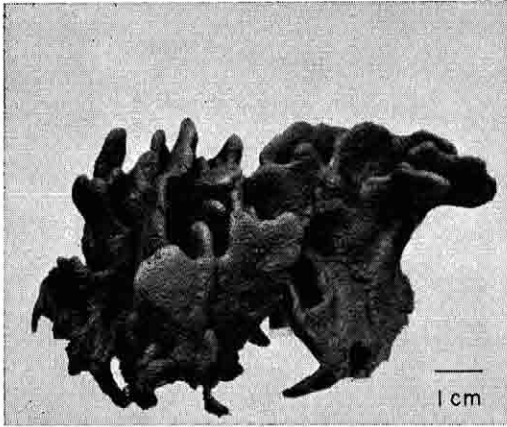


FIG. 7b. *Dysidea herbacea* (Keller). Sta. 60.



FIG. 7c. *Dysidea herbacea* (Keller). Cross section of lamella to show the disposition of fibres and surface detritus.

benfels belong to the genus *Dysidea*. Many features of the type description (de Laubenfels, 1954:18) however, are inconsistent with this generic identification. This can possibly be explained if one assumes that among his specimens, which are here correctly assigned to *Dysidea herbacea*, de Laubenfels collected a fragment at least of *Phyllospongia dendyi* and subsequently sectioned and described this and not the *Dysidea*. The growth form of these two sponges is similar, and they occur in the same locality.

Burton (1934) lists several synonyms of *D. herbacea*, not all of which belong to this species. The holotype of *Spongelia delicatula* Row has been examined and is certainly *D. herbacea*; similarly with Row's specimen assigned to *Phyllospongia cordifolia*. *Spongelia digitata* Solas bears some resemblance to *D. herbacea* but cannot certainly be referred here. De Laubenfels' Pacific specimens labelled *D. herbacea* belong to a new species, *Dysidea granulosa*.

DISTRIBUTION: Red Sea (Keller, Row, Top-sent); Indian Ocean (Dendy); Australia (Hentschel, Burton); Marshall Islands (de Laubenfels).

Dysidea chlorea de Laubenfels

Fig. 8a, b

Dysidea chlorea de Laubenfels, 1954, p. 37, fig. 19.

Dysidea chlorea de Laubenfels, 1955, p. 138.

OCCURRENCE: Sta. 47, 92, 219.

DESCRIPTION: In habit the three specimens above agree relatively closely with the type description. They are digitate sponges with projections 2.0–4.0 mm wide rising to a height of 2.5 cm from an apparently encrusting base 1.5 mm thick. In the sponge from Sta. 47 it is difficult to decide what the growth form was, as the specimen has been crushed. It could have been sprawling or even erect, since the projections are developed on both sides of the body, and the body is 3.0 mm thick at one end. The holotype (USNM 22971) consists of two fragments of a sponge that may have been similar to the specimen from Sta. 219 but which had the vertical projections slightly more crowded.

COLOR: In alcohol, yellowish brown (Sta. 219) (Y-R-Y 7/4) to dark brick red (yR 4/4) (Sta. 47).

TEXTURE: Soft and easily compressible.

SURFACE: Conulose with conules 0.3–1.0 mm high distributed at intervals of 1.2–3.5 mm. No oscules or pores are visible.

SKELETON: A loose reticulation of exceedingly fine fibres, cored with sand grains and showing little division into ascending and connecting fibres except where a fibre enters a conule. Often the fibre projects up to 400 μ beyond the sponge surface and macroscopically the conules appear to have fine white apical hairs.

The fibres are from 25–80 μ in diameter. Fragments of sand and spicule debris occur in the dermal membrane on one surface only but form a very thin layer, not a continuous cortex.

HISTOLOGY: A dermal membrane 12–20 μ thick overlies a cortical region of variable thickness. The dermal region is made up of a densely cellular layer with little extracellular matrix; the cells have prominent nuclei and granular cytoplasm. Deep to this layer is a zone in which the concentration of spongin A greatly exceeds that of the cortex; this layer appears to serve as a basement membrane. The cortex contains many granular spindle-shaped cells with prominent nuclei set in a clear ground substance.

The endosome is cavernous and contains large numbers of symbiotic blue-green algae. Flagellate chambers are abundant, large, and euryplous.

Dimensions of flagellate chambers.

Holotype, USNM 22971:	59–70 \times 36–62 μ
Sta. 47:	62–75 \times 37–48 μ
Sta. 219:	55–75 \times 38–48 μ

DISCUSSION: The species of *Dysidea* are extremely difficult to define on morphological grounds since, frequently, specimens of fundamentally different habit are identical or closely comparable in internal structure. De Laubenfels

considered it possible that *Dysidea chlorea* was merely a variant of *D. fragilis*.

Much attention has been given to the variability of *D. fragilis* (Burton, 1934; de Laubenfels, 1948), which appears to be a sponge in which the amount and type of debris incorporated in the skeleton can vary within wide limits; detritus is, however, not usually present in the form of a superficial cortex. The presence of such a sand cortex is characteristic of *D. chlorea*. A further difference between the two species is the nature of the fibres, which are extremely fine and regular in all specimens of *D. chlorea*. These features, in conjunction with the peculiar growth form, are sufficient to separate *D. chlorea* and *D. fragilis*.

In *D. herbacea* a complex lamello-digitate habit is coupled with coarse, irregular fibres and a well-defined sandy cortex. Until it is known to what degree these features are relevant in separating the species of *Dysidea*, it is practicable to retain both *D. chlorea* and *D. herbacea*.

DISTRIBUTION: Marshall Islands; Hawaii (de Laubenfels).

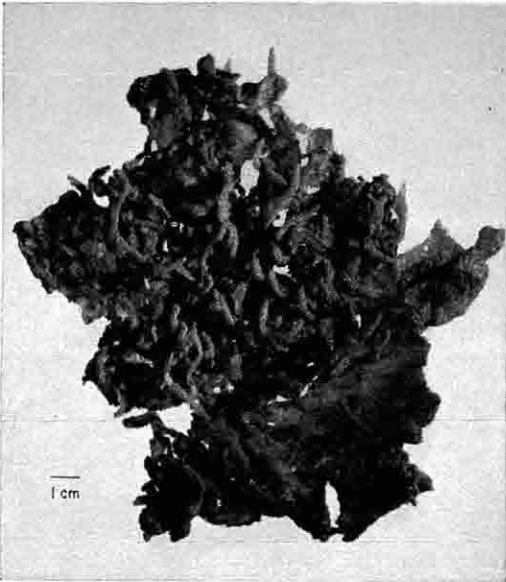


FIG. 8a. *Dysidea chlorea* de Laubenfels. Sta. 219. USNM 23705.

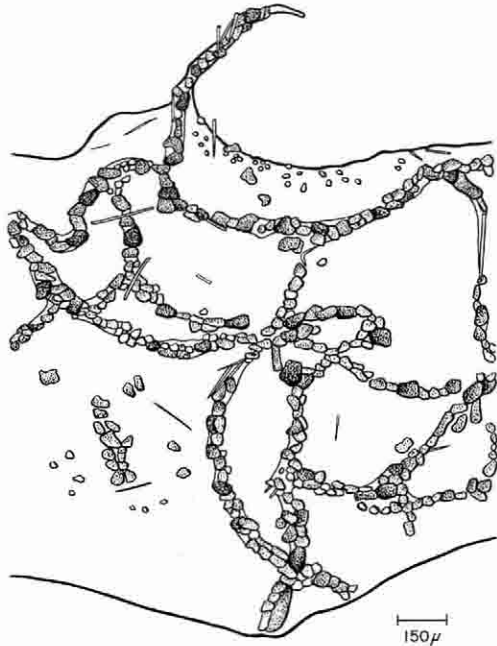


FIG. 8b. *Dysidea chlorea* de Laubenfels. Cross section of the sponge base showing the loose fibre network.

Dysidea granulosa n. sp.

Fig. 9

OCCURRENCE: Sta. 61, 125, 220A (holotype).

DESCRIPTION: *Dysidea granulosa* is represented in this collection by three specimens, all of which are thin cylindrical erect sponges growing from a narrow base. One specimen is incipiently branched. The holotype and only complete specimen (Sta. 220A; Fig. 9, left) is 12.5 cm high, 4.0–6.0 mm in diameter.

COLOR: White, in alcohol.

TEXTURE: Varies from stiff and brittle in the specimen most heavily packed with detritus to firm but flexible in the holotype.

SURFACE: Covered with fine conules, and the general appearance is granular. Oscules are scattered at irregular intervals over the surface and are 2.0–3.5 mm in diameter.

SKELETON: There is no distinction between primary and secondary fibres in the skeleton; the whole is a compact reticulation with irreg-

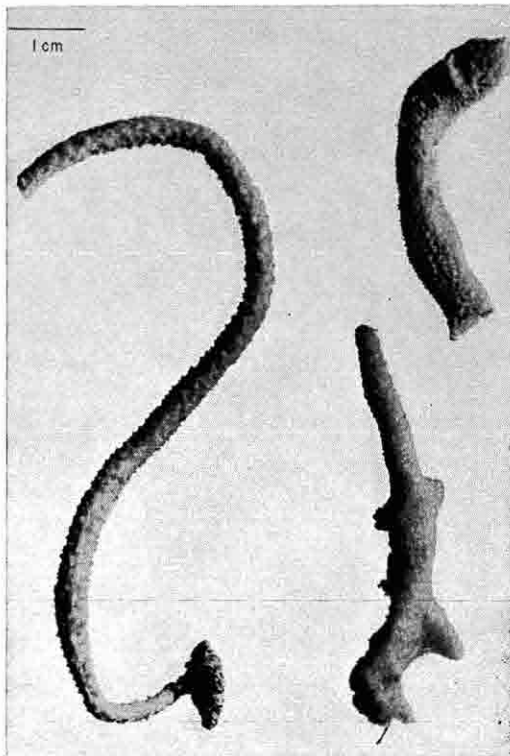


FIG. 9. *Dysidea granulosa* n. sp. Left, Sta. 125; upper right, Sta. 61; lower right, Sta. 220A. Holotype.

ular meshes. The fibres are uneven, from 50–162 μ in diameter and cored with sandy detritus. Very little clear spongin remains in the fibres except occasionally where the fibre narrows abruptly and no detritus occurs. The dermal membrane is densely charged with detritus, and this extends inward as a sand cortex up to 80 μ deep in some places.

ENDOSOME: Flagellate chambers are oval, eurypylous, 54–75 \times 40–54 μ ; the tissue surrounding the chambers in one specimen is packed with filamentous blue-green algae.

DISCUSSION: This sponge can be differentiated from other species of *Dysidea* by its consistently simple fingerlike habit in conjunction with fine evenly distributed surface conules. In other features, such as the absence of any distinction between primary and secondary fibres and the presence of a sandy cortex, *D. granulosa* can be compared with *D. herbacea* and *D. arenaria*. However, these three species are sharply distinct in habit.

The difficulty of fixing on morphological characters to separate species of *Dysidea* has been mentioned above. In all cases dealt with here growth form and habit seem to be the most reliable characters. De Laubenfels' (1954) specimens assigned to *Dysidea herbacea* properly belong in *D. granulosa*.

Dysidea arenaria n. sp.

Fig. 10a, b

OCCURRENCE: Sta. 125 (Holotype, USNM 23698).

DESCRIPTION: A single specimen of this sponge is in the Palau collection and this is designated as holotype. The sponge is irregularly ramose, 9.0 cm high, 10 cm wide, with frequent anastomoses between the branches. Individual branches are 3.0–7.0 cm high, 0.9–3.5 cm thick, rising from a narrow base of attachment.

COLOR: In alcohol, grayish-white (close to M.P., Pl. 36 A/1).

TEXTURE: Stiff, just compressible, and brittle owing to the large quantities of incorporated debris.

SURFACE: Extremely irregular, coarsely conulose, and deeply pitted between conules. The

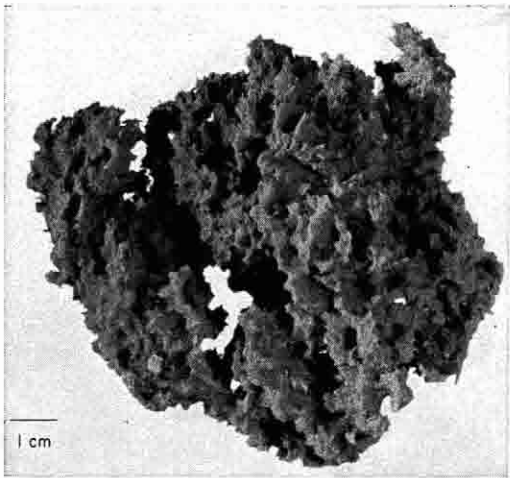


FIG. 10a. *Dysidea arenaria* n. sp. Holotype. USNM 23698. Sta. 125.

conules are often multiple structures, 1.0–5.0 mm high and 20–50 mm apart, receiving as many as four fibres. A prominent tracery of subdermal fibres shows through the dermal membrane, which is packed with sandy detritus.

SKELETON: Fibres range from 70–120 μ in diameter and are not clearly distinguishable into primary and secondary. They are arranged in a reticulate pattern, the meshes of which are compact near the periphery, open toward the center. Where several fibres converge into a conule it is sometimes possible to describe one as "primary." All fibres are cored with detritus and little clear spongin remains.

ECTOSOME: A thick sand cortex, 85–100 μ deep, is present over the entire sponge.

ENDOSOME: The endosome contains large quantities of extra-fibrillar debris, thus rendering study of the soft tissues extremely difficult. Flagellate chambers are oval, 60–85 \times 45–60 μ , and eurypylous.

DISCUSSION: This sponge has several features in common with *Dysidea granulosa*: the ramose form, the lack of distinction between primary and secondary fibres, and the presence of a distinct sand cortex. The large and irregular surface conules, the complexity of branching, the incorporation of great quantities of debris in the endosome, and the prominent tracery of sub-

dermal fibres give this sponge a very different appearance from *D. granulosa* from the same locality. *D. arenaria* cannot be confused with *D. fragilis*, as it possesses a sand cortex and lacks distinct primary and secondary fibres.

GENUS *Euryspongia* Row

Euryspongia lobata n. sp.

Fig. 11a, b

OCCURRENCE: Sta. 100, 220 (Holotype, USNM 23710).

DESCRIPTION: This species is erect, lobate to digitate.

DIMENSIONS (in cm):

	Height	Length	Width
Sta. 100	5.5	3.5	1.3
Sta. 220	8.0	9.0	2.8

COLOR: In alcohol, gray (Sta. 220) near (Y-R-Y 7/2), or reddish-brown (Sta. 100) between (RY-R 4/2) and (RY-R 4/4).

TEXTURE: Extremely soft and fleshy, slightly elastic.

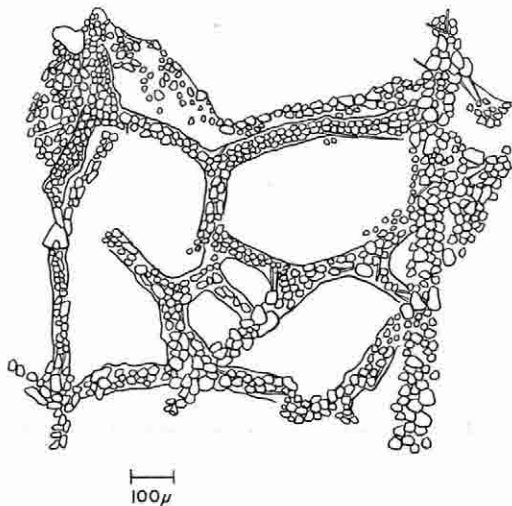


FIG. 10b. *Dysidea arenaria* n. sp. Portion of the skeleton drawn at right angles to the surface. At this point primary and secondary fibres can be distinguished; in the interior of the sponge this distinction is lost.

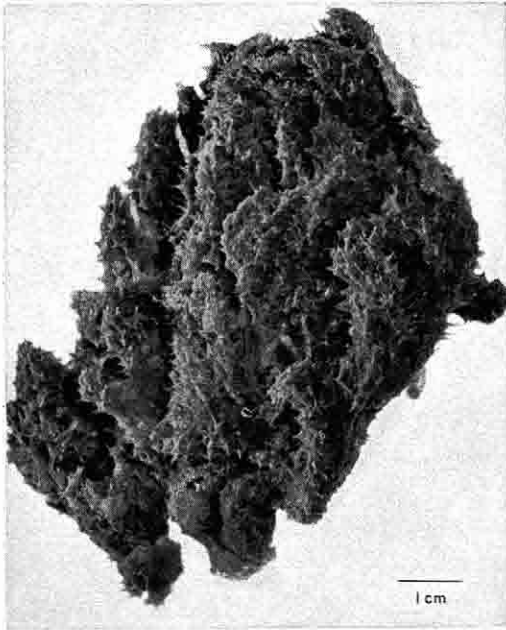


FIG. 11a. *Euryspongia lobata* n. sp. Holotype. USNM 23710. Sta. 220.

SURFACE: Coarsely conulose, with sandy detritus arranged in close-set lines diverging from each conule.

	Conule Height (mm)	Conule Spacing (mm)	Oscules (mm)
Sta. 100	1.5-4.0	1.0-5.0	1.0-2.0 lateral
Sta. 220 (Type)	1.0-3.5	1.0-5.5	1.5-3.0 lateral

In the interconular areas the pattern of the surface detritus becomes netlike.

SKELETON: In features of the skeleton this species is somewhat intermediate between *Dysidea* and *Euryspongia*.

The primary fibres are cored with spicule debris and are slightly fasciculated. Secondary fibres arise more or less at right angles, are much branched forming rounded meshes, and often include spicule fragments. These never form a continuous core and are not a constant feature of the secondary fibres. The spongin shows no sign of concentric lamination.

Primary fibres are $86-125\mu$ (108μ) in diameter, secondaries are $37-57\mu$ (42μ).

ECTOSOME: The thin dermal membrane contains abundant sandy debris which does not extend into the cortical region. The latter is a compact layer, $30-60\mu$ deep, of collagenous tissue containing isolated branched cells and abundant symbiotic blue-green algae.

ENDOSOME: Flagellate chambers are abundant, large, oval, and eurypylous, $75-90\mu \times 50-62\mu$. Collagenous tissue containing spindle-shaped cells and algae surrounds the groups of chambers and lines the larger canals.

DISCUSSION: Coring material extends into the secondary fibres of this sponge and in this regard it resembles a *Dysidea*. In all other features, however, it is more typical of *Euryspongia*.

Euryspongia lobata is not particularly close to any other species described thus far in this genus. The surface conules are larger, the primary fibres finer and slightly fasciculated, the fibre reticulation more compact. Except for its

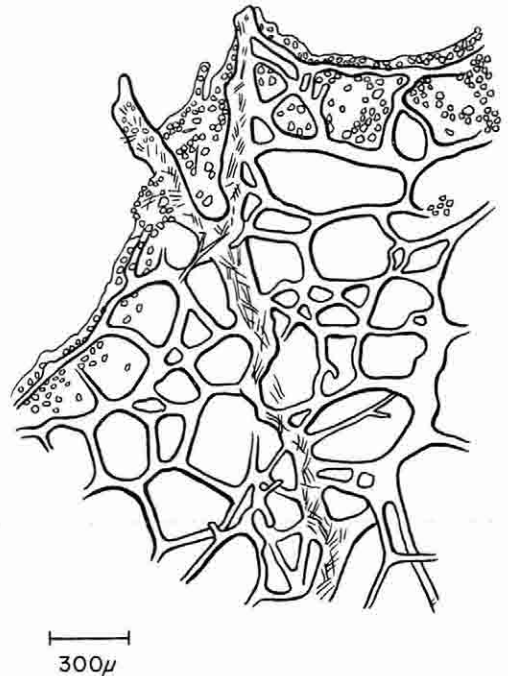


FIG. 11b. *Euryspongia lobata* n. sp. Portion of the fibre network.

possession of a eurypylous chamber system and a pronouncedly conulose surface this sponge could be referred to *Leiosella*.

There are no other species of *Euryspongia* known from this area. *Euryspongia phlogera* de Laubenfels (USNM 22952) is not a dysideid.

ORDER HAPLOSCLERIDA Topsent

FAMILY HALICLONIDAE de Laubenfels

GENUS HALICLONA Grant

Haliclona velinea (de Laubenfels)

Fig. 12

Acervochalina velinea de Laubenfels, 1954, p. 52, fig. 30.

? *Acervochalina finimita* Ridley, 1884, p. 399.

non *Chalina finimita* Schmidt, 1870, p. 33.

OCCURRENCE: Sta. 25.

DESCRIPTION: Only one small specimen of this sponge was collected; it was growing upon a branch of coral but became detached during collection. The habit is thickly encrusting; the sponge, which appears to be entire, is 1.7 cm long, 0.6–1.5 cm wide, 0.8 cm high.

COLOR: In alcohol, sandy except for a thin greyish-black surface layer.

TEXTURE: Relatively soft, easily compressible.

SURFACE: Irregular owing to incorporated calcareous debris. Where the darkly pigmented dermal membrane is entire, the macroscopic appearance is smooth, even slightly slimy. Under low magnification small surface conules are apparent. No pores or oscules are visible.

SKELETON: A reticulation of very fine spongin fibres which have no regular arrangement. Thicker ascending fibres are usually simple, but often two will unite and later diverge. Most connecting fibres arise at right angles to the ascending fibres but there are many exceptions, particularly in the deeper regions of the sponge where the fasciculation of primary fibres and branching of secondaries is common. Primary fibres are 16–24 μ in diameter and contain two, occasionally three, rows of oxaeas; secondary fibres are 5.0–8.5 μ in diameter and never contain more than one spicule row. Spicules are also abundant interstitially.

SPICULES: Extremely fine, slightly curved

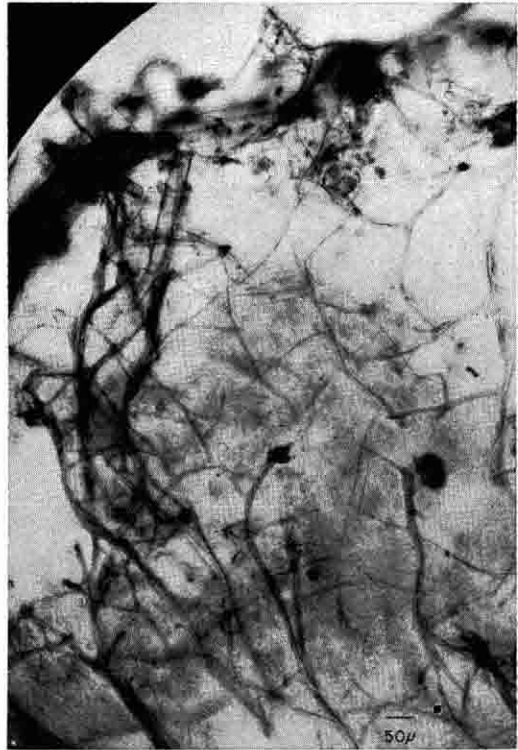


FIG. 12. *Haliclona velinea* (de Laubenfels). Photomicrograph showing the network of fine fibres, the conulose surface, and the darker dermal layer.

oxaeas are the only spicules present.

DIMENSIONS: 88–102 \times 1.2–2.5 μ .

ECTOSOME: No ectosome is differentiated save the pigmented dermal membrane, 12–15 μ thick.

ENDOSOME: Fleshy and contains abundant spherical flagellate chambers 25–30 μ in diameter.

DISCUSSION: De Laubenfels (1954) states that spicules were sparse in this species; this is not the case in either the present specimen or the holotype (USNM 22854). Burton (1934: 529) puts forward a convincing argument for synonymizing *Acervochalina* Ridley with *Haliclona* Grant, and in doing so reverses his earlier (1927) decision to retain *Acervochalina* as a genus of the pachychalinid group lacking a dermal skeleton. When Ridley set up *Avervochalina* he named *Chalina limbata* Montagu (per Bowerbank) as the type. His generic diagnosis contains no reference to the presence of

a dermal skeleton, but Bowerbank (1865:373) distinctly mentions the dermal skeleton in this sponge. If Bowerbank's description is correct then *Acervochalina* cannot be synonymous with *Haliclona*; one can only assume that Burton, having access to Bowerbank's specimens, has checked this point.

Copious slime production is the character used by de Laubenfels (1954) to distinguish between *Acervochalina* and *Haliclona* but this, as Burton (1934) points out, is hardly ground for generic distinction.

It is probable that de Laubenfels' statement regarding Ridley's specimens of *Acervochalina finimita* (Schmidt) is correct, and that the North Australian specimens should be synonymized with *A. velinea* de Laubenfels. Only one statement in Ridley's description leaves this in doubt; he mentions stout primary fibres, but gives no measurements. Only reference to Ridley's specimens can decide this synonymy, but in terms of distribution, de Laubenfels' suggestion seems very likely to be correct.

DISTRIBUTION: Marshall Islands (de Laubenfels); Torres Strait, Queensland (Ridley).

Haliclona koremella de Laubenfels

Haliclona koremella de Laubenfels, 1954, p. 59, fig. 34.

OCCURRENCE: Sta. 10, 35.

REMARKS: The two specimens differ from the holotype in the dimensions of the fibres and in the number of spicule rows incorporated in primary and secondary fibres (Table 1).

DISTRIBUTION: Palau Islands (de Laubenfels).

GENUS *Cribrochalina* Schmidt

Cribrochalina olemda de Laubenfels

Fig. 13

Cribrochalina olemda de Laubenfels, 1954, p. 77, fig. 47, pl. IV, fig. a.

OCCURRENCE: Sta. 135.

REMARKS: De Laubenfels (1954) emphasized the difficulty of being certain that *Cribrochalina olemda* is not synonymous with some earlier described sponge since, in many early works, characters of the skeleton were described poorly, if at all, the tubular shape often being considered sufficient for identification. *C. olemda* appears, however, to be sufficiently distinct from such similar species as *Spinosella infundibuliformis* Lendenfeld to be considered a new species.

The single Palau specimen conforms closely to the type description. De Laubenfels was in some doubt as to the correct generic position of this sponge. Topsent (1920) has redescribed the type of *Cribrochalina*, *C. infundibula* Schmidt, and when his description is combined with Schmidt's type description, *Cribrochalina* emerges as a cup or funnel-shaped sponge, with concentric lines on the internal surface, having a complex multispicular network of vertical fibres, a well-defined system of subdermal cavities, and a protoplasmic dermal membrane containing no dermal skeleton.

C. olemda answers perfectly to this redefinition of *Cribrochalina*, having a faint pattern of concentric lines on the inner face of the tube, fasciculate fibres, protoplasmic dermis, and subdermal cavities. (This feature is not mentioned

TABLE 1

SPECIMEN	DIAMETER OF FIBRES		NO. SPICULE ROWS IN FIBRES	
	Primary	Connecting	Primary	Connecting
Sta. 10	32-87 μ (63 μ)	12-50 (29 μ)	10-20 rows	7-12 rows
Sta. 35	18-50 μ (25 μ)	10-32 (16 μ)	6-16 rows	3-12 rows
USNM 23129	100 μ	15 μ	4-7 rows	usually none

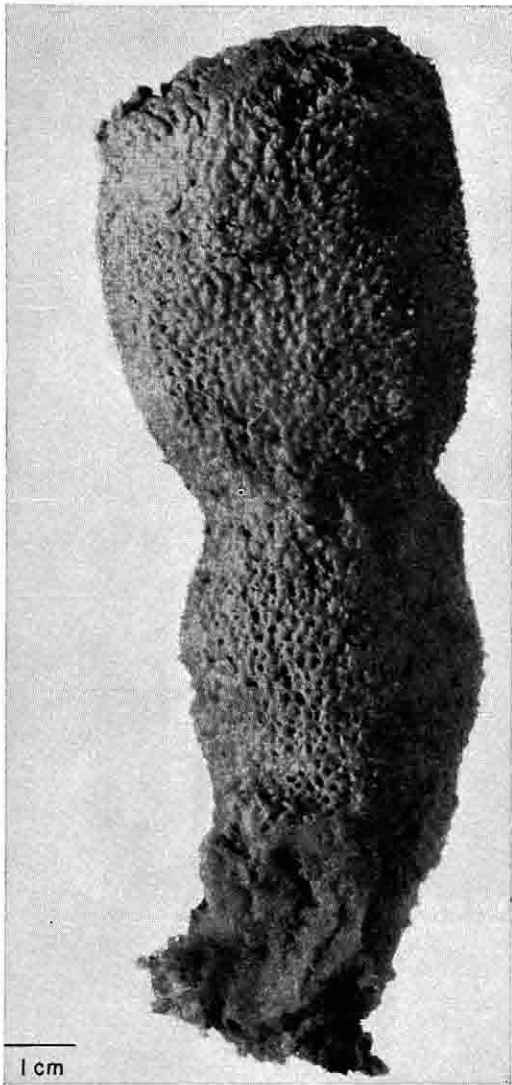


FIG. 13. *Cribrochalina olemda* de Laubenfels. Sta. 135.

by de Laubenfels and is visible only in specimens preserved in alcohol.)

DISTRIBUTION: Palau Islands (de Laubenfels).

GENUS *Xestospongia* de Laubenfels

Xestospongia de Laubenfels, 1932, p. 115.

Neopetrosia de Laubenfels, 1949, p. 10.

Neopetrosia de Laubenfels, 1954, p. 81 pars.

Xestospongia exigua (Kirkpatrick)

Fig. 14*i*, *ii*, *iii*

Petrosia exigua Kirkpatrick, 1900, p. 139, pl. XII, fig. 7; pl. XIII, fig. 4.

Xestospongia exigua de Laubenfels, 1949, p. 126.

non *Xestospongia sapra* de Laubenfels, 1954, p. 79, fig. 48.

Neopetrosia pandora (pars.) de Laubenfels, 1954, p. 81, fig. 49.

OCCURRENCE: Sta. 10, 47, 100.

DESCRIPTION: One specimen (Sta. 47) of this species is an erect sponge with numerous slender branches which sometimes anastomose; the other two are repent, with extremely irregular stout branches (Table 2).

SURFACE: Characterized by a reticulate pattern formed by the ascending endosomal columns which fan out distally and support the aspiculous dermal membrane. This pattern is uniformly evident in two specimens (Sta. 47 and 10) where the endosomal spicule tracts are narrower and the texture of the sponge is correspondingly softer; it is less pronounced but still visible in the third specimen. All of de Laubenfels' specimens of *Neopetrosia pandora* show this reticulation; it is also plain in his specimen of *Xestospongia exigua* from Yap, and was described by Kirkpatrick (1900) for the type specimen of *Xestospongia exigua*. The illustrations of *Petrosia similis* Ridley and Dendy (Pl. III, figs. 3, 4, 6), although lacking in detail, convey the impression of a reticulate surface as is described in the text.

SKELETON: In all three specimens the skeleton is basically an isodictyal reticulation with unispicular to multispicular ascending tracts developed to varying degrees. In the specimen from Sta. 100 these tracts are abundant and up to 300μ wide. In other specimens tracts, $36\text{--}50\mu$, six to eight spicules wide, are common; larger tracts up to 100μ wide occur infrequently. In all cases numerous spicules occur usually aligned parallel to the ascending tracts.

Faint traces of spongin occur distributed sporadically along some of the ascending tracts. Immediately below the surface the ascending tracts fan out into brushes, $62\text{--}187\mu$ across, the outer spicules of which project slightly beyond the dermal membrane.

TABLE 2

CHARACTERISTIC	STA. 10	STA. 47	STA. 100
Color in life	blue		
Color in alcohol	greyish-brown externally (rY 4/2), reddish-brown internally (YR 4/6)	brown (yY-R 4/2)	pale brown (Y-R-Y 6/4)
Branch height	repent	mostly broken but greater than 20 cm	
Branch diameter	almost massive in form owing to frequent anastomoses 0.9-2.5 cm	0.4-1.2 cm always cylindrical or oval	extremely irregular often flattened 0.6-3.0 cm
Texture	firm, just compressible	firm, just compressible	cork-like, extremely brittle
Oscule diameter	1.2-2.5 mm	1.0-2.5 mm	0.8-4.0 mm
Spicule dimensions	105-132 × 3.0-5.5 μ	99-126 × 1.5-5.0 μ	105-130 × 3.5-5.5 μ

DISCUSSION: The initial diagnosis of *Xestospongia* de Laubenfels (1932) reads, "characterized by having only oxeas as spicules and these so abundant that any reticulate arrangement is obscured; there is no special dermal skeleton." On the same page, in the description of the type species, *Xestospongia diprosopia*, an endosomal reticulation prominent enough to enable measurements of the meshes is described. A second species, *Xestospongia vanilla*, described in the same work conforms more closely to the generic diagnosis.

It is difficult to see the differences between *Xestospongia* de Laubenfels and *Neopetrosia* de Laubenfels if only the generic diagnoses are considered. *Neopetrosia*, with type species *Haliclona longleyi*, is defined as "differing from *Haliclona* by having a smoother surface, more brittle consistency and other important differences which we are not yet ready to discuss."⁵ The erection of *Neopetrosia* was premature and it remains an incompletely defined genus.

It is unquestionably correct that there are at least two separate groups of sponges in *Petrosia*, some with the spiculation of the type species (*Petrosia dura* (Schmidt)) possessing a der-

mal skeleton and having a rock-like texture, others with oxeas, no dermal skeleton, retaining the stony texture and having little or no trace of a reticulate skeleton. The erection of *Xestospongia* for the latter group was thus justified, but the genus requires redefinition in terms of western Pacific material which has been subsequently assigned to it.

The specimen from Yap (USNM 22733), described as *Xestospongia exigua* (Kirkpatrick) by de Laubenfels (1949), is identical except in form with the holotype of *Neopetrosia pandora* de Laubenfels 1954 (USNM 23046) and is distinctively different in spiculation from *Xestospongia sapra* de Laubenfels. *Xestospongia sapra* has oxeas, strongyles, and styles of irregular, curved, even wavy form and has a microconulose surface. De Laubenfels (1954) stated that his specimens of *X. exigua* and *X. sapra* both belonged to *sapra*; this is not the case.

In describing *Neopetrosia pandora*, de Laubenfels mentioned the great variability of his specimens in details of spiculation and in habit. This can be endorsed from a study of the type series and the Palau collections. In view of this variability it is difficult to see why de Laubenfels did not relate his Yap specimen of *X. exigua* to this complex. It is possible that de Laubenfels described more than one species under *N. pandora*; specimen 403 (USNM 23024)

⁵ This refers to Bergmann's work on the sterols of sponges. Those of *H. longleyi* were distinctive; unfortunately no further data have been produced which pertain to this species or to the genus *Neopetrosia*.

is quite removed from all others by its spiculation. Apart from this all specimens can be regarded as belonging to one variable species. The question is, should this be a species of *Xestospongia* or of *Neopetrosia*? Either would require expanding the generic diagnosis. In addition to the basic reticulate structure, the Palau specimen from Sta. 100 has large tracts of vertically aligned spicules up to 275μ wide and is thus approaching the type of structure which *Xestospongia* should possess and which is exemplified in *X. vanilla* and *X. (Petrosia) coraloides*. This particular specimen is almost stony and brittle. However, the differences which separate these sponges are only differences of degree. Spicule tracts are present, but are much narrower in the specimens from Sta. 10 and

Sta. 47, and these specimens although firm and brittle, could not be described as stony.

It is suggested that the definition of *Xestospongia* should be rephrased to include sponges like the type species, where a distinct reticulate skeleton is present but where accumulation of spicules may be so great as to obscure this in parts or in all of the sponge except the subdermal region. Many sponges assigned to this genus have a reticulate surface pattern.

Neopetrosia does not differ in any way from *Xestospongia* as defined above and as understood by de Laubenfels (1950:49). The only species assigned to *Neopetrosia* to date are *Haliclona longleyi* de Laubenfels, the type species, *Neopetrosia pandora* from the Palau Islands, and *Petrosia similis* Ridley and Dendy; all three

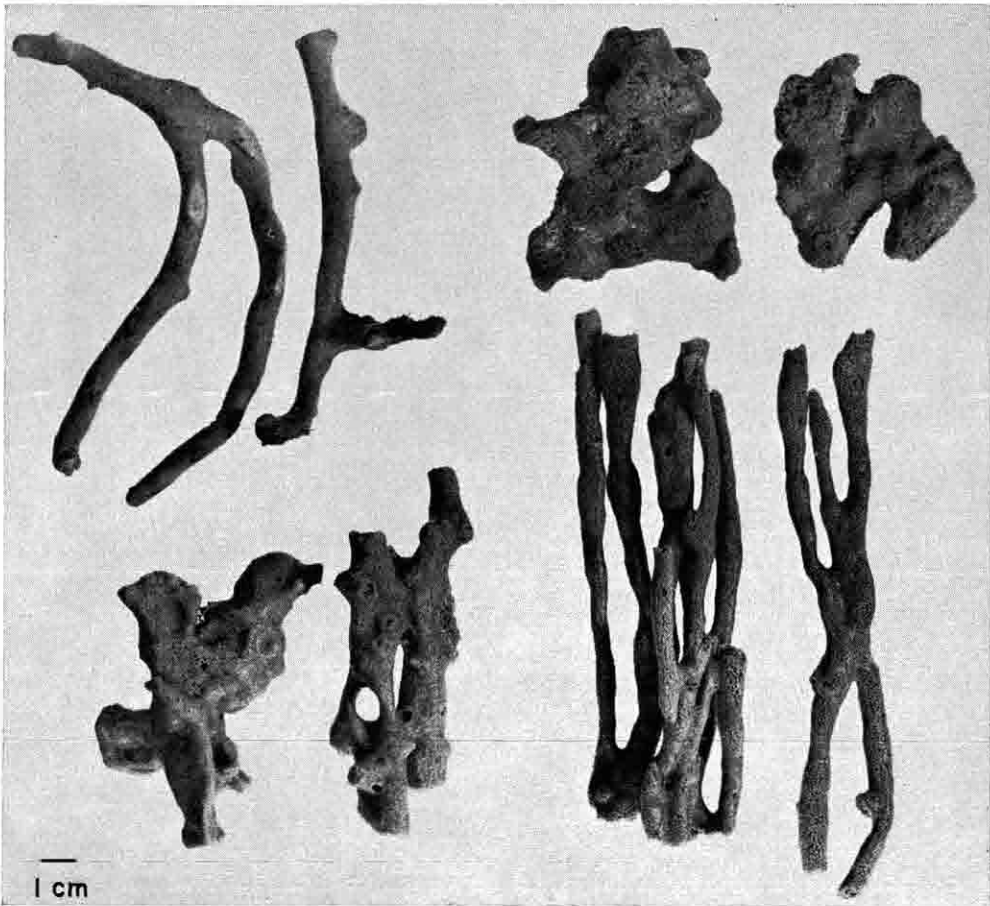


FIG. 14. *Xestospongia exigua* (Kirkpatrick). (i) Upper right, Sta. 100. (ii) Lower left, Sta. 10. (iii) Lower right, Sta. 47. *Clathria cervicornis* (Thiele). (iv) Upper left, Sta. 220B.

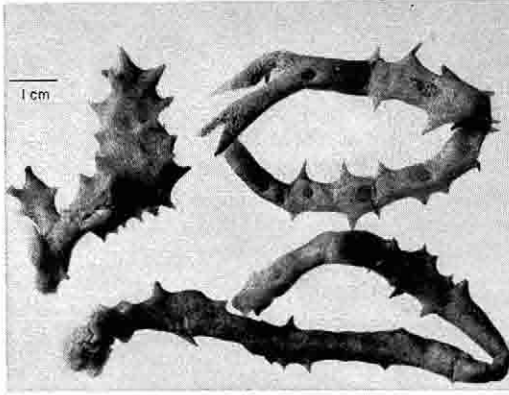


FIG. 15a. *Callyspongia subarmigera* (Ridley). Sta. 125.

species can be transferred to *Xestospongia*, with *N. pandora* falling to *X. exigua* (Kirkpatrick).

DISTRIBUTION: Christmas Island (Kirkpatrick); Yap Archipelago, Palau, Marshall Islands (de Laubenfels).

FAMILY CALLYSPONGIIDAE de Laubenfels

GENUS *Callyspongia* Duchassaing and Michelotti

Callyspongia subarmigera (Ridley)

Fig. 15a, b, c

Cladochalina subarmigera Ridley, 1884, p. 397, pl. XXXIX, fig. H, pl. XLI, fig. L.

Pachychalina fibrosa var. *gracilis* Wilson, 1925, p. 412.

Callyspongia subarmigera Burton, 1934, p. 540.

OCCURRENCE: Sta. 125.

DESCRIPTION: A repent sponge composed of unbranched cylindrical stems 4.0–9.0 mm in diameter, bearing prominent spinous processes and having oscules, 2.5–3.5 mm, arranged along the upper surface.

SURFACE: Smooth, the pattern of the dermal skeleton somewhat obscured by fine coral sand.

SKELETON: In all essential features the skeleton conforms with the type description of this species (Ridley, 1884:397). The construction of the endosomal skeleton is essentially radial with polyspicular primary fibres diverging from an excentric hub. Secondary fibres arise at right angles to these. Between the rectangular meshes of the secondary fibres a fine system of tertiary, mono- or bi-spicular fibres ramifies in irregular

fashion. The stout endosomal fibre system terminates abruptly immediately below the surface. Both primary and secondary fibres give rise to a system of fine vertical fibres which support the primary and secondary meshes of the dermal skeleton. These supporting fibres are of equivalent diameter to the primary meshes of the dermal skeleton.

Fibre dimensions (in μ).

Skeleton	Primary	Secondary	Tertiary
Dermal	12–28 meshes 300–375	4–12 meshes 55–78	none
Endosomal	37–60	12.5–50	2–15

The endosome incorporates much debris and a few interstitial spicules.

SPICULES: Extremely fine strongyles, 72–90 \times 0.8–1.5 μ . In a few cases slightly stouter tornote oxeas occur.

DISCUSSION: *Callyspongia subarmigera* Ridley is a well-characterized species; the type description differs from the Palau specimen only in possessing tornote oxeas exclusively, where the Palau sponge has strongyles predominantly and just occasional oxeas. In this respect the



FIG. 15b. *Callyspongia subarmigera* (Ridley). Section of the skeleton showing the radial primary fibres and complex network of connecting fibres. The dermal network shows at the upper right.

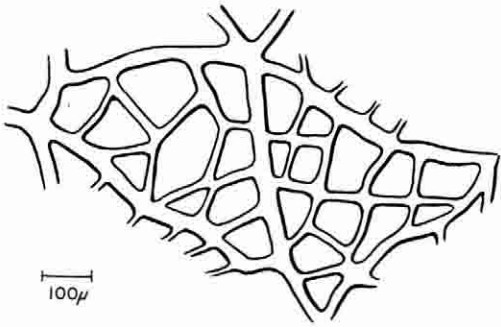


FIG. 15c. *Callyspongia subarmigera* (Ridley). Detail of the dermal skeleton.

latter is reminiscent of *Callyspongia armigera* from the West Indies.

Pachychalina fibrosa var. *gracilis* Wilson has stouter fibres and wider meshes throughout than does the Palau specimen. In construction and habit the two compare closely, and both have strongyles, those in Wilson's specimen being slightly stouter than those of the Palau specimen and nearer in this respect to the type. In all features except the possession of strongyles *Pachychalina diffusa* var. *affinis* Hentschel is close to *C. subarmigera* (Ridley).

DISTRIBUTION: Northern Australia (Ridley, Burton); Philippines (Wilson).

Callyspongia ridleyi Burton

Fig. 16a, b

Callyspongia ridleyi Burton, 1934, p. 543, fig. 7, a, b.

OCCURRENCE: Sta. 220A (six specimens).

DESCRIPTION: The specimens are probably all part of one large colony which is similar to that described as *Callyspongia ridleyi* by Burton. Both species of *Callyspongia* described here exhibit a marked tendency toward the formation of strongylote spicules. In the specimens of *C. ridleyi* strongyles are approximately 5% of the spicule total; their dimensions are equivalent with those of the tornote oxeas, $78-89\mu \times 2.0-3.5\mu$.

Fibre dimensions (in μ).

Skeleton	Primary	Secondary
Dermal	15-37 (26)	4.5-16 (11.5)
Endosomal	20-28 (25)	5-16.5 (12)

Australian specimens of *Callyspongia ridleyi* have substantially larger spicules ($200 \times 8\mu$) than the Palau specimens but compare very closely in all other respects. In the absence of specimens from intervening localities it is not possible to evaluate the significance of these spicule differences.

DISTRIBUTION: Northeastern Australia (Ridley, Burton).

FAMILY DESMACIDONIDAE Gray

GENUS *Gelliodes* Ridley

Gelliodes gracilis Hentschel

Gelliodes gracilis Hentschel, 1912, p. 395, pl. XXI, fig. 49.

Gelliodes gracilis de Laubenfels, 1954, p. 89, fig. 53, pl. V, fig. b.

OCCURRENCE: Sta. 125.

REMARKS: This specimen is identical with the Palau sponge described by de Laubenfels and assigned to this species (Bishop Museum 125). De Laubenfels expressed doubts as to whether *G. gracilis* should remain in *Gelliodes*, but gave no reasons for this. The Palau specimens have the fleshy conulose surface, fibrous structure, and spiculation of the type species of *Gelliodes* and appear to be correctly placed in this genus. The correspondence between the Palau specimens and *G. gracilis* Hentschel is close; the two possibly differ in surface features

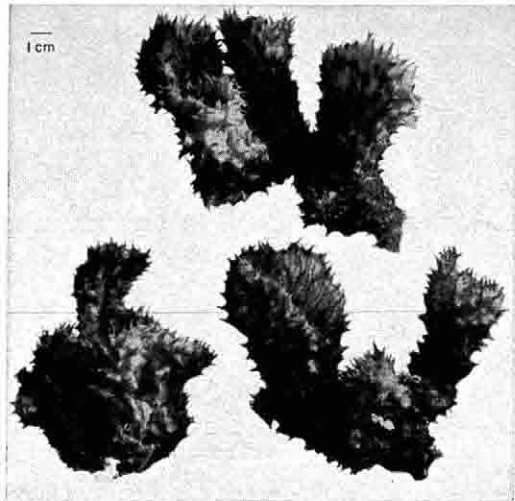


FIG. 16a. *Callyspongia ridleyi* Burton. Sta. 220A.

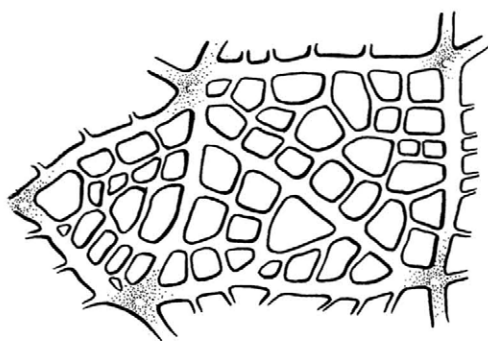


FIG. 16b. *Callyspongia ridleyi* Burton. Detail of the dermal skeleton.

but these are neither discussed in detail nor figured by Hentschel.

DISTRIBUTION: Malay Area (Hentschel); Palau Islands (de Laubenfels).

ORDER POECILOSLERIDA Topsent

SUBORDER PHORBASIFORMES de Laubenfels

FAMILY ADOCIIDAE de Laubenfels

GENUS *Adocia* Gray

Adocia turquoisia de Laubenfels

Adocia turquoisia de Laubenfels, 1954, p. 106, fig. 67.

OCCURRENCE: Sta. 92.

DESCRIPTION: The specimen is damaged. It grows as a system of irregular tubes, each with a terminal oscule; some tubes are laterally placed.

COLOR: In alcohol, pale creamy yellow (yY-R 6/4).

TEXTURE: Soft, the sponge easily compressible.

SURFACE: Smooth, and has a plain, but irregular, reticulate pattern outlined by stout tangential fibres in a subdermal position. Oscules are large, 4.0–5.0 mm in diameter, and are terminal on all branches.

SKELETON: The dermal skeleton is a unispicular isodictyal reticulation of oxeas with regular triangular meshes, 75–87 μ from apex to base. The unispicular isodictyal pattern is repeated in the endosomal skeleton, where small patches of spongin cement the spicule points. Running vertically through the endosome are occasional multispicular tracts, 12.5–62 μ in diameter. These only rarely branch in the body of the sponge.

Immediately below the dermal membrane they branch repeatedly in a tangential plane and form a conspicuous and irregular mesh in which the large tracts are up to 100 μ in diameter. The finer branches of this subdermal network delimit the pore areas which are overlain by the dermal skeleton.

SPICULES: Slightly curved or straight, evenly pointed oxeas 70–100 \times 1.8–4.5 μ .

ENDOSOME: Contains abundant, spherical, flagellate chambers, 30–36 μ in diameter. Abundant developing egg cells are present; these are oval, up to 350 \times 250 μ , with extremely prominent nuclei and granular cytoplasm.

DISCUSSION: The type description of *Adocia turquoisia* de Laubenfels makes no reference to the multispicular tracts below the dermal membrane. These are present, however, in the paratype (Bishop Museum 149), and the form of the latter is not incompatible with that of the fragments from the Palau Is. The oscules are similar, terminal on poorly developed lobes in one case, aligned along the upper surface of a branch in the other.

DISTRIBUTION: Palau Islands; Marshall Islands (de Laubenfels).

GENUS *Toxadocia* de Laubenfels

Toxadocia violacea de Laubenfels

Fig. 17

Toxadocia violacea de Laubenfels, 1950, p. 16, fig. 9.

OCCURRENCE: Sta. 10.

DESCRIPTION: The sponge is loosely encrusting (0.8 cm thick) upon specimens of *Coelocarteria singaporense* and is badly damaged; only one or two fragments of the dermal membrane remain. No oscules are visible.

COLOR: In alcohol, grayish.

TEXTURE: Extremely soft, and tends to fall apart at the touch.

SURFACE: Smooth; the dermal membrane supports a tangential dermal skeleton arranged as a unispicular isodictyal reticulum.

SKELETON: Basically a unispicular isodictyal reticulation the regularity of which is broken in places by alignment of spicules at right angles to the surface. Where this aggregation of spicules occurs the matrix is always more darkly

staining than usual and elongate fibrous cells are concentrated with their long axes parallel to the spicules. These columns usually traverse approximately one third of the thickness of the sponge.

The mesh of the endosomal reticulum is 100–125 μ ; three to six spicules join at the corners of the mesh and conspicuous patches of spongin occur at all intersections. In the deeper parts of the sponge the reticulum is less regular, and

occasionally three to four spicule lengths will be encased in spongin, simulating a fibrous structure.

SPICULES: *Megascleres*. Oxeas, straight or slightly curved, evenly tapered, 132–158 \times 1.8–6.0 μ .

Microscleres. Toxas, of relatively open form with little or no reflexure of the tips, 25–96 μ (60 μ).

DISCUSSION: This rather fragmentary specimen is identified with *Toxadocia violacea* from Hawaii chiefly upon spicule characters. Spiculation and violet color are the distinguishing features of *T. violacea*. The toxas of the type (USNM 22752) and the Palau specimen are closely comparable in shape, and the size range of the oxeas is close.

DISTRIBUTION: Hawaii (de Laubenfels).

GENUS *Orina* Gray

Orina sagittaria (Sollas)

Fig. 18a, b, c

Gellius sagittarius Sollas, 1902, p. 212, pl. XV, fig. 7.

Adocia sagittaria Burton, 1934, p. 538.

OCCURRENCE: Sta. 12, 60.

DESCRIPTION: The habit of this sponge is most distinctive, with a massive base producing one to three stout fistules from the upper surface. These anastomose and then subdivide terminally into a number of finer tubes which expand into an oval structure on which pores are located. The walls of the tubes contain vertical spicule tracts, and the terminal expansion is merely an open network of irregular tracts with little or no reticulate structure and a minimum of soft tissues. Lateral branches may arise from the upright fistules. One such branch shows a terminal expansion which is not plainly set off from the tube: the walls merely become transparent, the fibres are prominent, the surface hispid, and the lumen a little wider. This is interpreted as a developmental stage of the typical structure described above. The function of these terminal caps is unknown; they were often observed free floating in the field and may possibly be an asexual dispersal structure. There is noth-

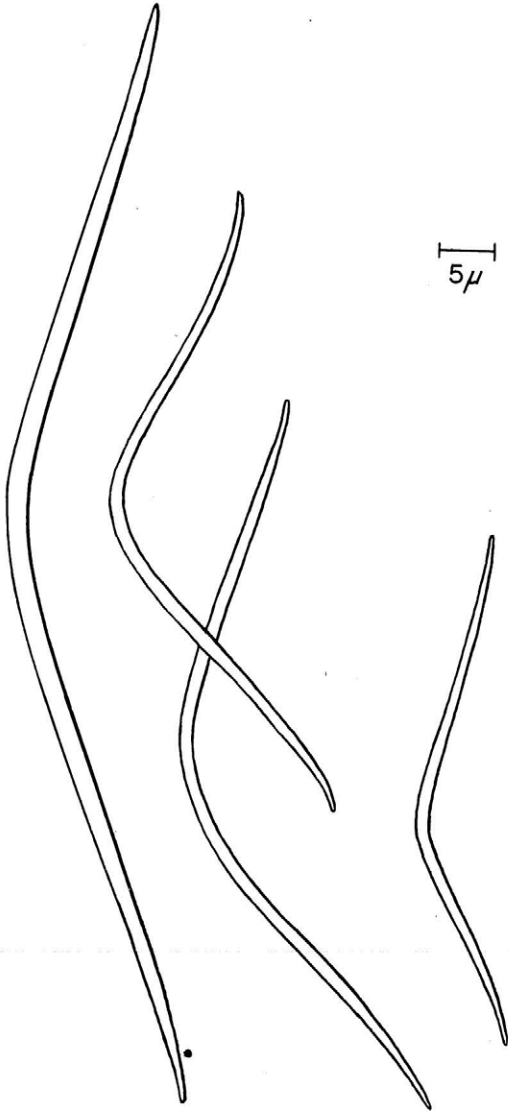


FIG. 17. *Toxadocia violacea* de Laubenfels. Toxa.

ing in their morphology to suggest this, however, and the very restricted occurrence of the sponge does not suggest the presence of an elaborate dispersal mechanism.

DIMENSIONS: *Basal mass*, 4.5 cm long; 4.0 cm high; 3.0 cm thick. *Fistules*, 8.5 cm high; 0.65–0.75 cm in diameter, 1.1 cm after anastomosis, walls 1.2 mm thick; lateral branch, 2.2 cm high; 0.5 mm in diameter, walls, 0.3 mm thick. *Terminal expansion*, 1.5 × 1.0 cm, 0.8 cm high.

COLOR: In life, bright red; in alcohol, brown (Sta. 12) (yY-R 4/2) or dull reddish-brown externally, between (RY-R 4/4) and (RY-R 3/4), to pale brown internally (rY-R 5/4).

TEXTURE: Firm and brittle with respect to the fistules and the dermis of the base; the endosome of the latter is soft and easily crumbled.

SURFACE: Smooth, except at the tips of branches or on the pore areas where fibres

project and render the surface conulose and slightly hispid. No oscules are visible, but numerous skeletal pores are discernible on the terminal expansions of the fistules.

SKELETON: The skeletal pattern of this sponge is a curious composite of an irregularly isodictyal network with spicule tracts produced in the fistules and the terminal caps and of a more or less halichondroid skeleton, with spicules in confusion, lining all large canals in the endosome. The dermal skeleton is made up of tangentially placed oxeas with no regular arrangement and of abundant sigmas. Below the dermis is an extensive subdermal space system, 700–800 μ deep, across which only isolated oxeas extend to support the dermal skeleton. These oxeas are part of the irregular reticulation which extends throughout the sponge and which is the basic endosomal skeleton. Most of the component spicules of the endosomal reticulum, except in the subdermal region, are coated with a coarsely granular dark brown material.⁶ In addition to this skeletal framework, dense aggregations of oxeas line all major canals. These spicules are chiefly disposed at right angles to the edges of the canals and give the sponge tissue an irregularly lobulate appearance in section.

In the fistules the skeleton shows little organization except toward the production of longitudinal tracts. These become extremely pronounced in the expanded tips of the fistules where few extraneous spicules occur.

SPICULES: *Megascleres.* Oxeas, slightly curved often a little wavy, evenly tapered, 325–375 × 5.5–10 μ .

Microscleres. Sigmas, with abruptly recurved tips and often centrally angulate, 10.5–20.5 μ . Toxa, of open form, either straight-sided or with slightly reflexed tips, 36–50 μ .

DISCUSSION: This specimen is the most complete so far recovered of this species; however, the more that is known of its morphology the more difficult it becomes to assign conclusively to a genus. The form of the sponge is peculiar, particularly in the production of fibrous terminal expansions to many of the fistules. Most likely these are pore sieves, and some tubes may termi-



FIG. 18a. *Orina sagittaria* (Sollas). Sta. 60.

⁶ This appears to be similar to the structure described for *Gellius luridus* by Lundbeck (1902:64).

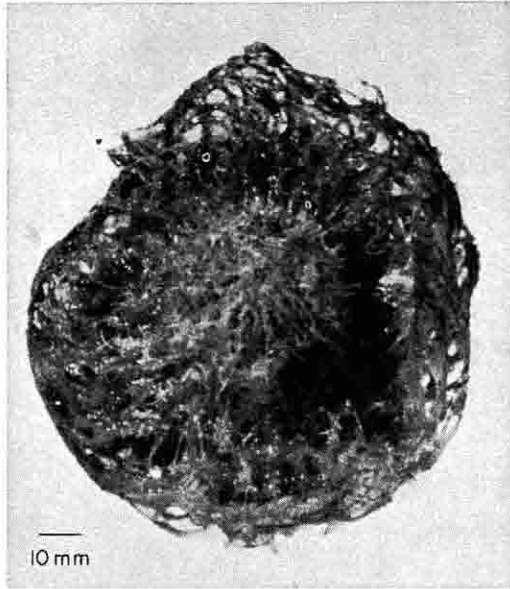


FIG. 18b. *Orina saggittaria* (Sollas). Apical view of one of the detachable caps from the oscular tubes.

nate in oscules. None of the latter have been observed. Careful study of the pore sieves must be done on fresh material since almost all soft tissues have fallen away from the fibres in alcohol-preserved material. The combination in this sponge of reticulate, fibrous, and confused skeleton underlines the difficulty of defining genera on skeletal pattern.

Burton (1934) has assigned *Gellius angulatus* var. *canaliculata* Dendy to this species but, in details of the skeleton and the size of the sigmas, the description of this sponge does not coincide with Sollas' description or the Palau specimens.

DISTRIBUTION: Malay area (Sollas); Great Barrier Reef (Burton).

GENUS *Kallypilidion* de Laubenfels

Kallypilidion poseidon de Laubenfels

Kallypilidion poseidon de Laubenfels, 1954, p. 110, fig. 70, pl. IX, fig. a.

OCCURRENCE: Sta. 67.

DISCUSSION: This species is well described by de Laubenfels (1954) and the single specimen from the Palaus conforms in detail with the description and with the paratype (Bishop Museum 169). De Laubenfels (1950) erected the

genus *Neoadocia* for *N. mokuoloea* from Hawaii, a sponge which has adociid construction and spiculation, except for the addition of raphides; the surface of this sponge is markedly punctate. *Neoadocia* and *Kallypilidion* are closely comparable; only color and shape separate the two genera.

DISTRIBUTION: Palau Islands, Marshall Islands (de Laubenfels).

GENUS *Pellina* Schmidt

Pellina carbonaria (Lamarck)

Fig. 19

Spongia carbonaria Lamarck, 1814, p. 375.

?*Thalasyias carbonaria* Duchassaing and Michellotti, 1864, p. 83, pl. XVII, fig. 4, pl. XIX, fig. 2.

Pachychalina carbonaria Arndt, 1927, p. 152, pl. 1, fig. 1, text fig. 13.

Phloeodictyon carbonarium Topsent, 1930, p. 26.

Pellina carbonaria de Laubenfels, 1936, p. 68, pl. 18, fig. 5.

Pellina carbonaria de Laubenfels, 1954, p. 101, fig. 63.

OCCURRENCE: Sta. 92, 133.

DISCUSSION: The two specimens have been compared closely with de Laubenfels' material from the same area (USNM 23113 and Bishop Museum M. 495) and with material from Ja-

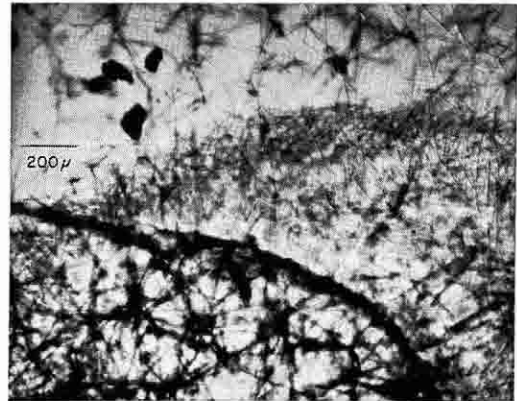


FIG. 18c. *Orina saggittaria* (Sollas). Section of the sponge showing the spongin coated spicule reticulum (lower left), the halichondroid skeleton (center right), and the open spicule reticulum in the subdermal position (upper).



FIG. 19. *Pellina carbonaria* (Lamarck). Sta. 133.

maica in an attempt to find characters which will serve to differentiate between the West Indian and the Pacific populations assigned to *P. carbonaria*.

Only minor differences can be found. The spicules are consistently larger in the Pacific specimens and, as far as is known, these specimens do not produce the blue-black exudate in alcohol that characterises *Pellina carbonaria* from Jamaica. The dermis is more easily detachable in the Pacific specimens than in the Jamaican specimens, but this feature also characterises Lamarck's type from the West Indies (Topsent, 1930).

De Laubenfels considered that the Pacific specimens which he assigned to *P. carbonaria* were closer to the type description than were his specimens from the Tortugas. His suggestion was that Lamarck may have made an error in the locality of his specimen and that in fact *Pellina carbonaria* (Lamarck) may have been from the Pacific. There is, however, no evidence to support this contention. A comparison of the spicule size and shape characteristics in this species from the two areas (Table 3), reveals that the Jamaican specimen and the type are closely comparable, as are the three Palau speci-

mens. The differences between the two groups are, however, slight. De Laubenfels' specimens from the Tortugas have substantially smaller spicules but show the strongylote and stepped condition so common in specimens from other localities.

It is difficult to argue on morphological grounds that there are two species involved here. There are indications that studies of pigments could reveal differences which, in conjunction with the slight morphological discrepancies, would justify the use of a new name for the Pacific specimens. Ecological data on this species would be a valuable adjunct to morphological studies. *P. carbonaria* in Jamaica inhabits *Zostera* flats and rarely produces fistules; nothing is known of the habitat and range of growth forms of this sponge from the Pacific.

DISTRIBUTION: West Indies (Lamarck); Curaçao (Arndt); Jamaica (Hechtel); Palau Islands (de Laubenfels); Freemantle (W.A.?) (Carter 1882).

GENUS *Siphonodictyon* n. gen.

This genus is established for *Siphonodictyon mucosa*, the type species, and is closely related to *Phloeodictyon* Carter. It differs notably in lacking a bark-like dermal region, in the production of great quantities of mucus, in the complete lack of spongin, in the cryptic habit and in the possession of a dermal skeleton represented by brushes of oxeads. *Phloeodictyon aberrans* Dendy from New Zealand should also be included in this genus.

Siphonodictyon mucosa n. sp.

Fig. 20a, b

OCCURRENCE: Sta. 92 (Holotype, USNM 23697), 92A (three specimens).

DESCRIPTION: The basal portion of the sponge fills large cavities in coral and sends up several brittle cylindrical tubes which terminate in either sieve areas or oscules. Excessive quantities of mucus are secreted from the basal mass and apparently are exuded over the external surface of the oscular tubes during life. A thick layer of jelly-like mucus invests the sponge inside the cavity. It is difficult to be sure that this layer is external to the sponge since, in places, a crisp layer of tangential oxeads overlies the

TABLE 3

SPECIMENS	LARGER OXEAS (<i>u</i>)	SMALLER OXEAS (<i>u</i>)	DETAILS OF SHAPE
<i>Pellina carbonaria</i> Palau (de L., 1954) USNM 23113	254–287 × 11.6–14.6	212–237 × 3.3–5.0	strongyles, styles, and oxeas often stair-stepped, some mucronate. Usually curved, rarely straight.
Sta. 92. Palau	237–290 × 7.0–14.8	207–246 × 3.0–6.0	oxeas, styles, strongyles, stepped or mucronate, curved or rarely straight; fine spicules always oxeote.
Sta. 133. Palau	225–260 × 9.0–10.5	207–225 × 3.5–6.6	oxeas which can be almost mucronate; stepped or strongylote, always curved, can be centrally angulate.
Jamaica	220–237 × 8.0–10	212–220 × 2.5–4.5	oxeas stair-stepped, mucronate often strongylote, smaller spicules often typical oxeas, always curved.
Topsent, 1930 (redescription of Lamarck's type)	220–215 × 8.0–14		oxeas, curved, only very slightly fusiform.
De Laubenfels, 1936 Tortugas	164 × 4.5 (rarely 172 × 5)		strongyles, stair-stepped.
Arndt, 1927 Curaçao	190–242 × 7–10	190–242 × 7–10	oxeas.

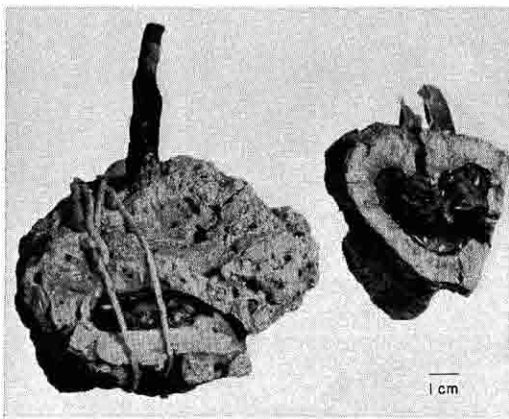


FIG. 20a. *Siphonodictyon mucosa* n. sp. Left, Sta. 92A; right, Sta. 92. Holotype. USNM 23697.

mucus and no dermal skeleton can be located at the inner boundary of the gel layer.

DIMENSIONS (Table 4).

COLOR: In life, black; in alcohol, dark brown (Y-R-Y 3/2) to pale brown (Y-R-Y 7/4) on the oscular tubes; the basal mass is pale brown (rY-R 5/4).

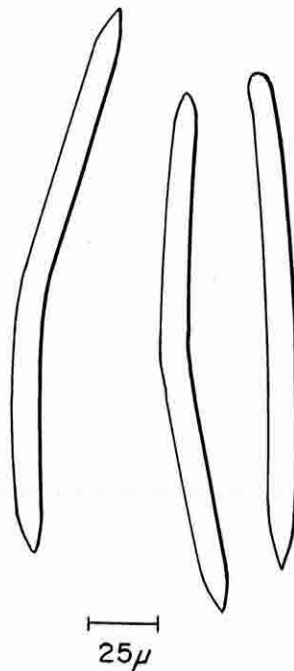


FIG. 20b. *Siphonodictyon mucosa* n. sp. Oxeas.

TEXTURE: The oscular tubes are brittle and incompressible; the body of the sponge is soft and gelatinous, easily torn.

SURFACE: All surfaces are smooth. Oscules are large and terminal on some of the erect tubes; pores are presumably restricted to the sieve ends of the remaining tubes.

SKELETON: A dermal skeleton is present in some areas of the oscular tubes in the form of an irregular reticulation overlying the fibres of the endosome. The meshes of this dermal reticulation are 275–500 μ from base to apex. On the basal portion of the sponge the dermal skeleton is developed as a tangential multispicular reticulum, present only in isolated places, external to the mucous layer.

The endosomal skeleton makes up almost the entire wall of the oscular tubes (900–1500 μ thick). The inner half of the endosome is occupied by stout fibres running longitudinally; these are 250–375 μ across and are connected at frequent intervals by stout transverse fibres, 62–125 μ in diameter.

The spicules are dense enough in some places to obscure the fundamental reticular pattern of the skeleton. Arising from this inner belt of fibres are numerous stout spicule brushes aligned at right angles to the long axis of the cylinder and running to the surface where they fan out and support the delicate dermal structures. These brushes are 300–750 μ long.

In the basal portion of the sponge the skeleton is somewhat confused and the details of structure are obscured by the abundance of darkly staining mucus. No spongin is associated with the skeleton and spongin A fibres appear to be absent from the ground substance of the endosome.

SPICULES: The spicules are stout, abruptly pointed oxeas, 194–212 \times 8.5–11.5 μ . There is considerable variation in shape: some are straight, some doubly curved or angulate, the majority are evenly curved. Styles are occasional.

FLAGELLATE CHAMBERS: These are abundant in the endosome, spherical, 18–20 μ in diameter.

MUCUS PRODUCTION: There is little development of soft tissue in the fistules and it appears that the production of mucus is entirely restricted to the base of the sponge. Mallory-stained sections of this region reveal numerous large oval darkly staining cells, 6.0–10 μ long, aggregated in groups of 10–20. These are probably secretory cells, but the preservation of the specimens did not permit use of any specific mucus stain.

DISCUSSION: There has been considerable confusion in the literature concerning the synonymy of *Oceanapia* Norman, *Rhizochalina* Schmidt, and *Phloeodictyon* Carter and the relationship of these sponges to the Coelosphaeriidae on the one hand and the Haplosclerida and Adociidae on the other. Since the genus *Siphonodictyon* is related to this group of sponges it is necessary to attempt to clarify the position.

Lundbeck (1902), after studying the holotypes of *Rhizochalina oleracea* and *R. carotta*, was convinced that *Rhizochalina* should be reserved for Schmidt's original two species and that *Phloeodictyon* Carter should be used to accommodate all species referred to *Rhizochalina* by later authors. *Rhizochalina* possesses well developed spongin fibres containing short oxeas; in *Phloeodictyon* relatively little spongin is associated with spicule tracts and the oxeas are larger. Lundbeck separates *Oceanapia* (type species, *Desmacidon jeffreysi* Bowerbank) from

TABLE 4

SPECIMEN	LENGTH OF TUBES FROM BASE TO TIP	DIAMETER OF TUBES	OVER-ALL LENGTH, BREADTH, AND THICKNESS OF SPONGE	THICKNESS OF MUCOUS LAYER
Sta. 92 ⁷	Broken	0.8 cm	4.0 \times 3.5 \times 2.9 cm	1.0–1.8 mm
Sta. 92A 1.	3.5 (2.1) cm 3.2 cm	0.8 cm	4.5 \times 1.5 \times 2.8 cm	1.5–3.0 mm
2.	2.0 cm 7.4 (5.2) cm	1.1 cm base 0.6 cm tip	—	—

⁷ This specimen is designated as holotype.

Phloeodictyon on the basis of the presence of sigmas in the former. The effect of Lundbeck's revision was to disperse the genera of Carter's *Phloeodictyina* through three separate divisions of the Haplosclerida by placing great emphasis on spiculation and amount of spongin present.

Spiculation is obviously not an adequate criterion for the wide separation of these genera. Topsent (1920), in his redescription of Schmidt's specimens of *Rhizochalina oleracea* and *R. carotta*, emphasizes the presence of sigmas in *R. carotta* and their absence from *R. oleracea*. These sponges are from the same locality, they are similar in form and construction and differ only in the presence or absence of sigmas. Lundbeck was prepared to leave these two species in *Rhizochalina* and at the same time to refer *Oceanapia* to the Gelliinae because it possessed sigmas.

Dendy (1921) recognizes all three genera and retains the group Phloeodictyinae as a subfamily, widely separate from the more typical Coelosphaerid genera (e.g., *Amphiestrella*, *Coelosphaera*) which he previously (1905) included with the Phloeodictyinae.

Burton (1934) considers *Rhizochalina* and *Phloeodictyon* to be synonyms of *Oceanapia*. He does not consider differences in microsclere content, amount of spongin and anatomy of fistules to be sufficiently significant to warrant maintaining the three genera. Burton concurs with Dendy in placing *Oceanapia* in the family Haploscleridae but does not recognize the Coelosphaerae as a separate section of the Ectyoninae. For example, he treats *Coelosphaera* as a myxiliid and *Coelocartheria* as a clathriid.

De Laubenfels (1936) has confused the Coelosphaerae and the Phloeodictyinae. He grouped them in one family, Coelosphaeridae, which he placed close to the Adociidae. The only possible justification for this view is that the spherical form and production of fistules is common to all genera involved. *Phloeodictyon* was considered by de Laubenfels to be a synonym of *Rhizochalina*, but *Oceanapia* was maintained because it possessed sigmas.

Of the four different treatments of these sponges outlined above, that proposed by Dendy is clearly the most logical and takes greatest note of the details of morphology of the speci-

mens concerned. In keeping with this view *Siphonodictyon* is placed in the Adociidae.

Burton (1934) has queried the value of the section Coelosphaerae as used by Dendy. It is probable that Burton is correct and that the genera of this group should be widely dispersed throughout the Poecilosclerida. This step is not taken here since many genera in no way connected with the region under consideration are involved.

FAMILY COELOSPHAERIDAE Hentschel

GENUS *Coelocartheria* Burton

Coelocartheria Burton, 1934, p. 563.

Ichnodonax de Laubenfels, 1954, p. 111.

Coelocartheria singaporense (Carter)

Phloeodictyon singaporense Carter, 1883, p. 326, pl. XIII, fig. 7.

Rhizochalina singaporensis var. Ridley, 1884, p. 421, pl. XII, fig. S.

? *Rhizochalina singaporensis* Ridley and Dendy, 1887, p. 34.

Rhizochalina singaporensis Lindgren, 1897, p. 481.

Rhizochalina singaporensis Lindgren, 1898, p. 297, pl. XIX, fig. 11.

Histoderma singaporensis Thiele, 1903, p. 955.

Coelosphaerella vesiculatum de Laubenfels, 1934, p. 21.

Coelocartheria singaporense Burton, 1934, p. 563.

Ichnodonax kapne de Laubenfels, 1954, p. 112.

Ichnodonax singaporensis Lévi, 1961, p. 518.

OCCURRENCE: Sta. 10, 15, 92.

DISCUSSION: The three specimens from the Palau Islands are identical, except in dimensions, with de Laubenfels' specimens of *Ichnodonax kapne* from the same locality. (The thinner, inhalant fistules are up to 6.5 cm long.)

Dendy (1905), in his description of *Histoderma vesiculatum*, mentioned that palmate isohelae were present in the type of *Phloeodictyon singaporense* Carter. If this fact is considered, then the only difference between *P. singaporense* and *Ichnodonax kapne* de Laubenfels is that the oxeads are thinner in the latter. Other specimens from the Palaus have slightly

TABLE 5

SPECIMEN	LOCALITY	HABIT	OXEAS	STRONGYLES	ISOCHELAE	FIBRES	COLOR
<i>Phloeodictyon singaporense</i> Carter, 1883	Singapore	incomplete specimen, sub-hemispherical with fistules	300 × 17μ	40-80 × 4μ	present (Dendy, 1905)	—	bright yellow in life, brown in dried state
<i>Rhizochalina singaporensis</i> var. Ridley, 1884	Torres Str., 7 fms.	tubular and elongate to barrel shape with fistules on upper surface	300 × 12.7μ to 280 × 4μ	present	presumably present (Burton, 1934)	—	chestnut to purplish brown in alcohol
<i>R. singaporensis</i> R. and D., 1887	Tristan da Cunha, 360 fms.	broken fistule only	no details, very doubtfully of the same species				
<i>R. singaporensis</i> Lindgren, 1898	China Sea	oval body with fistule	312 × 16μ	48-120 × 12μ	16μ	—	—
<i>Histoderma singaporensis</i> Thiele, 1903	Ternate	oval with fistules	300 × 15μ	small	15μ	—	brown
* <i>Histoderma vesiculatum</i> Dendy, 1905	Gulf of Manaar, deep water	elongate cylinder inflated at intervals to oval vesicles	300 × 9μ variable young forms present	40-100 × 5-7μ variable	16μ	165μ	pale brown with a purplish tinge
* <i>Ichnodonax kapne</i> de Laubenfels (1954)	Palau Is.	rhizome expanded into vesicles with vertical fistules from upper surface	262-290 × 5.5-11.5μ	46-112 × 3.5-7μ	14.5-17.5μ	187-312μ (main fibres only)	dark olive to medium yellow in life, red-brown in alcohol
<i>Ichnodonax singaporensis</i> Levi, 1961	Zamboanga	cushion-like with fistules	240-275 × 6-12μ	30-100 × 5-8μ	14-15μ	250-300μ	—
Sta. 10 Palau	Palau	rhizome expanded into vesicles with fistules mainly from upper surface	260-290 × 10-12μ	50-112 × 4-7μ	14-17.5μ	200-430μ (main fibres only)	brown in life, brown and black in alcohol
Sta. 15 Palau	Palau	identical to Sta. 10	237-300 × 3.5-13.5μ	50-112 × 3.5-9μ	14-18μ	—	golden brown in alcohol, yellowish-green in life

* The type of *I. kapne* and a spicule mount of the type of *H. vesiculatum* have been examined.

thicker oxes and Carter gave no range in dimensions for his specimens. Only Carter and de Laubenfels have reported the life color of their specimens; in both cases they were yellow. Examination of a spicule mount of the type of *Histoderma vesiculatum* Dendy (BM 1907.2.1.60) reveals greater variation in the dimensions of the oxes than reported by Dendy and leaves no doubt that this species is synonymous with *P. singaporense*. Burton (1934) erected the genus *Coelocartheria* for *P. singaporense*. No later authors have used this genus.⁸ De Laubenfels (1934) referred *H. vesiculatum* Dendy to *Ceolospaerella*, a genus defined as having toxas; he later (1954) erected a new genus, *Ichnodonax*, to receive a Palau sponge, *I. kapne*, which is now considered synonymous with *Coelocartheria singaporense* Carter.

Lévi (1961) considers *H. vesiculatum* Dendy to be a synonym of *P. singaporense*, which he referred to *Ichnodonax* as a species distinct from *I. kapne*. A tabulation of the salient characters recorded by all authors for *C. singaporense* and its synonyms (Table 5) affords little basis for retaining more than a single species, which has a general Indo-Pacific distribution.

DISTRIBUTION: Singapore (Carter); Torres St. (Ridley); China Sea (Lindgren); Ternate (Thiele); Ceylon (Dendy); Palau Islands (de Laubenfels); Zamboanga (Lévi).

SUBORDER MYXILLIFORMES de Laubenfels

FAMILY TEDANIIDAE Ridley and Dendy

GENUS *Iotrochota* Ridley

Iotrochota Ridley, 1884, p. 433.

Hiattrochota de Laubenfels, 1950, p. 19.

Iotrochota baculifera Ridley

Iotrochota baculifera Ridley, 1884, p. 435, pl. XXXIX, fig. M, pl. XLII, fig. F.

Iotrochota baculifera Thiele, 1899, p. 18.

Hiattrochota baculifera de Laubenfels, 1954, p. 124, fig. 77.

⁸ De Laubenfels (1936) states "*Coelocartheria* Burton has many monaxons, that is to say, styles." This is not the case; occasional stylote modifications of oxete spicules have been reported for *Coelocartheria singaporense*, but styles do not constitute a major proportion of the skeleton.

Hiattrochota biatti de Laubenfels, 1954, p. 125, fig. 78.

Hiattrochota mystile de Laubenfels, 1954, p. 126, fig. 79.

OCCURRENCE: Sta. 236A.

DESCRIPTION: Only two tiny specimens are in the Palau collection, both encrusting upon *Clathria fasciculata*; one is intact and has the variable surface features which characterize this species. The color reported by de Laubenfels for *Hiattrochota mystile*, to which this specimen compares most closely, is black in life. In alcohol both the type (USNM 23018) and the Palau specimens are deep purplish-red (R 3/4).

The spicule dimensions conform closely to those of the type of *H. mystile*.

Megascleres. Strongyles, 225–255 × 3.5–5.0 μ . Styles, 125–180 × 5.5–7.5 μ .

Microscleres. Birotulae, 13–16.5 μ usually with twelve teeth at each end; some appear to have only eight.

DISCUSSION: Several specimens of *Iotrochota* have been examined to determine whether the constantly recurring strongyles were localized at the surface; for if this is so, the genus *Hiattrochota* de Laubenfels cannot be maintained. In *I. birotulata* from Jamaica, *I. baculifera* from Bora Bora, the Palau specimens, and the holotype of *Hiattrochota mystile* there is a consistently higher proportion of strongyles to styles in dermal spicule preparations, and, although the pigmentation of these sponges somewhat obscures detail in sections, it appears that all tangential dermal spicules are strongyles.

The type species of *Hiattrochota*, *H. protea* from Hawaii, is probably a synonym of *I. baculifera*; the only features which distinguish it are the massive form and the absence of a well-defined skeleton of spicule tracts. For the present *H. protea* is retained as a separate species of *Iotrochota*. *H. ditrocha* from the Palau Islands also seems sufficiently distinct to remain as a separate species; it is ramose to repent in form and is reported to contain raphides.

The genus *Iotrochota* was grouped by de Laubenfels (1936) with his Desmacidonidae; it is obviously better to regard this genus as a myxillid in which some species (e.g., *I. purpurea*) have lost the ectosomal spicules. This is essen-

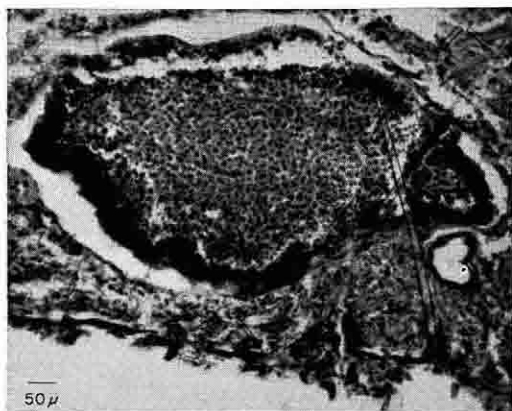


FIG. 21a. *Microcionia eurypa* (de Laubenfels). Section showing the basal spongin plate with embedded acanthostyles and styles. In the embryo traces of Spongin B are visible.

tially the position Dendy (1921) advocated for *Iotrochota*.

DISTRIBUTION: North Australia (Ridley); Celebes (Thiele); Philippines (Lévi); Marshall Islands; Truk (de Laubenfels).

SUBORDER MICROCIONIFORMES de Laubenfels

FAMILY MICROCIONIDAE Hentschel

GENUS MICROCIONA Bowerbank

Microcionia eurypa (de Laubenfels)

Fig. 21a, b

Dictyociona eurypa de Laubenfels, 1954, p. 143, fig. 91.

OCCURRENCE: Sta. 220A.

DESCRIPTION: This species is an encrustation, 0.5–0.8 mm thick, extending over both surfaces of a shell of *Chama* sp.

COLOR: In alcohol, pale brown, between (yY-R 8/4) and (yY-R 7/4).

SURFACE: Macroscopically smooth, granular, and minutely hispid under low magnification; no pores or oscules are visible. The dermal membrane is skin-like and packed with small subtylostyles.

SKELETON: A basal plate of spongin, 10–15 μ thick, supports vertically disposed acanthostyles. Long styles, either singly or in brushes, also diverge from this spongin plate in which they are embedded. Between adjacent spicule brushes

interstitial styles are abundant, many disposed parallel to the substrate. The styles from the basal spicule brushes extend throughout two-thirds of the thickness of the sponge; secondary brushes often arise obliquely from them and extend into the densely packed zone of ectosomal subtylostyles. The latter are arranged in brushes with heads inward, but the concentration of spicules, of both ectosomal and endosomal type, obscures the skeletal arrangement in the superficial regions of the sponge. The zone of ectosomal spicules is 100–125 μ deep, the external diameter of the spicule brushes is 100–130 μ .

There is scant development in this species of vertical columns of spongin; small localized thickenings of the spongin base do occur, however. In terms of Lévi's (1960) work upon the skeleton of the Clathriidae, this is a leptocionid state.

SPICULES: *Megascleres*. (i) Long, thin subtylostyles, often with asymmetric heads, slightly curved or straight, never spined; 237–490 \times 7.5–13 μ .

(ii) Short, slender ectosomal subtylostyles with microspined, often asymmetric heads; 112–200 \times 3.5–5.0 μ .

The smaller subtylostyles of the first category are those which occur in the endosome with no specific orientation. It is difficult to separate these spicules from the larger dermal subtylostyles except that the latter are always terminally microspined.

(iii) Short, accessory acanthostyles, evenly covered with slightly recurved spines; 80–106 \times 4.0–6.5 μ (including spines up to 13.5 μ). Some extremely small acanthostyles, up to 16–25 μ , are present; these are probably developmental stages.

Microscleres. (i) Palmate isochelae of two distinct size groups: large, 13.5–18 μ ; small, 3.5–5.0 μ .

(ii) Toxa of considerable size range, the larger tending to be very slightly flexed and resembling raphides, the smaller moderately curved with slightly reflexed tips; 36–181 μ (86 μ) and less than 1.0 μ in diameter.

The sponge contains embryos at a late stage of segmentation; these are localized just above the spongin base and occupy approximately half

the thickness of the sponge. Short tracts of spongin have developed inside the embryonic tissue (Fig. 21a).

DISCUSSION: This species is very closely comparable with *Microciona maunaloa* de Laubenfels from Hawaii, the two, insofar as can be determined, being the only species of *Microciona* having extremely small isochelae as a third microsclere category.

Sufficient small differences exist between the two species to allow the Palau specimen to remain as a separate species.

The size and shape of the acanthostyles, the shape of the larger subtylostyles, and slight size differences in the microscleres are the only divergent characters in the spiculation of the two species. The Palau specimen, however, does not show the color change to blue on fixation that

de Laubenfels reports for *M. maunaloa*, and its color in life is pale brown.

De Laubenfels (1954) described *M. eurypa* as a *Dictyociona*, presumably placing emphasis upon the slight spination of many of the styles. Topsent (1913) differentiated *Dictyociona* from *Microciona* by the presence in the former of a spicule fibre network rather than a series of independent plumose columns. *Microciona eurypa* possesses neither spined main megascleres nor a network of spicule fibres.

DISTRIBUTION: Palau Islands (de Laubenfels).

GENUS *Clathria* Schmidt

Clathria cervicornis (Thiele)

Fig. 14iv

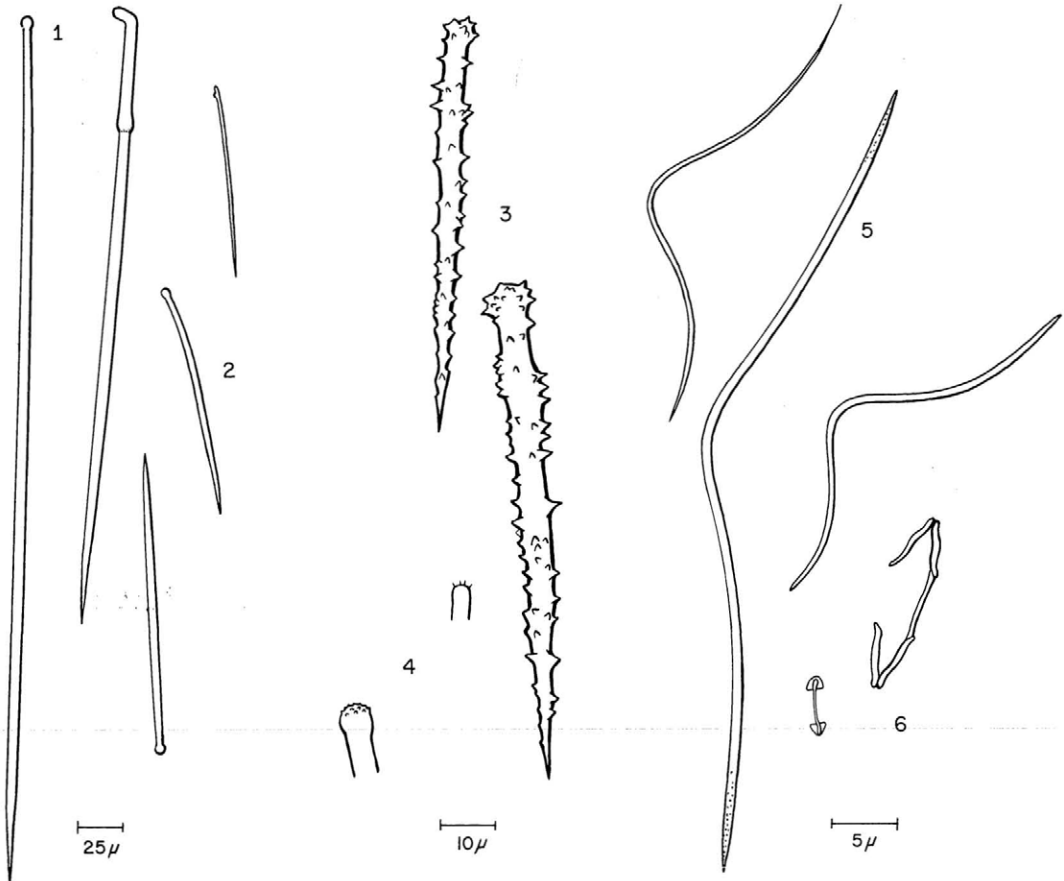


FIG. 21b. *Microciona eurypa* (de Laubenfels). Spicules: 1, Large styles. 2, Auxiliary subtylostyles. 3, Acanthostyles. 4, Ends of auxiliary subtylostyles. 5, Toxa. 6, Isocheiae.

TABLE 6

CHARACTERISTICS	<i>M. maunaloa</i>	<i>M. eurypa</i>
Large styles	425 × 13μ (and up)	287-490 × 7.5-13μ
Ectosomal styles	120-160 × 6μ (scattered spicules 240 × 9μ)	112-237 × 3.5-5μ
Acanthostyles	42 × 8μ	80-106 × 4-6.5μ
Large isochelae	14μ	13.5-18μ
Small isochelae	5-6μ	3.5-5μ
Toxa	56-132μ	36-181μ
Color in life	caramel-brown	coffee

Rhabdophlus cervicornis Thiele, 1903, p. 959, pl. 28, fig. 24.

Rhabdophlus cervicornis Brøndsted, 1934, p. 22.

Thalysias cervicornis de Laubenfels, 1954, p. 135, fig. 86.

OCCURRENCE: Sta. 220B.

DESCRIPTION: Several fragments of this sponge were collected and all are probably part of one colony. The habit is ramose, with irregularly disposed branches, 0.7-1.0 cm in diameter, in many cases reduced to short nodules, arising from a repent base which produces numerous short processes at right angles to its long axis.

COLOR: In alcohol, pale brown to gray (Y-RY 7/2) to (Y-R-Y 7/5) for the ectosome, mid-brown for the endosome (yY-R 4/4).

TEXTURE: The ectosome is soft and easily torn; the endosome is stiff and incompressible.

SURFACE: Macroscopically smooth, marked by ramifying subdermal canals. Under low magnification numerous dermal spicule tufts are visible and render the surface minutely hispid. Only two oscules are visible, 0.5 and 0.8 mm in diameter, situated on the main stem at the junction of a branch.

SKELETON: The spiculation and the arrangement of the skeleton are entirely typical of *Rhabdophlus* as redefined by Lévi (1960). A compact, fibrous endosome of plumoreticulate pattern is invested by an ectosome of comparatively fleshy nature supported by special ectosomal spicule brushes which are most pronounced in the subdermal position.

The endosomal fibres are cored in their central third by smooth subtylostyles often having asymmetric heads. Short acanthostyles echinate the fibres. Interstitial subtylostyles are abundant and are in no way distinct from the coring spicules or from the bulk of the ectosomal spicules. The subtylostyles making up the surface brushes tend to be finer and smaller than the interstitial spicules.

Endosomal spongin fibres are 70-350μ in diameter, with frequent anastomoses and little soft tissue remaining between them. The ectosome is 0.1-0.2 cm wide, supported chiefly by obliquely disposed bundles of subtylostyles and, at intervals, by short lateral branches from the endosomal fibres. These fibres never extend to the surface of the sponge. In the superficial region of the ectosome the spicules are of a slightly different type, grouped into brushes oriented at right angles to the sponge surface. These dermal brushes arise from a region 125-300μ below the sponge surface and fan out externally to a diameter of 200-350μ. Between the bases of the brushes is a zone of subdermal cavities overlain by the dermal membrane.

SPICULES: *Megascleres*. (i) Coring and interstitial subtylostyles, slender, slightly wavy or curved in the proximal third, with frequently asymmetric heads; 262-325 × 4.5-6.0μ (291 × 5.0μ).

(ii) Echinating acanthostyles, often with subtylote heads and clear of spines in the proximal half of the shaft; 50-62 × 4.5-6.5μ (57 × 5.7μ).

(iii) Auxiliary dermal subtylostyles; 95-132 × 3.0-4.5μ (109 × 3.8μ).

Microscleres. (i) Palmate isochelae, 8.0–13.5 μ (12 μ).

(ii) Toxa; 40–50 μ once flexed, steepness of flexure variable; not abundant.

EMBRYOS: Pale orange pigmented embryos (Y-R 6/4) are situated at the ectosome-ectosome junction and are particularly abundant in the more superficial ectosomal region in the vicinity of oscules. The embryos are 250–300 μ in diameter, somewhat discoid, and contain abundant fine subtylostyles.

DISCUSSION: This specimen is comparable in detail with de Laubenfels' specimen of *R. cervicornis* from the Marshall Islands. De Laubenfels describes the "microvelvet" surface attributable to the presence of projecting brushes of dermal spicules but makes no further mention of the dermal skeleton or of the spicules which constitute it. Spicule measurements differ only slightly from those given by Thiele (1903).

DISTRIBUTION: Ternate (Thiele); East Indies (Brøndsted); Marshall Islands (de Laubenfels).

Clathria fasciculata Wilson

Clathria fasciculata Wilson 1925, p. 442, pl. 42, fig. 6, pl. 49, fig. 7, 8.

Clathria fasciculata de Laubenfels, 1954, p. 140, fig. 89.

OCCURRENCE: Sta. 220A, 236A.

DESCRIPTION (Table 7): The two specimens are erect, ramose or incipiently so.

COLOR: In alcohol, pale red-brown, near (y4-R 7/4).

TEXTURE: Tough and elastic.

SURFACE: Uniformly conulose. The shape of the conules varies from rounded to pointed and in one specimen they tend to be aligned in verti-

cal rows. The dermis appears granular and, in places where dermal spicule tufts are developed, is slightly hispid; this is more evident at the apex of conules than elsewhere. No oscules are apparent; pores are visible between the conules and above subdermal cavities where the dermal membrane is thinnest.

SKELETON: The characteristic feature of this species is the presence of fasciculate ascending fibres cored by styles. Between these fasciculate columns, which are 300–750 μ in diameter (individual fibres 75–150 μ), is a dense and irregular reticulum of secondary fibres. External to the fibres auxiliary styles are abundant. In the endosome these have no regular arrangement; in the ectosome they are obliquely or tangentially disposed or, in places, organized to form dermal brushes. Echinating acanthostyles are present on all fibres, usually occurring singly, but sometimes in tufts at the nodes.

The ectosome is a cavernous layer varying from 250–900 μ in thickness, according to the size of the subdermal cavities at any given point. Thin obliquely oriented tracts of auxiliary styles run across the ectosome between subdermal cavities. The main spicule concentration in this region is in the tangential spicules and dermal brushes situated in the dermal membrane.

SPICULES: *Megascleres*. (i) Smooth styles, slightly curved, coring the endosomal fibres; 162–250 \times 5.5–11 μ (200 \times 7.5 μ).

(ii) Slender straight auxiliary styles occurring throughout the sponge except in the fibres; 100–270 \times 2.5–6.6 μ (200 \times 4 μ).

(iii) Echinating acanthostyles, short, slightly tylote with spines concentrated on the head and distal half of the shaft; 50–62.5 \times 5–7 μ (58 \times 6.25 μ).

TABLE 7

SPECIMEN	HEIGHT	WIDTH	LENGTH OF BRANCHES	BRANCHES	SHAPES OF CONULES	HEIGHT AND SPACING OF CONULES
Sta. 220A	4.5 cm	5.0 cm	—	stem 3.0 cm	rounded or sharp pointed	0.4–3.0 mm high 2.0–4.5 mm apart
Sta. 236A	6.5 cm	0.7–1.0 cm	1.5 cm	stem 0.7–1.0 cm	sharp	0.5–3.0 mm high 2.0–6.0 mm apart

Microscleres. (i) Palmate isochelae, 8.0–14.5 μ (12.25 μ).

(ii) Toxa of considerable range of size and shape, the smaller being tricurvate, the larger approaching raphides, very little flexed, and occasionally completely straight, rare; 33–137 μ (75 μ).

DISCUSSION: This species, both as described by Wilson (1925) and as represented in the Palau collection, is intermediate between *Clathria* Schmidt and *Rhabdophylus* Ehlers in the features of the dermis. Lévi (1960) redefined and maintained both genera, laying considerable stress on the tufted arrangement of the dermal spicules in *Rhabdophylus* as opposed to the irregular, oblique to tangential arrangement in *Clathria*. The configuration of the dermal spicules varies from place to place in *Clathria fasciculata*. *Microcionia eurypa* has almost as well-developed a system of dermal brushes as has a typical *Rhabdophylus*, and many other examples of this type of dermal specialization can be cited in *Microcionia* in conjunction with the nonplumose skeleton which to a great degree characterizes the genus. It is difficult to differentiate clearly between *Microcionia* and *Clathria* on the basis of the form of the skeleton because of the existence of such intermediate forms as *Microcionia prolifera*; clearly, the dermal skeleton is too variable to be of sys-

tematic importance. For the latter reason *Rhabdophylus* is not maintained as a genus distinct from *Clathria*. The question of the possible synonymy of *Microcionia* and *Clathria* is not considered here since only detailed study of large collections and type material will suffice to resolve it.

It appears from the material in this collection that a firmer basis for the generic separation of *Rhabdophylus* would be to stress the great axial condensation with sharply demarcated ectosomal and endosomal regions, rather than the notoriously variable dermal skeleton.

DISTRIBUTION: Philippines (Wilson); Palau Islands; Truk (de Laubenfels).

FAMILY OPHLITASPONGIIDAE de Laubenfels

GENUS *Mycale* Gray

Mycale lissochela n. sp.

Fig. 22a, b

OCCURRENCE: Sta. 220 (Holotype, USNM 23702), 220A (Paratype, USNM 23701).

DESCRIPTION: Both specimens of this species are thickly encrusting, in one case over a hydroid, in the other over a coral fragment. In specimen 220A the sponge contains many small zoanthids and around each of these the sponge dermis is raised in a membranous chimney. These do not appear to be the oscules, since groups of smaller openings lying flush with the sponge surface are common.

DIMENSIONS (TABLE 8).

COLOR: In alcohol, pinkish-gray (220A) (Y-R 7/2) to (rY 8/4) pale creamy yellow (220).

TEXTURE: Extremely soft and very slightly elastic.

SURFACE: Smooth, and the dermis is variable in structure. In specimen 220A the fleshy tissues of the dermis are arranged so as to form a reticulate pattern; in the other specimen this pattern is only faintly discernible in isolated areas. For the most part the fleshy tissues are uniformly dispersed, and no pores or oscules are visible.

SKELETON: Composed of thin curving sparsely branched tracts composed of subtylostyles. Immediately below the surface the larger tracts break up into three or more divergent

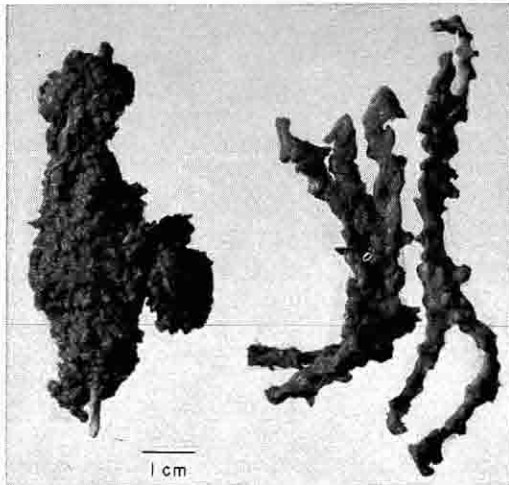


FIG. 22a. *Mycale lissochela* n. sp. Left, Sta. 220A, USNM 23701; right, Sta. 220. Holotype. USNM 23702.

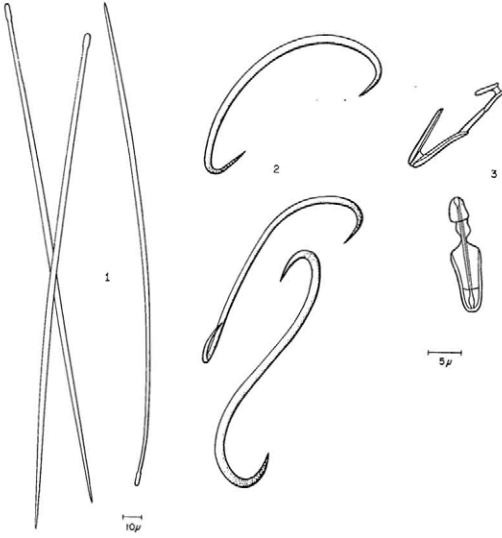


FIG. 22b. *Mycale lissochela* n. sp. Spicules: 1, Subtylostyles. 2, Sigmas. 3, Palmate anisochelae.

branches. Interstitial megascleres are abundant throughout the sponge and occur tangentially disposed in the dermal membrane. Microscleres, sigmas, and isochelae, occur throughout the sponge; sigmas are particularly abundant in the dermis.

Fibres range from 10–75 μ in diameter.

The construction of the sponge is relatively compact; there is no development of huge subdermal or interfibrillar spaces as in many mycalids.

SPICULES. *Megascleres.* Subtylostyles, straight or very slightly curved with elongate oval heads; 212–275 (252) \times 3.0–4.5 μ (3.6 μ).

Microscleres. (i) Sigmas, C-shaped with sharply reflexed tips, which are frequently in different planes; occasional S-forms occur. These spicules are abundant throughout the flesh and

in the dermal membrane; 19–40 μ (33.9 μ). (ii) Palmate anisochelae, small spicules with thin alae; 3.0–3.5 μ wide, 13–20 μ (16.2 μ) long.

DISCUSSION: Burton (1956) has drawn attention to a group of species within *Mycale* which have in common (a) small narrow anisochelae⁹ of one size group only, (b) a single category of sigmas which are approximately twice the size of the chelae, (c) tylostyles or subtylostyles between 200–300 μ . To this list of characters Burton adds a fourth, "the spiculation of Topsent's subgenus *Carmia*." This statement is quite misleading, as none of the species Burton then proceeds to list has the spiculation of *Carmia*.

Mycale lissochela is extremely close in spiculation and structure to *Mycale cecilia* de Laubenfels, *M. microsigmatosa* Arndt, *Mycale senegalense* Lévi, and *M. phyllophila* Hentschel, and is comparable to *M. angulosa* (D. and M.), *M. fistulata* Hentschel, *M. serpens* (Lendenfeld), and *M. tenuispiculata* (Dendy). The last four species, however, are massive rather than encrusting.

Mycale angulosa is comparatively well known; it has a distinctive habit, cavernous architecture, and rare microscleres. Thus, despite close similarity in spiculation to the other species mentioned it can certainly be maintained as a separate species. *Mycale cecilia* cannot be distinguished from *M. microsigmatosa* and the latter can only be considered distinct from *M. phyllophila* Hentschel on the grounds of distribution. Lévi (1959) has already indicated that his *M. senegalense* is probably synonymous with *M. microsigmatosa* Arndt. *M. maunakea* de

⁹ Burton's text reads "isochelae," which I have interpreted as a misstatement; it is confusing, however, as some species of *Mycale* are reported to have isochelae.

TABLE 8

SPECIMEN	THICKNESS (cm)	LENGTH (cm)	WIDTH (cm)	OSCULES (mm)
Sta. 220	0.2–0.35	broken	—	not apparent
Sta. 220A	0.3–1.1	7.5	1.5–3.5	0.4–0.6

TABLE 9

SPECIES	MEGASCLERES	SIGMAS	ANISOCHELAE	HABIT	COLOR
<i>Mycale cecilia</i> Panama de L., 1936	tylostyles 300 × 7-10μ	30μ	22-25μ 12-15μ narrow alae	encrusting	green with red embryos
<i>Mycale cecilia</i> Hawaii de L., 1950	long headed tylostyles figure indicates styles 240-250 × 4-6μ	30-42μ	15-24μ no mention of 2 categories, narrow	encrusting	variable
<i>Mycale maunakea</i> Hawaii de L., 1951	tylostyles 160-240 × 2-6μ (210 × 5μ)	37-42μ	13-22μ	encrusting	pale pink
<i>Mycale senegalense</i> Lévi	subtylostyles ovoid heads 220-280 × ?	30-40μ	20-22μ	encrusting	gray-red
<i>Mycale phyllophila</i> Hentschel, 1911, Australia	tylostyles to subtylostyles 206-259 × 4-5μ	31-40μ	19-20μ (6μ across) 11-12μ (4μ across)	encrusting	
<i>Mycale fistulata</i> Hentschel, Australia	subtylostyles 248-296 × 3-4μ	42-65μ	24-26 × 7-9μ	encrusting to erect 15 cm	
<i>M. fistulata</i> var. <i>micro-</i> <i>sigmatosa</i> Arndt, 1927, Curaçao	subtylostyles 250-294 × 3μ	32-38μ	8-19μ	encrusting	
<i>Mycale lissochela</i> Palau Is.	subtylostyles	19-40μ	13-20μ	encrusting	

Laubenfels is distinctive only in the possession of a completely non-reticulate skeleton.

Mycale lissochela differs from other species in this group in having tangential megascleres in the dermis, not regularly arranged but certainly representing a dermal skeleton. This species is closest to *M. phyllophila* Hentschel; the chief difference between the two is in the spiculation of the epidermis, which consists of irregularly strewn megascleres in *M. lissochela* and of microscleres only in Hentschel's species. In the absence of large population samples it is difficult to evaluate the significance of this difference. In view of the emphasis placed on the morphology of the dermis in the systematics of the genus *Mycale*, it is preferable to note the differences rather than to ignore them by synonymizing the two species.

There are other species mentioned by Burton as being part of this group; of these *Mycale euplectelloides* Row, *M. regularis* Wilson, and

M. imperfecta Baer have much larger sigmas and have a fibroreticulate skeleton, and *Mycale fistulifera* Row has a distinct lobate habit. *Mycale mytilorum* Annadale may belong to this group, but this reference cannot be verified.

Mycale (Aegagrophila) cavernosa n. sp.

Fig. 23a, b, c

OCCURRENCE: Sta. 125 (a single specimen which is designated Holotype, USNM 23703).

DESCRIPTION: Two fragments of this sponge were obtained; it appears to have grown upright from a broad base of attachment. The fragments are lobate, much folded, and give the impression of having shrunk and distorted considerably after fixation; both contain large quantities of fine debris. Dimensions are 5 cm high, 20 cm wide, 1.5 cm thick; and 5 cm high, 2.5 cm wide, 0.7 cm thick.

COLOR: In alcohol, is grayish-white.

TEXTURE: The sponge is soft but slightly elastic.

SURFACE: Deeply folded and raised into mounds. The dermal membrane is $60\text{--}125\mu$ thick, and contains a more or less regular spicule reticulum and large quantities of fine calcareous debris. Projecting spicules from the subdermal brushes render the surface slightly hispid.

Small oscular areas are dispersed irregularly over the surface, each giving access to a large subdermal cavity. Circular and oval pores are evenly scattered over the entire dermal membrane and range from $62\text{--}100\mu$ in diameter.

SKELETON: The dermal skeleton is made up of a series of intersecting fibres varying from 1–8 spicules wide ($4.5\text{--}38\mu$) and delimiting roughly triangular meshes, $62\text{--}375\mu$ across. In addition to the megasclere skeleton, the dermis contains isolated anisochelae, usually of the smaller category. Immediately beneath the dermal membrane are huge subdermal cavities

which extend deep into the interior of the sponge. The primary fibres of the endosome are stout, sparsely branched, and invested with spongin, which is just visible as a thin clear zone external to the spicules along the fibre, but which is more abundant at the intersection of branches. A weak system of secondary fibres is present but does not form a coherent reticulum; the over-all aspect of the skeleton is lax, with considerable emphasis on the interstitial material, both spicules and calcareous debris.

Primary fibres range from $90\text{--}185\mu$ (135μ) in diameter; secondary fibres, $25\text{--}100\mu$ (62μ). At intervals the dermal membrane is supported by radiating spicule brushes, $20\text{--}50\mu$ wide, usually occurring in groups of 3–5. These are united by spongin to the nodes of the dermal skeleton. These spicule brushes arise from the

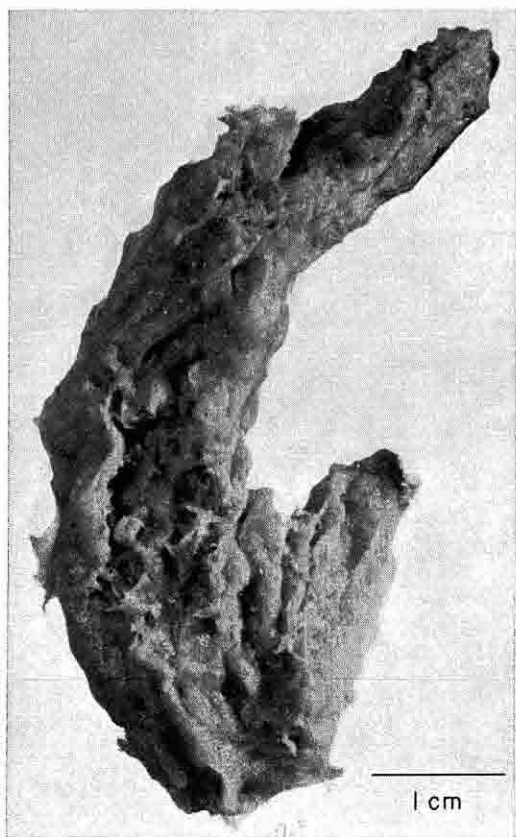


FIG. 23a. *Mycale cavernosa* n. sp. Sta. 125. Holotype. USNM 23703.

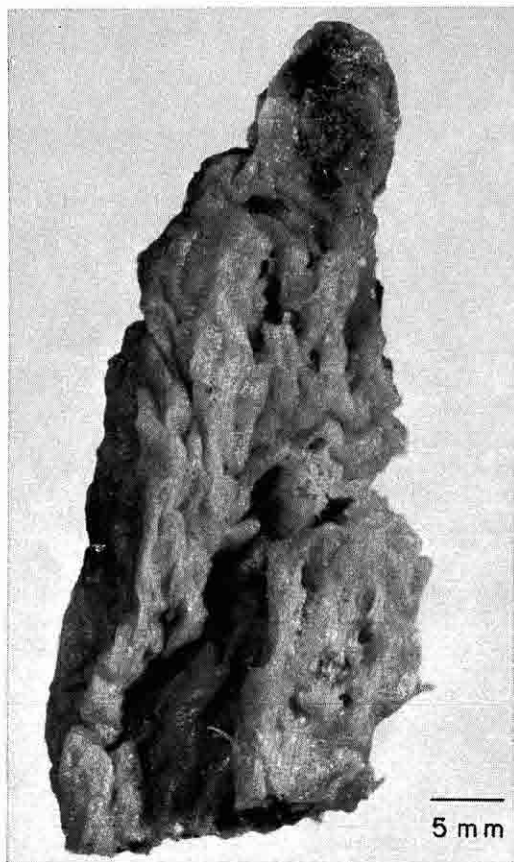


FIG. 23b. *Mycale cavernosa* n. sp. Sta. 125. Holotype. USNM 23703.

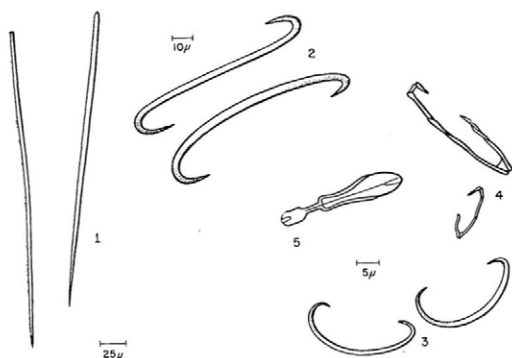


FIG. 23c. *Mycale cavernosa* n. sp. Spicules: 1, Subtylostyles. 2, Large sigmas. 3, Small sigmas. 4, Anisochelae. 5, Anisochela, face view.

secondary fibres which run at an acute angle to the surface of the sponge. Often the primary fibres run without branching to the surface. The details of branching and interrelations of the three orders of endosomal fibres are very difficult to clarify owing to the excessive amounts of foreign matter present.

SPICULES: Megascleres. Smooth, often slightly wavy or curved styles with a slight constriction of the shaft behind the head. The finer styles tend to be interstitial, the stouter spicules are contained in fibres; $262-351 \times 0.8-8\mu$ ($306 \times 4.2\mu$).

Microscleres. (a) Sigmas, of two size groups: (i) large stout C- or S-shaped sigmas with strongly reflexed tips; $92-105 \times 1.5-5\mu$ ($97.5 \times 3.6\mu$), and (ii) small abundant C-shaped sigmas with sharply reflexed tips and one end rotated; $19-26.5\mu$ (23μ).

(b) Palmate anisochelae of two size groups, never arranged in rosettes: (i) larger, often with acutely recurved alae, the latter one-half to two-thirds the length of the shaft; $29-40\mu$

(33μ), and (ii) smaller, extremely abundant with acutely recurved alae, rarely more than half the length of the shaft; $11-15\mu$ (13.5μ).

HISTOLOGY: Soft tissue is much reduced in this sponge except in the dermis, and the structure and disposition of such tissues is masked by incorporated debris.

DISCUSSION: *Mycale cavernosa* falls clearly into Topsent's subgenus *Aegrophila* since it possesses a dermal reticulation of spicule fibres. It differs from all other members of this subgenus in the combination of a relatively regular dermal skeleton with comparatively small fine megascleres supplemented by extremely large sigmas.

GENUS *Neofolitispa* nom. nov.

Neofolitispa dianchora (de Laubenfels)

Fig. 24a, b

Monanchora dianchora de Laubenfels, 1935, p. 331, pl. 1, fig. 4.

Folitispa pingens de Laubenfels, 1954, p. 159, fig. 104.

Monanchora clathrata Lévi, 1961, p. 135, fig. 8.

OCCURRENCE: Sta. 59, 92, 100.

DESCRIPTION: Two specimens are erect, lobate to massive; the third is encrusting with occasional low processes.

DIMENSIONS (Table 10).

COLOR: In life, scarlet; in alcohol, externally from pale fawn (Y-R-Y 8/2-Y-R-Y 8/4) to greenish-yellow (Y 5/4) and pale brown (R-Y-R 6/4) merging into greenish-yellow. Interior, pale yellow-green (Y 7/4).

TEXTURE: Compressible but tough; somewhat slimy.

SURFACE: Irregularly lumpy, the dermal

TABLE 10

SPECIMEN	HEIGHT (cm)	WIDTH (cm)	THICKNESS (cm)	SURFACE PROCESSES (mm)
Sta. 59	4.5	2.0	1.2	up to 1.0
Sta. 92 encrusting	—	7.0-6.5	—	up to 11
Sta. 100	4.0-6.5	9.5	3.5	1.5-6.0

membrane smooth and skinlike, slightly granular to hispid in patches. In two specimens (Sta. 92 and 59) the pores have remained open over most of the surface and under low magnification give the sponge a regular lacy appearance. At irregular intervals the pore reticulation of the dermal membrane overlies deep subdermal cavities; there is no differentiation of the membrane at such points, but they presumably represent oscular sieves, 0.8–2.0 mm in diameter.

SKELETON: The ectosomal skeleton is composed principally of brushes of subtylostyles arising from the endosomal fibres and spreading tangentially into the dermal membrane. In addition to these tangential megascleres, which are never abundant, the dermal membrane contains great numbers of isochelae predominantly of the larger category.

The endosomal skeleton is a system of plumose fibres cored by subtylostyles invested by

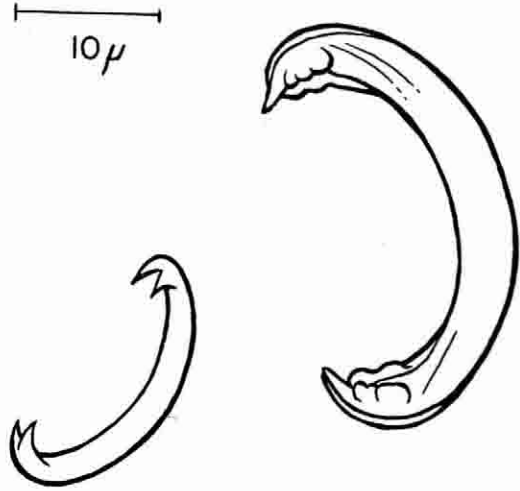


FIG. 24b. *Neofolitispa dianchora* (de Laubenfels). Isochelae.

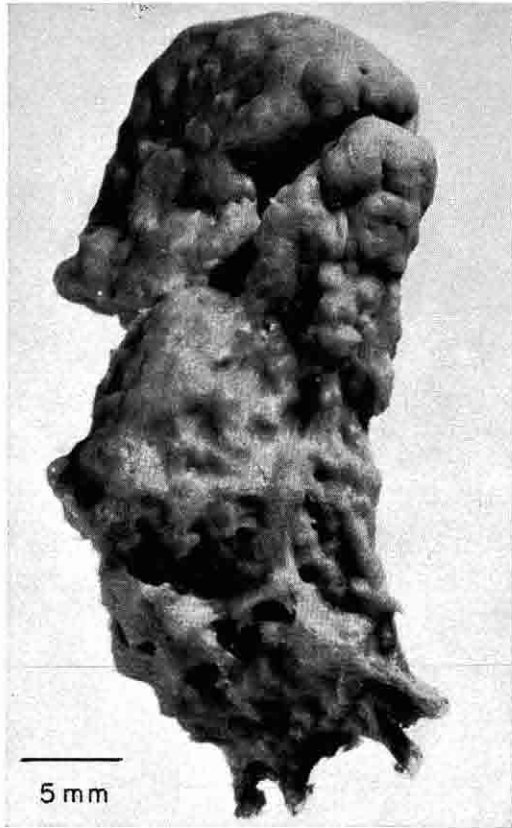


FIG. 24a. *Neofolitispa dianchora* (de Laubenfels). Sta. 59.

spongine, in the deeper regions of the sponge losing most of the spongine and narrowing to the point below the surface where they break up into subdermal brushes.

In addition to the ectosomal and endosomal fibres, there are abundant interstitial spicules which, in the encrusting specimen, predominate over the spicules arranged in fibres. This gives the skeleton a somewhat confused aspect, but the incipient plumose structure is still discernible. The specimen from Sta. 92 closely approximates the holotype of *Folitispa pingens* (USNM 22924) in features of the skeleton. The dermal concentration of isochelae is present in the type, although not mentioned by de Laubenfels, and there are some tangential dermal megascleres in addition to the subdermal spicule brushes. In neither the Palau specimens nor the type is there any localization of distinct megasclere categories or any occurrence of echinating spicules.

Fibre dimensions are variable, up to 380μ in diameter in the center of the sponge, narrowing to approximately 125μ at the point where the subdermal spicule brushes arise.

SPICULES: Megascleres. Straight subtylostyles often stair-stepped terminally or occasionally modified to tylostrogyles. Some spicules are true tylostyles with irregular heads; $262\text{--}360 \times 3.5\text{--}8.0\mu$ ($342\text{--}6.0\mu$).

Microscleres. Unguiferate anchorate isochelae of two sizes: (a) large, strongly-curved chelae with thick shaft, slightly expanded at each end, the expansions bordered by four sharp triangular teeth; $27-34 \times 3.6-4.2\mu$ ($29.5 \times 4.0\mu$), and (b) small, fine, almost C-shaped chelae with three sharp teeth at each end; the two lateral teeth are often directed almost at right angles to the shaft, while the central tooth continues the axis of the shaft; $6.5-20 \times 1.0\mu$ approximately.

REPRODUCTIVE STAGES: Eggs and embryos are present in one specimen and in the holotype. The embryos contain numerous very fine megascleres but apparently no microscleres. They are ovoid, approximately $375 \times 500\mu$; cellular detail is not discernible.

DISCUSSION: De Laubenfels (1935) added a species, *M. dianchora*, to *Monanchora* Carter which, up to that time contained only the type species, *Monanchora clathrata*¹⁰, a poorly known species described from a single wave-worn Australian specimen. *Monanchora dianchora* does not resemble Carter's species at all closely but is identical to *Folititspa pingens* described by de Laubenfels (1954) from the central Pacific.

Folititspa was erected by de Laubenfels (1936) for *Hymedesmia laevisissima* Dendy. This sponge has small dermal tylostyles in brushes, tangential spicules in the dermal membrane, in addition to large endosomal tylostyles and peculiar isochelae of one category only, differing from those of *M. dianchora* in being slightly spatulate isancorae rather than unguiferate isancorae.

Only two species other than the type (*H. laevisissima*) have been described in *Folititspa*: *F. pingens* (= *M. dianchora*) and *Folititspa acuata* Lévi (1958). Both of these have unguiferate isancorae of two size groups in addition to tylostyles which, in *F. acuata*, are divisible into two size groups; in *F. dianchora*, although there is a special arrangement of dermal megascleres, there is no size differentiation of these spicules. Lévi (1958) pointed out that de Laubenfels, in describing *Folititspa pingens*,

had added a species to *Folititspa* which did not conform to the characters of the type, there being no megasclere differentiation and the skeleton being confused. Restudy of the type of *F. pingens* shows that a plumose skeletal arrangement is present, although feebly developed owing to the encrusting form. It is important to note that the form of the isochelae is different in the type species, *H. laevisissima* (isancorae spathuliferae) and the two later species (isancorae unguiferae). Since this genus is defined principally on chela-type it is difficult to reconcile these two groups in *Folititspa* as it is presently defined.

Lévi mentions *Amphilectus unguiculatus* Dendy as being close to the *Folititspa* group. De Laubenfels (1936) made this sponge the type of *Okadaia*, a new genus possessing "tylostyles and strap-like sigmas with toothed ends." In 1949 de Laubenfels noted that *Okadaia* was preoccupied and replaced this name with *Neosperiopsis* and stated "the diagnosis remains the same." In the same work, however, he named *Neosperiopsis deichmannae* as the type species. *Neosperiopsis deichmannae* is in no way related to *Amphilectus unguiculatus*, the type of *Okadaia*. Hartman (1958) has shown that the microscleres of *N. deichmannae* are perfectly normal isochelae of the "Homoedictya" type and that the species is almost indistinguishable from *Isodictya palmata* Bowerbank. *Neosperiopsis* thus falls to *Isodictya*. It should be pointed out that *Okadaia* was initially founded upon a misreading of Dendy's description of *Amphilectus unguiculatus*. Dendy clearly stated that this species possesses isochelae (not sigmas, as de Laubenfels states); further, these chelae are unguiferate isancorae.

There are several points in common between *Amphilectus unguiculatus* and *Folititspa dianchora*: semi-plumose structure, no size differentiation of the megascleres, occasional mucronate or strongylote modification of the tips of the megascleres, spicule size, and chela type. The greatest differences between them are the lack of any dermal megascleres in *A. unguiculatus*, and absence of the small isochelae.

In summary, *Folititspa dianchora* and *Folititspa acuata* are very closely related species which can not be generically linked with *Hy-*

¹⁰ *M. clathrata* has one type of microsclere, 5-anchorate with long points (8-29 μ overall dimensions), subtylote megascleres (393 \times 10 μ); surface characters unknown, shape unknown.



FIG. 25. *Pseudaxinyssa pitys* de Laubenfels. Sta. 92.

medesmia laevissima, the type of *Folitissa*. The name *Neofolitissa* is proposed here to receive them. *Amphilectus unguiculatus* is certainly very close to *Neofolitissa*, but without reference to type material it cannot be placed in the genus. Probably *Esperiopsis viridis* Kieschnick should be included in *Neofolitissa*, but this cannot be verified from the literature.

Monanchora Carter is retained for *M. clathrata*, a poorly known Australian sponge which Lévi (1961) has incorrectly recorded from the Philippines.

DISTRIBUTION: Puerto Galera, Philippines (de Laubenfels); Palau Islands, Marshall Islands (de Laubenfels).

GENUS *Desmacella* Schmidt

Desmacella lampra de Laubenfels

Desmacella lampra de Laubenfels, 1954, p. 150, fig. 98.

OCCURRENCE: Sta. 104.

REMARKS: This sponge is encrusting to a thickness of 1.2 mm over a specimen of *Telestoa* and in the fragment collected shows no tendency to become massive. The color in alcohol is salmon pink (RY-R 6/8). The holotype (USNM 23088) has an identical external color

in alcohol. The dermal membrane contains tangential megascleres, and rare sigmas.

DISTRIBUTION: Marshall Islands (de Laubenfels).

ORDER HALICHONDRIDA Topsent

FAMILY AXINELLIDAE Ridley and Dendy

GENUS *Pseudaxinyssa* Burton

Pseudaxinyssa pitys de Laubenfels

Fig. 25

Pseudaxinyssa pitys de Laubenfels, 1954, p. 178, fig. 117.

OCCURRENCE: Sta. 92A, Sta. 140 (fragments only).

REMARKS: This specimen is from the same location as the holotype (USNM 23103 and Bishop Museum 137) and is closely comparable with it in size and structure. The spiculation of both the type and the present specimen includes styles and occasional strongyles as modifications of the oxeas.

SPICULES: Oxeas; $612-812 \times 5-16\mu$. The holotype shows a corresponding range of spicule size.

DISTRIBUTION: Palau Islands (de Laubenfels).

GENUS *Phycopsis* Carter

Phycopsis sp. cf. *terpnis* de Laubenfels

Phycopsis terpnis de Laubenfels, 1954, p. 176, fig. 116.

OCCURRENCE: Sta. 220A.

DESCRIPTION: A massive, cake-shaped sponge, 13 cm in diameter, 6.5 cm thick. Prominent circular oscules, 0.8–1.0 cm in diameter, are scattered over the upper surface. Each osculum is surrounded by a low collar, 0.4–0.8 cm high with walls 0.8–2.5 mm thick. In all cases the osculum functions somewhat as an exhalant cloaca, receiving 3–12 small exhalant openings about 1.0 cm below the sponge surface.

COLOR: In alcohol, white.

TEXTURE: Crisp and brittle.

SURFACE: Uneven, hispid.

SKELETON: A confused mass of oxeas, $670-1100 \times 8-22\mu$ ($877 \times 15.5\mu$). The structure

of ectosome and endosome is cavernous, the former having slightly denser protoplasmic matrix than the endosome in which no cellular material remains in this specimen. Small patches of spongin occur binding groups of 2-3 spicules either at their tips or along their axes.

DISCUSSION: The poor preservation of this specimen renders it useless for the purpose of close comparison with the type specimen of *Phycopsis terpnis*. The holotype of *Phycopsis terpnis* (USNM 23061) is, unfortunately, only a small portion of the sponge and its spiculation does not compare in detail with that figured by de Laubenfels in the type description. All the stout spicules of this specimen are strongyles, $600-875\mu \times 19-24\mu$ ($692 \times 20\mu$), which narrow very abruptly to relatively thin, rounded tips. The finer spicules are typical, evenly tapered oxeas, $700-880 \times 7-15\mu$ ($793 \times 9.5\mu$), as figured. It seems clear that in the holotype there are, indeed, two megasclere categories.

The present specimen is referred to this species since it compares well with the type

description, the main difference being the possession of slightly larger oxeas. It is possible that the holotype has been wrongly labelled or, should this not be the case, that it is equivalent to the Palau specimen and merely has the stouter spicules modified to strongyles. If the latter were true, one would expect styles and occasional oxeas to occur, but such spicules cannot be located in the holotype nor are there any styles or strongyles in the Palau specimen. This divergence of spicule characters is the only difference between the two specimens. Clearly, additional specimens from other localities are required before it can be definitely stated that the two are the same.

DISTRIBUTION: Ponapé, Caroline Islands (de Laubenfels).

FAMILY DESMOXYIDAE Hallmann

GENUS *Higginsia* Higgin

Higginsia mixta (Hentschel)

Fig. 26

Dendropsis mixta Hentschel, 1912, p. 415.

Higginsia mixta Hallmann, 1917, p. 656.

OCCURRENCE: Sta. 258.

DESCRIPTION: A thickly encrusting sponge with irregular digitiform processes arising over the whole surface.

DIMENSIONS: 3.8 cm high, 2.5 cm long, 0.6 cm thick.

COLOR: In alcohol, gray.

TEXTURE: Compact, compressible, and resilient.

SURFACE: Unevenly conulose, smooth between conules, hispid over-all but particularly at the apices of the conules and toward the ends of the erect processes.

SKELETON: Somewhat lax and irregular, with a tendency for concentration of ascending tracts toward the center of the vertical processes. Small patches of spongin occur along all spicule tracts, but no actual spongin-encased fibres occur. The long styles and stout oxeas form the ascending tracts and these curve out at an acute angle to the surface. In the subdermal region fine, centrally-angulate oxeas are added to the spicule tracts and these, with the huge styles,

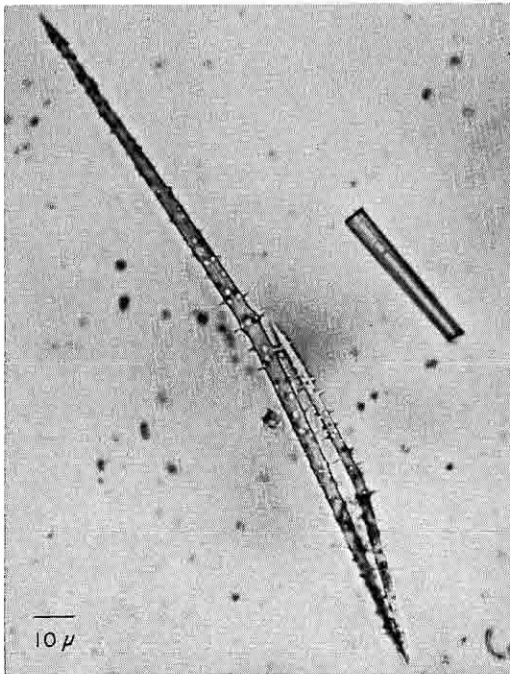


FIG. 26. *Higginsia mixta* (Hentschel). Sta. 258. Acanthoxeas.

are the spicules that project beyond the surface. Small centrally flexed acanthoxeas occur throughout the sponge, but are particularly abundant in the dermal membrane where they are oriented tangentially and form a marked crust.

SPICULES: *Megascleres*. (a) Long curved styles, $1900-3125 \times 14.5-17.5\mu$ ($2425 \times 16.4\mu$). These spicules occur at the center of all spicule tracts and usually extend outward through a surface conule surrounded by fine oxeas. (b) Stout oxeas, $1025-1150 \times 16-20.8\mu$, forming the bulk of the spicule tracts. (c) Slender, centrally-angulate oxeas generally disposed in subdermal tufts and piercing the surface around a large central style; $650-912 \times 5.5-6.8\mu$ ($792 \times 6.2\mu$).

Microscleres. Abundant acanthoxeas, finely spined, centrally-angulate often with a central belt of slightly larger spines. Frequent smooth spicules of similar dimensions occur; these are always centrotlyote; $62.5-200 \times 2-4.5\mu$ ($132 \times 3.6\mu$).

DISCUSSION: This specimen compares in detail with *Dendropsis mixta* Hentschel. Hallmann (1917) has put forward a convincing argument for merging *Dendropsis* and *Higginsia*. Higgin and his nomenclature is adopted here. Burton (1959:256) has published a key to the species of *Higginsia* in which *H. mixta* is listed as having "main megascleres seldom exceeding 0.9 mm in length." Both Hentschel's specimen and the Palau specimen have two categories of megascleres, including the principal oxeas, which regularly exceed 1000μ in length.

DISTRIBUTION: Aru Islands (Hentschel).

GENUS *Myrmekioderma* Ehlers

Myrmekioderma granulata (Esper)

Fig. 27a, b

Alcyonium granulatum Esper, 1830, p. 71, pl. XXIV.

Myrmekioderma granulatum Ehlers, 1870, p. 28.

Acanthoxifer ceylonensis Dendy, 1905, p. 157, pl. IX, fig. 5.

Acanthoxifer ceylonensis Dendy, 1922, p. 129.

Myrmekioderma granulatum Burton, 1937, p. 39, pl. VII, fig. 42.

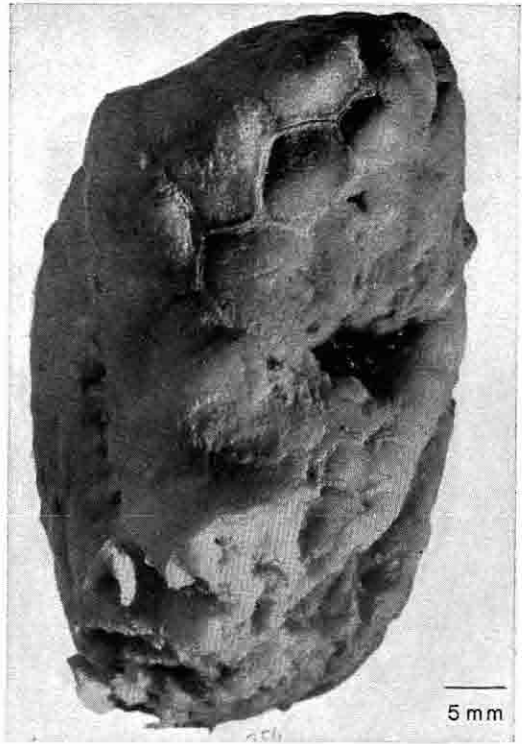


FIG. 27a. *Myrmekioderma granulata* (Esper). Sta. 594, Ifaluk.

Myrmekioderma tylota de Laubenfels, 1954, p. 119, fig. 74.

Myrmekioderma granulata de Laubenfels, 1954, p. 121, fig. 75.

Neoprosyopa atina de Laubenfels, 1954, p. 190, fig. 127.

Acanthoxifer fourmanoiri Lévi, 1956, p. 5.

Myrmekioderma granulata Lévi, 1961, p. 14, fig. 17.

OCCURRENCE: Sta. 100, 220A, 59 Palaus; 142, 155-157; 594 Ifaluk.¹¹

DESCRIPTION: This sponge is massive to encrusting, occurring usually as a thin crust over coral or growing inside bivalve shells. The only

¹¹ Station data for Ifaluk localities: 142. Oct. 20, 1953. Lagoonward reef margin. West reef between Elargalap and NW end of Falarik Island. Depth 1 fathom. 155-157. Oct. 23, 1953. Lagoonward reef margin. SW reef. Transect E. between Elangalap islet and Ella islet. Depth 1 fathom. 594. Oct. 7, 1953. Ifaluk lagoon near the pass.

TABLE 11

SPECIMEN	LOCALITY	ENDOSOMAL MEGASCLERES	ACANTHOXEAS	MICROSCLERES	SURFACE
<i>Myrmekioderma granulata</i> Ehlers	East Indies	oxeas to styles 740-940 μ	350-400 μ	not mentioned	coarsely tuberculate
<i>Acanthoxifer ceylonensis</i> BM 1905	Gulf of Manaar	oxeas, strongyles, styles 700-(828)-1032 \times 10.5-(12)-13 μ	237-(337)-400 6.5-(9.5)-13 oxeas predominate, styles frequent, strongyles rare	trichodragmata (160 \times 4 μ), raphides up to 82 μ in length	tuberculate polygonal
<i>Myrmekioderma granulata</i> Ehlers Burton 1937	Gulf of Manaar	oxeas to styles ? 170 \times 12 μ	400 \times 8 μ	trichodragmata 16 \times 4 μ	tuberculate polygonal
<i>Myrmekioderma styx</i> de Laubenfels, 1953. USNM 23400	Gulf of Mexico 12.5 m	oxeas, styles, strongyles 650-(738) 800 \times 11-(13.5)- 16 μ	oxeas only 300-(337)-375 \times 7- (19)-12.5 μ	raphides or trichodragmata 20-50 μ	coarsely tuberculate, with sunken "pore areas," finely hispid
<i>Myrmekioderma tygota</i> de Laubenfels, 1954. USNM 22059	Ponapé	oxeas, strongyles, styles 400-(625)-762 \times 7- (10.5)-13 μ	predominantly oxeas, strongyles and styles frequent 225-(372)-475 \times 5- (8)-10 μ	raphides up to 120 μ , trichodragmata 40-56 \times 8-12 μ	tuberculate with prominent grooves, smooth in places, finely hispid
<i>Myrmekioderma granulata</i> de Laubenfels, 1954. USNM 23073	Truk	oxeas, styles, strongyles 350-(542)-637 \times 6- (9.3)-10.5 μ	predominantly oxeas, strongyles and styles frequent 300-(332)-370 \times 5- (7.5)-12 μ	raphides up to 90 μ , trichodragmata 35-85 \times 6-12 μ	tuberculate, grooves plainly visible, occasionally smooth, finely hispid
<i>Neoprosyopa atina</i> de Laubenfels, 1954. USNM 22974	Ebon Atoll	oxeas and strongyles 600-(666)-762 \times 6- (7.2)-8 μ	predominantly oxeas, styles frequent, strongyles rare 212-(334)-350 \times 5- (6)-7.5 μ	trichodragmata 35-65 \times 6-10 μ , individual raphides up to 86 μ	tuberculate, but smooth in places, very irregular owing to the incorporation of coral fragments; pores visible in surface grooves

TABLE 11 (Continued)

SPECIMEN	LOCALITY	ENDOSOMAL MEGASCLERES	ACANTHOXEAS	MICROSCLERES	SURFACE
Sta. 220 Palau	Iwayama Bay	oxeas, styles, strongyles 725-(863)-1062 μ	312-(333)-362 \times 6.5- (8)-10 μ oxeas, styles, and strongyles	trichodragmata 40-86 \times 6-10 μ , individual raphides up to 120 μ	tuberculate, much of the surface pattern obscured by fine debris; pores not visible; hispid
Sta. 594 Ifaluk		oxeas almost always mucronate, strongyles abundant, styles frequent 525-(647)-825 \times 6.5-(8.3)-10.5 μ	oxeas, styles, and strongyles 312-(332)-362 \times 5.5-(6.5)-10 μ	trichodragmata present in sections, individual raphides up to 115 μ	tuberculate, pore grooves plainly visible, surface largely clear of debris, finely hispid
Sta. 100 Palau	Iwayama Bay	oxeas, strongyles also abundant, some styles 650-(788)-875 \times 7- (12)-16.5 μ	oxeas predominate, some styles and strongyles 287-(327)-375 \times 6.5- (8.5)-11.5 μ	raphides only in spicule preparations (no section pre- pared) up to 130 μ	surface badly damaged
<i>Acanthoxifer fourmanouiri</i> Lévi, 1956	Madagascar Nossi bé	oxeas 600-800 \times 10-12 μ , strongyles and styles 500-600 \times 10-12 μ	330-400 \times 13-17 μ	raphides in trichodragmata up to 160 μ long	hispid; covered with fine sand
<i>Myrmeioderma granulata</i> Lévi, 1961	Aldabra 42 meters	styles and oxeas 700-800 μ	350-425 μ	raphides up to 90 μ	"hispid, excavated by deep irregular cavities"

In all cases the measurements quoted are based upon re-examination of type material; in the case of *Acanthoxifer ceylonensis* only a spicule mount was available.
In all specimens examined trichodragmata are rare and measurements are based upon few examples.

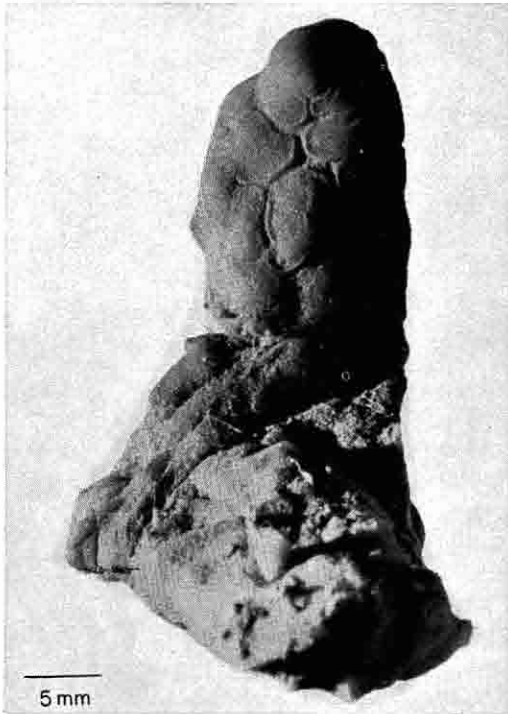


FIG. 27b. *Myrmekioderma granulata* (Esper). (*Myrmekioderma tylota* de Laubenfels. Holotype.)

massive specimen is Ifaluk 594, the dimensions of which are 4.8 cm high, 6 cm wide, 3 cm thick.

COLOR: In alcohol, usually pale cream to pale yellowish (rY 8/4) overall, occasionally with a pink coloration (pR 5/4) in places.

TEXTURE: Firm, compact; somewhat fleshy and crumbly in the endosome.

SURFACE: In massive and thickly encrusting specimens the characteristic pattern of polygonal tubercles is clearly developed, although not necessarily over the whole surface; thinly encrusting specimens do not show this clearly. In all cases the surface is finely hispid. None of the present specimens is sufficiently well preserved to demonstrate the presence of pores in the grooves between the tubercles; these, however, show plainly in USNM 22974, the type of *Neoprosyopa atina* de Laubenfels.

SKELETON: By far the most precise description of the skeleton of this species is given by Dendy (1905) for *Acanthoxifer ceylonensis*,

and this applies in detail to the Palau and Ifaluk specimens. The dense cortical or ectosomal region is composed of closely adjacent brushes of vertically disposed acanthoxeas. Toward the margins of the surface tubercles the orientation of the spicules changes from vertical to oblique. The spicule brushes thin out leaving gaps in the ectosomal skeleton corresponding with pore cracks; these open below into subdermal cavities which extend up to 800μ below the surface. Cortical acanthoxeas project up to 180μ beyond the sponge surface, rendering it hispid, maximally so over the central region of the tubercles.

The endosomal skeleton is basically a confused mass of acanthoxeas and larger, smooth, predominantly diactinal megascleres. At irregular intervals the large megascleres are organized into tracts originating at the base of the sponge and curving outward to the base of the ectosome. Small amounts of spongin are associated with these tracts.

SPICULES: *Megascleres*. (a) centrally-flexed to straight acanthoxeas with exceedingly fine, regular spines over the entire spicule, sometimes more abundant at the ends. Both stylote and strongyote modifications are frequent; the oxeads could often be better described as mucronate strongyles. These spicules are remarkably uniform in their range of size and shape in all of the specimens examined. Very slender developmental stages are frequent. (b) Long, relatively thin, smooth oxeads, strongyles, or, less frequently, styles, which make up the bulk of the endosomal skeleton. These spicules are frequently wavy; only in three specimens are straight and somewhat stouter spicules the rule (*Acanthoxifer ceylonensis*; USNM 22059; and Sta. 100). Many spicules of this category have either slightly stairstepped or mucronate tips.

Microscleres. Raphides in loose trichodragmata which, in all specimens examined, break up when the spicules are boiled in acid. Some single raphides occur. The length of these spicules is more variable than earlier reports indicated (Table 11).

HISTOLOGY: The ectosome is collenchymatous with a slight concentration of spongin A at the inner boundary. The endosome is cavernous, relatively fleshy, containing abundant

spherical flagellate chambers, 23–30 μ in diameter.

DISCUSSION: Dendy (1922) suggested the possible synonymy of his genus *Acanthoxifer* with *Myrmekioderma* Ehlers, the only difference between the two being the presence of trichodragmata in *Acanthoxifer*. Burton (1937) and Lévi (1961) have adopted this synonymy. De Laubenfels (1936), however, retained *Acanthoxifer* as a genus of the Rhabdisticinae but based his decision on a misinterpretation, having regarded the acanthose megascleres as a second category of microscleres which he termed "spiny microhabds." De Laubenfels (1954) recorded *Myrmekioderma granulata* (Esper) from Truk and described a new species, *Myrmekioderma tylota*, from Ponape, the latter differing from *M. granulata* in having small "tylotes" as microscleres instead of trichodragmata. In the same work a new genus of Hymeniacionidae, *Neoprosypa*, was erected for the single species, *Neoprosypa atina*.

Comparison of the type specimens of *Myrmekioderma tylota* and *Neoprosypa atina* with de Laubenfels' specimens of *Myrmekioderma granulata* (see table) reveals that all these sponges are identical. The "small tylotes" of *M. tylota* are diatoms; further, trichodragmata do occur in this species.

A spicule preparation of the holotype of *Acanthoxifer ceylonensis* Dendy shows a very similar range in variation of spicule size and shape to that found in de Laubenfels' and in my Pacific specimens. Further, the surface features and skeletal arrangement correspond in detail.

Lévi (1956) described *Acanthoxifer fourmanoiri* from Madagascar and considered this distinct from *Acanthoxifer ceylonensis* Dendy in having longer raphides making up the trichodragmata and a tangential or oblique arrangement of dermal acanthoxeas. Dendy mentioned that many of the dermal spicules were obliquely disposed in *A. ceylonensis*. This disposition is characteristic of the sides of the surface tubercles in all of de Laubenfels' specimens and those from Ifaluk and the Palaus. With the description of a specimen of *Myrmekioderma granulata* from Aldabra, Lévi (1961) provided data which reduced the gap between the raphide

dimensions of *A. fourmanoiri* and other specimens of *M. granulata* from Ceylon and the central Pacific. The Palau specimens possess long raphides, as do de Laubenfels' specimens. The differences are not what they appear to be from the literature and do not justify the division of this genus into separate species.

In the generic diagnosis of *Neoprosypa* de Laubenfels states that "all or nearly all of the megascleres are completely acanthose." This is an error; the type specimen of *N. atina* has the minutely acanthose megascleres and also the smooth endosomal megascleres characteristic of *M. granulata*. The ectosomal megascleres are clearly set off from the endosome in *Neoprosypa atina*, but they tend to be oblique over large areas due to the extremely irregular habit of the sponge. In this respect *N. atina* approaches *A. fourmanoiri* Lévi. Ehlers' (1870) redescription of *Alcyonium granulatum* Esper makes no mention of trichodragmata; these, however, are rare and inconspicuous in every Pacific specimen examined and, as de Laubenfels (1954) has pointed out, they could easily have been overlooked.

The position of *Myrmekioderma styx* de Laubenfels from the Gulf of Mexico is problematic. The holotype has been re-examined and few differences can be found to separate this species from the Indo-Pacific *M. granulata*. The surface is more coarsely and irregularly tuberculate and the skeleton is a vague and irregular endosomal reticulum of acanthoxeas broken by dense tracts of large oxeas and acanthoxeas, running vertically toward the ectosome. In the ectosome the acanthoxeas are either vertical in brushes, vertical but densely packed, or tangential to oblique. It is impossible to separate this specimen from others assigned to *M. granulata* on the basis of spiculation, and skeletal and surface differences are not conclusive. In view of the geographic discontinuity between *M. styx* and other specimens assigned to *M. granulata* the two species are retained at present.

The systematic position of *Myrmekioderma* Ehlers has been frequently debated. Dendy (1905) created the subfamily Heteroxyinae within the Haploscleridae to receive *Heteroxya* Topsent and *Acanthoxifer* Dendy (= *Myrmekioderma*). In 1922 Dendy suggested the

synonymy of *Acanthoxifer* and *Myrmekioderma* and removed the Heteroxyinae to the Desmacidonidae (Subfamily Axinellinae, section Heteroxyeae). Topsent (1928) elevated the Heteroxyinae to family rank, added *Anacanthaea* Row, and endorsed the relationship of the group to the Axinellidae. Burton (1937) placed *Myrmekioderma* in his section Raspeliaceae, which includes all axinellid families.

Wilson (1925) was unaware of the synonymy of *Acanthoxifer* with *Myrmekioderma* and referred *Acanthoxifer* and *Anacanthaea* to *Spongisorites* Topsent on the basis of Dendy's (1905) redefinition of this genus and information derived from study of a new sponge, *Spongisorites suluensis* Wilson. Wilson urged the relationship of the above sponges to the Epipolasisida, as Jaspidae without microscleres. De Laubenfels (1936) has in part sustained this view in making *S. suluensis* Wilson the type of *Epipolasis*, which is placed in the Sollasellidae. This cannot, however, apply to *Acanthoxifer* and *Anacanthaea*; these sponges have their closest relatives in the genus *Higginsia*, to which they are closely allied in Dendy's 1922 classification. Wilson's reason for uniting the genera is that *S. suluensis* has tangential dermal oxeas on the oscular face (see *Spongisorites sensu* Dendy) and oxeas in radial brushes on its pore face; these characters are compared to *Acanthoxifer* and *Anacanthaea*. This is a simplification which entirely overlooks previous synonymy and certain structural features, such as the presence of a vague fibrous structure in the choanosome of *Acanthoxifer* (*Myrmekioderma*) accompanied by traces of spongin, and the variable disposition of the dermal oxeas in this genus. *Anacanthaea* does not possess a separate category of dermal oxeas. Furthermore, both genera share the distinctive surface pattern of polygonal tubercles delimited by pore grooves (Fig. 27a, b). None of these features has been recorded for *Spongisorites*.

Wilson was correct in his assessment of the systematic position of *S. suluensis*;¹² he was in error in assuming *Spongisorites* to be a homogeneous genus. A proper evaluation of the re-

lationships of *Spongisorites* Topsent and *Epipolasis* de Laubenfels is urgently required but must await the restudy of type material.

De Laubenfels (1936) placed *Acanthoxifer* in the Epipolasisida (Raphidistinae), *Heteroxya* in the Coelosphaeridae, *Anacanthaea* in the Axinellidae, and *Myrmekioderma* in the Phorbasiidae, thereby rejecting the opinions of all previous authors. In the case of *Heteroxya* and *Myrmekioderma* he expressed doubts as to their correct placing; in the case of *Acanthoxifer* he misread the type description; *Anacanthaea* was placed with the axinellids on the tenuous ground that the spicules are stairstepped and mucronate.

It is not at all clear that *Heteroxya* Topsent is as close to *Myrmekioderma* and *Anacanthaea* as Dendy considered. *Heteroxya* has in common with the other two genera a densely spiculiferous cortex composed of radially disposed acanthoxeas, a hispid surface, and the large, smooth oxeas. It differs in morphology of the surface, in the scarcity of endosomal megascleres, lack of raphides, and in spicule size and shape. There is no mention of variability in spicule terminations in *Heteroxya* as reported for *Myrmekioderma*. The endosomal megascleres in *Heteroxya* are extremely large ($2000 \times 35\mu$) and project beyond the surface; the acanthoxeas are $235 \times 12-23\mu$, much stouter than in *Myrmekioderma*. None of the above features, however, supports a coelosphaerid affinity for *Heteroxya* as de Laubenfels suggested.

At present the morphological evidence supports Dendy's decision that *Myrmekioderma* and *Anacanthaea*, with the possible addition of *Heteroxya*, should be placed near *Higginsia*, in a family close to the Axinellidae.

DISTRIBUTION: East Indies (Esper); Gulf of Manaar (Dendy 1905, Burton 1937); Coetivy (Dendy 1922); Truk, Ponape, Ebon (de Laubenfels); Madagascar, Aldabra (Lévi).

ORDER HADROMERIDA Topsent

FAMILY SPIRASTRELLIDAE Hentschel

GENUS *Spirastrella* Schmidt

Spirastrella aurivilli Lindgren

Fig. 28a, b

¹² The type specimen of this sponge, USNM 21297, has been re-examined.

Spirastrella aurivilli Lindgren, 1897, p. 484.

Spirastrella aurivilli Lindgren, 1898, p. 322, pl. 17, fig. 11, pl. 18, fig. 4.

Spirastrella aurivilli Vosmaer, 1911, p. 21, pl. 19, fig. 22a-c.

Spirastrella aurivilli Burton, 1934, p. 571.

Cliona aurivilli de Laubenfels, 1936, p. 154.

OCCURRENCE: Sta. 92A, 258.

DESCRIPTION: The specimen from Sta. 92 is damaged, the other is entire and in good condition. It fills a cavity, $9.5 \times 7.5 \times 16$ cm, inside coral limestone; 0.5–1.5 cm of coral remains surrounding the central sponge mass. The sponge produces numerous hollow papillae with slightly expanded flattened tips. These run to the surface through straight channels obviously bored by the sponge. They range from 0.8–12 mm in internal diameter, up to 18 mm in external diameter, and extend up to 3.5 cm above the surface of the rock. A great number of papillae are flush with the surface of the rock or project only 1–2 mm from the channels; these always have a single opening. Many

of the larger papillae are irregular and bear 2–3, rarely 6 openings, each terminal upon a stout branch of the axial papilla.

COLOR: In alcohol, dull pinkish-red (R 5/2).

TEXTURE: The central mass is soft and rubbery; the papillae are hard, stiff, and relatively brittle.

SURFACE: The external surface of the papillae is finely hispid and lumpy, reminiscent of many massive species of *Spirastrella*. The terminal region of the papillae is usually markedly irregular, suggesting that contortion is a temporary condition resulting from contraction of all external openings.

SKELETON: Lindgren's (1898) description of the disposition of the skeleton in *S. aurivilli* forma *excavans* applies with slight alteration to this specimen. In Lindgren's specimen the spirasters were not only absent from the papillae but were rare in the interior of the sponge; the large tylostyles were also rare.

In the specimen from Sta. 92 the spirasters are extremely abundant in the base; large tylostyles are abundant throughout both speci-

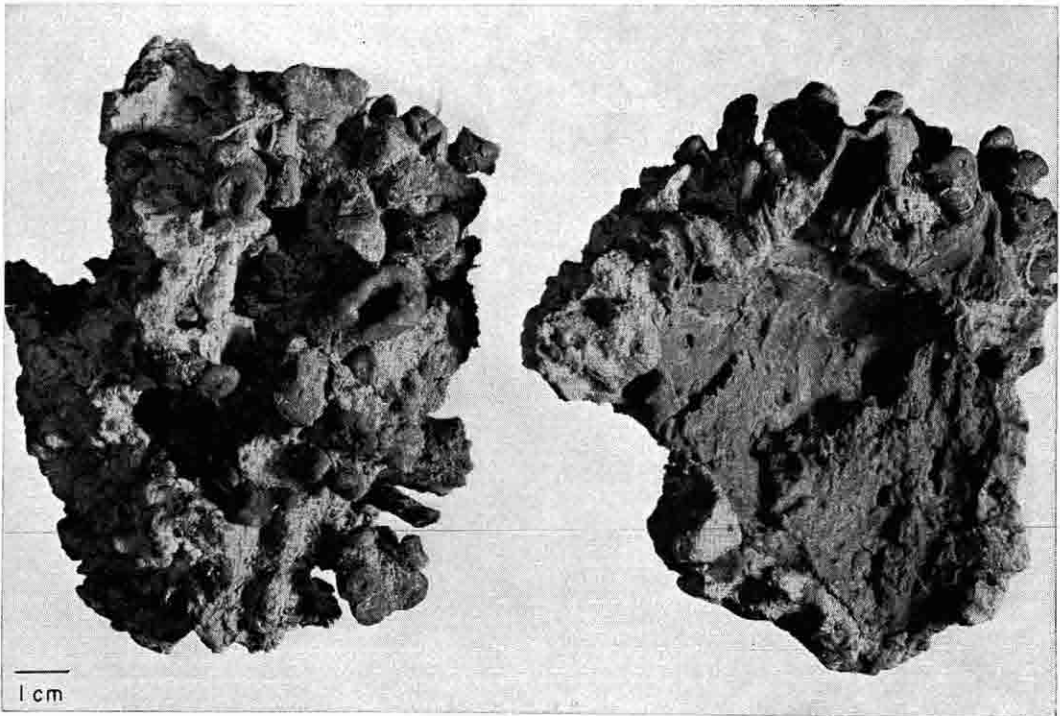


FIG. 28a. *Spirastrella aurivilli* Lindgren. Sta. 258.

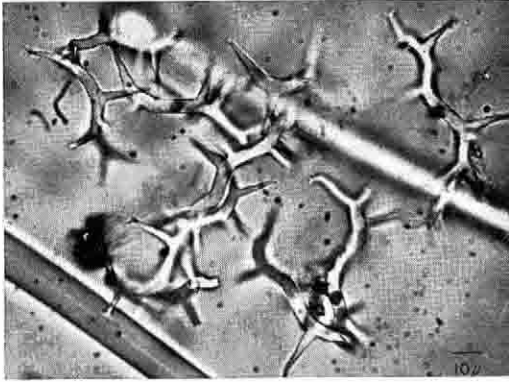


FIG. 28b. *Spirastrella aurivilli* Lindgren. Spirasters.

mens. The tylostyles constitute almost the entire skeleton of the papillae and are arranged in two distinct layers, an inner vertical layer and a central layer. A few tylostyles possibly constitute a third, dermal layer at right angles to the surface.

SPICULES: Megascleres. Tylostyles, of two size groups: (a) large, stout, straight or slightly curved tylostyles in which the head is most often subterminal. These spicules make up the bulk of the skeleton; $500-680 \times 18-33\mu$. (b) Smaller tylostyles with a great range in length and diameter and always with subterminal heads. The finer spicules tend to be found in the dermal spicule brushes of the sponge base; $250-525 \times 7-16.5\mu$ ($356 \times 10.5\mu$).

Microscleres. Large spirasters with stout, somewhat contort axes, at irregular intervals producing long branches which frequently have bifurcate tips; $36-50\mu$ (42μ), shaft; $3.0-5.0\mu$ thick.

DISCUSSION: *Spirastrella aurivilli* was referred to *Cliona* by de Laubenfels (1936:154) on the basis of Burton's remarks on the three species of *Spirastrella* found on the Great Barrier Reef. Burton (1934) clearly stated that young stages of *Spirastrella inconstans* Dendy and specimens of *Spirastrella aurivilli* are capable of boring. At the same time he noted that the excavations were always of simple type and showed little resemblance to the complex galleries of *Cliona*.

In neither of the Palau specimens is there any trace of complex boring; the inhalant and exhalant tubes lead through simple straight channels in the coral.

The distinctive microscleres and predominantly boring habit of *S. aurivilli* serve to differentiate the sponge from the vast complex which Vosmaer (1911) includes in *S. purpurea*.

DISTRIBUTION: Java Sea (Lindgren); Great Barrier Reef (Burton).

Spirastrella vagabunda Ridley

RESTRICTED SYNONYMY:

Spirastrella vagabunda Ridley, 1884, p. 468.

Spirastrella vagabunda var. *trincomaliensis* Ridley, 1884.

Spirastrella vagabunda Dendy, 1905, p. 122.

Spirastrella vagabunda Wilson, 1925, p. 343.

Anthosigmella vagabunda de Laubenfels, 1954, p. 201, fig. 136, pl. ix, fig. b.

OCCURRENCE: Sta. 12, 92, 124.

DESCRIPTION: Specimens from Sta. 12 and 92 are massive, digitate, with prominent oscules on the flattened tips of the branches and can be compared closely with de Laubenfels' specimens (1954: pl. ix, b). The third specimen (Sta. 124) is a small subspherical sponge with a nodulose surface and prominent oscules scattered on the upper surface. It is probable that this represents only the apical portion of a branch of a sponge similar to the above. *S. vagabunda* usually lies buried in the sand and the terminal portions of branches appear capable of constricting and detaching from the parent body, possibly serving as a means of asexual reproduction.

Only a few facts about these specimens will be given to indicate how they differ from previously described specimens.

Two specimens (Sta. 12 and 92) conform closely in morphology to *S. vagabunda* as understood by most authors, having the dermal layer of outwardly directed small tylostyles, a dermal crust of spirasters, and lacking a second larger microsclere category.

The megascleres of the third specimen (Sta. 124) range from styles, to tylostyles (with terminal subterminal and polytylote heads), to tylostrogyles, and tend to be finer than the tylostyles of the other specimens. The cortex is without special organization, constituted of closely packed, interlacing spicules, the smaller types, styles and tylostyles, predominating. The

TABLE 12

SPECIMEN	TYLOSTYLES	SPIRASTERS
Sta. 12	300-687 (515) × 6-20 (13)	13.5-17 (15.5)
Sta. 92	290-635 (408) × 6.5-23.5 (14.5)	9-15 (16)
Sta. 124	250-637 (440) × 5.5-15 (9.9)	13-24 (18)

variability of the spicules in this sponge has already been noted by Dendy (1905) for *S. vagabunda* var. *trincomaliensis*. The cortical structure is comparable to that described for the type of *S. vagabunda* Ridley (1884). Microscleres in this specimen are extremely rare.

SPICULE DIMENSIONS (in μ) (Table 12).

DISCUSSION: De Laubenfels (1951, 1954) advocates retaining *Spirastrella* for four species, *cunctatrix*, *decumbens*, *coccinea*, and *potamophora*. All of these are considered to be persistently encrusting; the massive species are removed to other genera, in the case of *S. vagabunda* to *Anthosigmella*. *Anthosigmella* Topsent is defined essentially on the possession of anthosigmas, peculiar microscleres with short, truncate spines aligned on the convex surface of a C- or S-shaped spiraster. Certainly, some authors have described spirasters with spines restricted to the convex surface for *S. vagabunda* (e.g., Dendy, 1905); these were, however, present as an extreme variant of the normal spiraster. Nothing comparable to the anthosigma of *Anthosigmella varians* (Duchassaing and Michelotti), the type species of *Anthosigmella*, has ever been described for *S. vagabunda*. De Laubenfels himself (1954) comments on the rarity of such microscleres and on their irregularity in his Pacific specimens.

Vosmaer (1911), while creating extensive synonymies within *Spirastrella* which have been subsequently rejected by most authors, did produce a great deal of evidence for the fact that no species of *Spirastrella* described up to that time was persistently encrusting. De Laubenfels' decision to restrict *Spirastrella* was arbitrary; he produced no facts to support his con-

tention and made no attempt to reassign species other than *S. vagabunda*, which he assigned incorrectly.

DISTRIBUTION: Torres Straits (Ridley); Trincomalle, Ceylon (Carter); Mergui archipelago (Carter); Indian Ocean (Dendy, 1921); Philippines (Wilson, 1925); central Pacific (de Laubenfels, 1954).

GENUS *Timea* Gray

Timea granulata n. sp.

Fig. 29

OCCURRENCE: Sta. 53 (Holotype, USNM 23699).

DESCRIPTION: A thinly encrusting sponge, up to 0.5 mm thick, covering an area of approximately 3.0 sq cm on a coral fragment around the base of *Tetilla microxea*.

COLOR: In alcohol, pale brown.

SURFACE: Unevenly hispid and finely granular owing to the concentration of microscleres in the dermal region. No apertures are visible and much coarse calcareous debris is distributed over the surface.

SKELETON: Basically a confused mass of tylostyles which in isolated patches are organized into vertically disposed brushes. The larger tylostyles are always vertical and often project up to 200 μ beyond the sponge surface. Both types of microscleres occur in a dense dermal crust.

SPICULES: *Megascleres*. Tylostyles, varying greatly in length and width with terminal and rounded or subterminal, ovate heads tapering evenly to sharp points; 170-687 × 1.5-8 μ (401 × 4 μ).

Microscleres. Chiasters, of two distinct size groups but identical structure. Six to nine stout

rays diverging from a centrum, the diameter of which is equal to approximately half the length of the rays. Each ray is terminated by four to six short conical spines. Occasional spicules have one or two rays, or some of the terminal spines reduced to irregular protuberances. The two groups are: (a) larger, and extremely abundant, $13-16.5\mu$ (14.8μ), and (b) smaller, common, but less than 3% of total, $4.0-5.8\mu$ (4.8μ).

DISCUSSION: Separation of the species of

Timea rests to a great extent on the form and variety of the microscleres. In this respect *T. granulata* is closest to *Timea (Hymedesmia) trigonostellata* (Carter) from the Gulf of Manaar, differing from this specimen chiefly in the size and shape of the megascleres. Those microscleres in which the rays are reduced can be compared with the lophasters of *Timea (Hymedesmia) lophastraea* Henschel. In this species, however, all the microscleres are lophasters, small amphioxeas occur as supplementary spicules, and most of the megascleres are styles.

In several species of *Timea* (e.g. *ballezi*, *mixta*, *bistellata*, *squamata*) there is great variability in the terminations of the microsclere rays. *T. granulata*, with *T. trigonostellata* and *T. lophastraea*, is remarkably constant in this respect.

FAMILY PLACOSPONGIIDAE Gray

GENUS *Placospongia* Gray

Placospongia melobesioides Gray

RESTRICTED SYNONYMY:

Placospongia melobesioides Gray, 1867, p. 127.

Placospongia melobesioides Vosmaer and Vernhout, 1902, p. 13, pl. 1, fig. 5-9, pl. 11, fig. 1-4, fig. 6, pl. 111, pl. IV, fig. 1-8, pl. V, fig. 2, 6, 10, 12.

Placospongia melobesioides de Laubenfels, 1954, p. 220, fig. 152.

OCCURRENCE: Sta. 220A.

REMARKS: The species is represented by several large pieces of a single ramose sponge. It compares in detail with specimens described by earlier authors (Vosmaer, de Laubenfels) from various Indo-Pacific localities. The presence of small irregular spheres (up to 2.0μ in diameter) among the microscleres is a diagnostic character of *P. melobesioides*.

DISTRIBUTION: Wide Indo-Pacific distribution.

ORDER EPIPOLASIDA Sollas

FAMILY JASPIDAE de Laubenfels

GENUS *Asteropus* Sollas

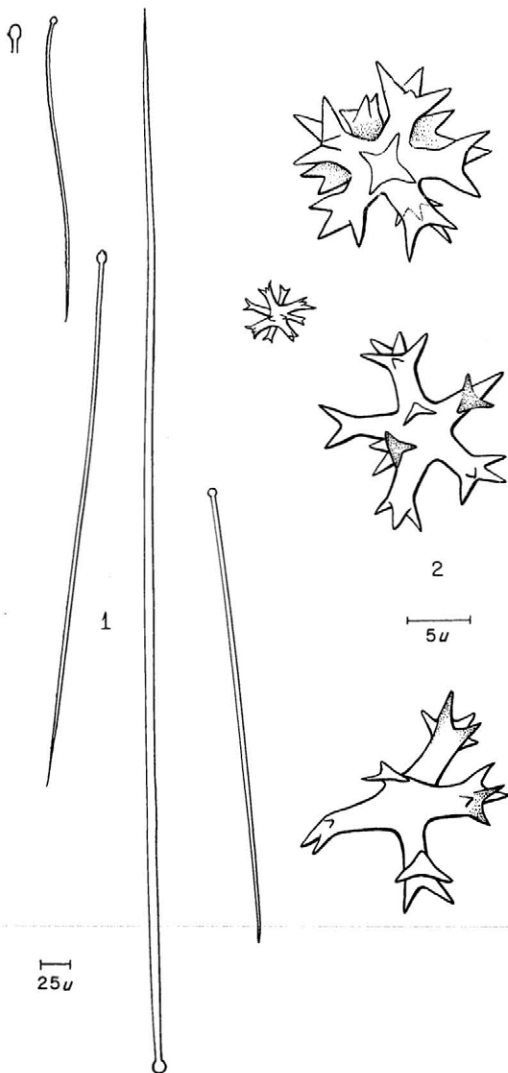


FIG. 29. *Timea granulata* n. sp. Sta. 53. Holotype. USNM 23699. Spicules: 1, Tylostyles. 2, Chiasters.

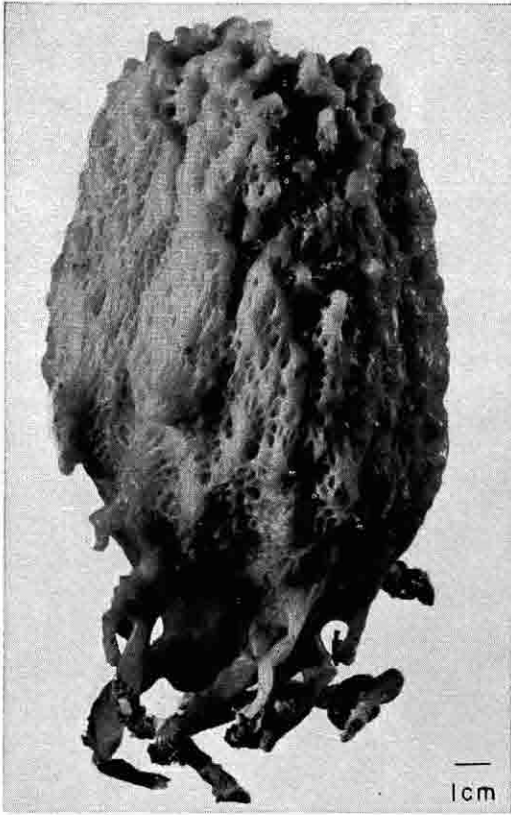
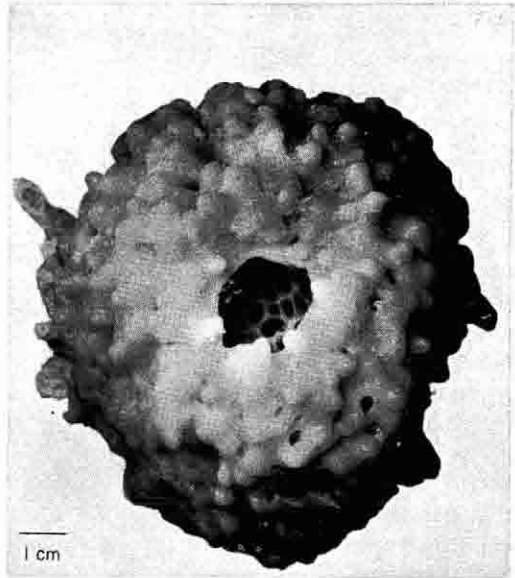
FIG. 30a. *Asteropus sarasinorum* (Thiele). Sta. 136.FIG. 30b. *Asteropus sarasinorum* (Thiele). Apical view showing the cloacal opening and the openings of the exhalant channels to the base of the cloaca.*Asteropus sarasinorum* (Thiele)

Fig. 30a, b, c

Melophus sarasinorum Thiele, 1899, p. 8, pl. 1, fig. 2, pl. 5, fig. 3.*Jaspis bandae* Brøndsted, 1934, p. 8, fig. 4, 5, 6.*Stellettinopsis isis* de Laubenfels, 1954, p. 221, fig. 153, pl. 10, a.

OCCURRENCE: Sta. 136, 252.

DESCRIPTION (Table 13).

The intact specimen compares in detail with *Stellettinopsis isis*, which is well described and figured by de Laubenfels. The larger specimen which has been cut into thirds (one part of which is missing) is identical with the figures of *Melophus sarasinorum* Thiele and *Jaspis bandae* Brøndsted. The surface processes fring-

TABLE 13

SPECIMEN	SHAPE AND SIZE			CLOACA		THICKNESS FROM CLOACA TO EXTERIOR
	Height	Width	Depth	Diameter	Depth	
Sta. 136	18 cm	10.5 cm centre 6.5 cm apex	7.5 cm	1.8 cm	5 cm	
Sta. 252 (incomplete specimen)	22 cm	—	—	contracted	12 cm	5 cm base 2.5 cm apex

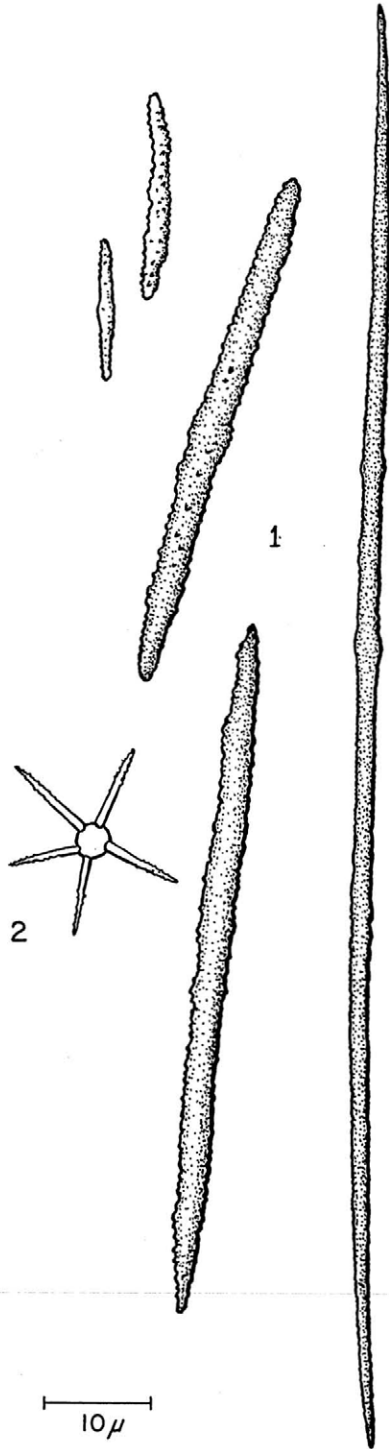


FIG. 30c. *Asteropus sarasinorum* (Thiele). Microscles: 1, Microxeas of three size categories. 2, Euaster.

ing the cloacal opening are more pronounced in the younger specimens, the surface pattern of pores and tubercles is more regular and the ectosome is thinner.

Jaspis bandae was described from an entire, dried specimen and no mention is made of a cloaca. One of the Palau specimens has contracted upon fixation in such a way as to almost obscure the cloacal opening; it is possible that *Jaspis bandae* possesses a cloaca similarly hidden by contraction.

COLOR: In alcohol, straw color (rY 8/4).

TEXTURE: Variable. Stiff but compressible, somewhat waxy, in the smaller specimen, to hard, just compressible, almost woody, in the larger sponge.

ECTOSOME: This layer is often thicker than de Laubenfels (1954:223) states, varying from 2–4 mm. In all other details of ectosomal and endosomal structure and disposition of the skeleton, de Laubenfels' description cannot be added to.

SPICULES: *Megascleres*. (a) Oxeas, of extremely variable dimensions, not, however, as stout as the maximum diameter quoted by other authors (Table 14). The ends are often stair-stepped on the larger spicules, and most spicules are slightly bent in the middle. A great number of spicules are about $800 \times 10\mu\text{--}15\mu$. (b) Styles, occasional only; they appear to be modifications of the smaller oxeas.

Microscles. (a) Microxeas, varying from small, microspined, centrotylote rhabds extremely similar to those of *Ancorina*, to large, straight or slightly curved, finely spined and often centrotylote microxeas. It is possible to select three size groups of these spicules as Brøndsted (1934) has done. Intermediates regularly occur, however, and it is safe to regard these spicules as all of one type. The small rhabds are concentrated as a surface layer 12–15 μ deep. They also occur scattered throughout the ectosome and abundantly throughout the endosome where they intermingle with the larger microxeas. (b) Asters, with microspined rays, usually pointed, but often strongly truncate. The tylote modification figured by Brøndsted for *Jaspis bandae* has never been observed.

DISCUSSION: This sponge can be considered

congeneric with Carter's *Stellettinopsis simplex* which Sollas (1888) has made the type of *Asteropus*. *Asteropus* has been used subsequently by Hentschel (1909) and Dendy (1905, 1916, 1924); until recently only de Laubenfels persisted in the use of *Stellettinopsis*. He has added three new species, *ketostea*, *isis*, and *kaena*. Lévi (1961) has described *S. cherbonnieri*.

Sollas mentioned (1888:201) that *Stellettinopsis corticata* Carter, which was designated as the type species of the genus *Stellettinopsis* by de Laubenfels (1936), possessed triaenes and was, consequently, generically distinct from *S.*

simplex, which lacked triaenes. Sollas then took the rather unwarranted action of dropping *Stellettinopsis* entirely and erecting a new genus, *Algol*, for *S. corticata*. De Laubenfels is correct in regarding *Algol* Sollas as a synonym of *Stellettinopsis* Carter which is doubtfully distinct from *Ancorina*; he is, however, incorrect in persisting in the use of the name *Stellettinopsis* for sponges which consistently lack triaenes.

Stellettinopsis corticata Carter must be placed among the Ancorinidae; its possible synonymy with *Ancorina* can be decided only after a re-examination of the type specimen.

All other species described in *Stellettinopsis*

TABLE 14

SPECIMEN	OXEAS	MICROXEAS	ASTERS
<i>Melopbus sarasinorum</i> Thiele, 1899 Celebes	1330 × 50μ	175 × 4μ 60 × 6μ 18-20 × 3μ	15-18μ 15-20 rays often strongylote
<i>Jaspis bandae</i> Banda Neira East Indies	1000-1200μ 35-40μ Styles 800-900 × 35-40μ	120-150 × 4-5μ 25-28 × 3-4μ 9 × 3μ all intermediates occur	15-25μ 8-12 rays strongylaster to tylaster
<i>Stellettinopsis isis</i> de Laubenfels, 1954 Palau Is.	1230 × 44μ (maximum) 1000 × 20μ (common)	60 × 3μ 45 × 4μ 18 × 3μ	12μ 10-15 rays euasters
Sta. 136, Palau	730-1080 × 9.5-28μ (969 × 21μ) Styles 850-925 × 15-17μ	range of all groups 10-135 × 2-4.5μ individual categories { 120-135 × 3-4.5μ 28-50 × 2.5-3μ 12-20 × 2-3μ	12-19μ (14μ) euasters to strongylasters
Sta. 252, Palau	875-1150 × 6-33μ (964 × 18.5μ) Styles 880-987 × 15-20μ	range of all groups 9-150 × 2-5.5μ individual categories { 125-150 × 3-4μ 30-70 × 2-5.5μ 9-20 × 2-3.5μ	11.5-20μ (15μ) 8-20 (approx.) rays euasters to strongylasters
<i>Stellettinopsis isis</i> de Laubenfels, USNM 23137 TYPE	575-1150 × 11-39μ (943.5 × 25μ) strongyloxeote spicules occur throughout this range	range of all groups 9-150 × 2-4μ (the larger microxeas are rare in this specimen) 125-150 × 2.5-3.5μ other categories as quoted by de Laubenfels	11.5-18 (14.5μ) 10-20 rays (approx.) euasters to strongylasters

must be transferred to *Asteropus*.¹³ The systematic position of this genus is difficult to ascertain. However, since the absence of triaenes in *A. simplex* (Carter) is well authenticated,¹⁴ and no rare or malformed triaenes have been reported for other species, it seems permissible to leave *Asteropus* in the Epipolasida.

Within this genus as at present defined there are two groups of species based upon microsclele content: (1) *Asteropus simplex*, *A. ketostea*, and *A. kaena* having streptasters which are often termed sanidasters or scepterelliform asters; (2) *Asteropus sarasinorum*, (Thiele) with diactinal microscleles varying from *Ancorina*-like rhabds to substantial micoxeas, and *Asteropus cherbonnieri* (Lévi), which lacks the smaller rhabds. Should a new generic name eventually be required for the latter group then *Melophus* Thiele should be used. An analogous situation is that of *Ancorina* Schmidt (with sanidasters) and *Ecionemia* Bowerbank (with miciorhabds); all recent authors consider these to be synonyms.

With regard to the synonymy of *Asteropus sarasinorum* (Thiele), there is no doubt after examination of the type of *S. isis* (USNM 23137) and the Palau specimens that these are conspecific with *Melophus sarasinorum* Thiele from the Celebes. De Laubenfels has three times misrepresented this species in the literature. In 1936 (p. 70) he referred *Melophus* to the Adociidae. In 1950 he corrected this and stated that *Melophus* lacked asters, giving this as the main reason for not uniting *Melophus* and *Stellettinopsis*. Thiele (1899) described and figured asters in *Melophus sarasinorum*, the only species in the genus. Finally, de Laubenfels (1954)

proposed the synonymy of the two genera but considered *sarasinorum* to be distinct from *isis*. In support of this contention he cited the small size of *sarasinorum*. Thiele, however, stated that his specimen was 20 cm high and 14 cm wide, a size quite comparable with that of *Stellettinopsis isis*.

Jaspis bandae Brøndsted is closely comparable with both *M. sarasinorum* and *S. isis*. The specimen was dried and consequently details of internal anatomy are not available.

DISTRIBUTION: Celebes (Thiele); East Indies (Brøndsted); Palau Islands, Truk Island (de Laubenfels).

GENUS *Jaspis* Gray

Jaspis coriacea (Carter)

Stellettinopsis coriacea Carter, 1886, p. 126.

Coppatias coriaceus Sollas, 1888, p. 207.

Jaspis coriacea de Laubenfels, 1936, p. 151.

OCCURRENCE: Sta. 106.

DESCRIPTION: An irregularly massive to encrusting sponge which binds large pieces of coral and shell debris. The over-all size of the sponge is 8.5 × 5.5 cm, up to 3.5 cm thick.

COLOR: In alcohol, pinkish-white externally, flesh color internally.

TEXTURE: Firm, compressible.

SURFACE: A great proportion of the surface is covered with adhering shell fragments; the clear regions are hispid and minutely granular.

SKELETON: A thin dermal region is marked by the presence of a dense crust of microscleles and some tangential oxaeas. Below this is an ectosomal layer, a region of large subdermal cavities bounded internally by a dense zone of spongin A. Some spicule tracts traverse this region, others end internally to it; those that traverse the ectosome are accompanied by relatively large concentrations of spongin. Abundant large cells with granular cytoplasm occur toward the inner boundary of the ectosome. The endosomal skeleton is made up of tracts of oxaeas disposed radially and diverging toward the surface. The irregular habit of the sponge inhibits the development of a radial skeleton in many regions and the tracts become tangential and somewhat confused. Two

¹³ With the exception of *Stellettinopsis annulata* Schmidt, which Topsent (1923) has referred to *Sphinctrella*, and *S. carteri* Ridley, *S. coriacea* Carter, *S. lutea* Carter, *S. purpurea* Carter, and *S. tuberculata* Carter, all of which were referred to *Coppatias* by Sollas (1888) and which consequently fall into *Jaspis*. The last four species are all considered to be synonyms of *Jaspis stellifera* (= *Jaspis coriacea*) by Shaw (1927); this synonymy requires further evidence since the type descriptions of *S. coriacea* and *J. stellifera* are not at all comparable.

¹⁴ Dendy (1924) has mentioned occasional malformed oxaeas and triaene derivatives in *Asteropus simplex* from New Zealand.

types of oxeas occur. The larger make up the bulk of the skeleton; the finer, smaller spicules occur principally in the endosome, in and between the radial tracts and less abundantly in the cortex where they are scattered tangentially. There is no well-defined layer of cortical oxeas.

SPICULES: *Megascleres*. Oxeas of two size groups: (a) large, straight, evenly tapered to sharp points, occasionally stylote; $737\text{--}1712 \times 11\text{--}30\mu$ ($1272 \times 18.7\mu$), and (b) small, fine identical in form to the larger; $200\text{--}587 \times 1.5\text{--}3.5\mu$ ($356 \times 3.5\mu$).

Microscleres. Euasters, occasionally modified to strongylasters, with 8–15 rays and centrum with diameter approximately one third the length of the rays; $5.2\text{--}12\mu$ (8μ).

DISCUSSION: Dendy (1916:252) gives an excellent synopsis of the early history of the generic nomenclature of *Jaspis* Gray and *Coppatias* Sollas, and his conclusions as to the synonymy of these genera have been supported by all later authors. *Stelletinopsis coriacea* Carter is the type species of *Coppatias* Sollas and is thus, presumably, entirely typical of *Jaspis* except that there is slightly greater organization of the skeleton into radial tracts. The Palau specimen indicates that this feature is extremely variable, being somewhat dependent upon the habit of the sponge.

Jaspis coriacea from the Palau Islands corresponds in detail with Carter's rather fragmentary type description, the only discrepancy being the slightly larger size of the smaller oxeas. Dendy (1916) has commented on the difficulty of deciding whether these spicules are microscleres or megascleres. In view of their shape, size, and disposition in the Palau specimen, it is likely that they are megascleres.

DISTRIBUTION: South Australia (Carter).

ORDER CHORISTIDA Sollas

FAMILY ANCORINIDAE Gray

SUBFAMILY ANCORININAE de Laubenfels

Ancorina acervus (Bowerbank)

Fig. 31a, b

RESTRICTED SYNONYMY:

Ecionemia acervus Bowerbank, 1862, p. 1101, pl. lxxiii, fig. 1.

Ecionemia acervus Bowerbank, 1873, p. 322, pl. xxx, figs. 1–6.

Stelletta bacillifera Carter, 1887, p. 78, pl. vi, figs. 9–14.

Ecionemia bacillifera Burton, 1937, p. 5, pl. 1, fig. 2.

Hezekia walkeri de Laubenfels, 1954, p. 236, fig. 163.

Ecionemia spinastra Lévi, 1958, p. 8, fig. 3.

Ecionemia acervus Burton, 1959, p. 194.

OCCURRENCE: Sta. 220A Palau (two large specimens); Ifaluk 32F; 41D; 42D (2 specimens); 49C; 50B; 65D; 87F; 88E; 197–198C; 208C; 344; 690 (2 specimens); 798.¹⁵

DESCRIPTION: An encrusting to massive sponge which in the present collections is growing upon coral fragments, bivalve shells, and *Halimeda*. The size range is considerable, from a small hemispherical sponge (Ifaluk 41-D5) to a massive specimen (220A-1) unfortunately incomplete, but at least 120 cm long and 5 cm thick.

COLOR: De Laubenfels (1954) gives field observations on the color of this sponge and the range that he quotes covers all color variants listed by Burton (1937). The Palau and Ifaluk specimens are grayish to fawn in alcohol, between (yYR 8/2) and (yYR 6/2). The surface is irregularly mottled with dark brown R-Y-R 3/2 in almost all specimens.

SURFACE: Appears generally smooth and

¹⁵ Station data for Ifaluk localities:

32F. Sept. 4, 1953. Reef east of the south end of Falarik Island. Intertidal.

41D, 42D, 49C, 50B. Sept. 17, 1953. Reef east of the south end of Falarik Island. Covered by a few inches of water at low tide.

65D. Sept. 21, 1953. Western reef between Elangalap islet and the north end of Falarik Island. Intertidal.

87F, 88E. Sept. 29, 1953. Inner reef flat, 70 ft from shore; reef east of the south end of Falarik Island. Intertidal.

197–198C. Oct. 31, 1953. Reef east of the east end of the channel between Falarik and Falalap. Intertidal.

208C. Sept. 30, 1953. SW reef between Ella and Elangalap islets. 4–20 ft.

344. Sept. 20, 1953. Seaward shore of Elangalap. Lowtide.

690. Oct. 22, 1953. Seaward reef at south end of Falarik.

798. Oct. 31, 1953. South end of Falarik, seaward reef.

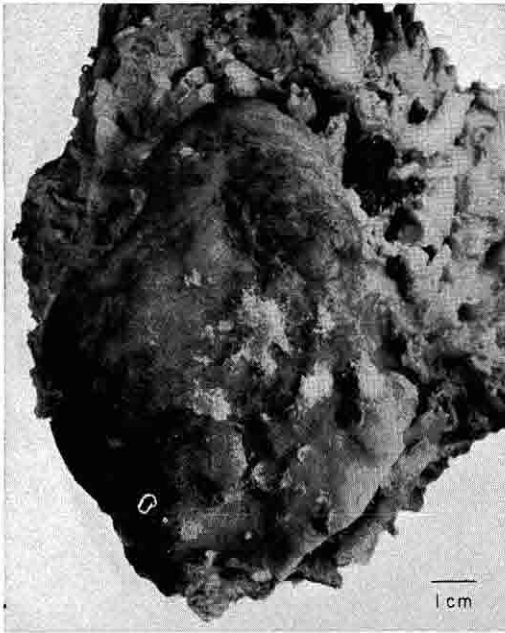


FIG. 31a. *Ancorina acervus* (Bowerbank). Sta. 220A.

granular; in places it is coarsely hispid and is microhispid over-all. Oscules are small, concentrated in dorsal or lateral oscular areas which measure up to 1.8×1.0 cm. Individual oscules are circular or oval, ranging from 0.4–2.0 mm in maximum dimensions. In specimen 798 from Ifaluk, skeletal pores approximately 0.1 mm in diameter are visible over most of the surface.

SKELETON: The endosomal skeleton is made up of radially disposed oxeas which vary greatly in size and abundance; near the surface oxeas give way to small orthotriaenes with rare prototriaenes, anatriaenes, and large orthotriaenes in that order. Between the cladomes of the surface orthotriaenes is a layer of radially disposed small oxeas. The most abundant microscleres are microspined microrhabds and these are aggregated at the surface to form a dense crust. The sponge is weakly corticate. The cortex is the region containing the clads of the triaenes and the radial oxeas, a densely spiculiferous zone containing some collenchymatous tissue; it is clearly separate from the endosome in the deeper region of which fleshy tissues predominate over skeletal elements.

Apart from the microrhabds which occur abundantly throughout the sponge, the distribution, relative abundance, and form of microscleres is extremely variable.

In the holotype of *Hezekia walkeri* (USNM 22925) and the two specimens from the Palaus, anthasters occur in tracts deep in the endosome; these spicules are very sporadically distributed and only fortuitously seen in sections. Fine tylasters also occur, chiefly in the endosome lining large canals, but they are occasionally present in superficial spicule preparations. In all of the Ifaluk specimens anthasters are lacking, and tylasters with long, fine rays and small tylospherasters are the endosomal microscleres. In addition the microrhabds of these specimens are thinner and more finely spined than those of the Palau group. The specimens having anthasters can be compared with *Stelletta truncata* Kieschick (1898), those with tylospherasters approach very closely to *Ecionemia acervus* Bowerbank. Burton (1937) has produced evidence for the view that these two types are extremes in a single variable species.

SPICULES: *Megascleres* (Table 15). These spicules are essentially the same as described by all earlier authors, the only variability being in the presence or absence of prototriaenes (present but rare in all specimens from the Palaus) and in the length of the cladi of the anatriaenes, which are somewhat longer in the Palau specimens than in the Ifaluk group.

Microscleres. Three types are present in each sponge: (a) spined microrhabds, which are uniformly abundant, varying slightly in diameter and degree of spining; they are thicker and have more pronounced spination in the Palau specimens; (b) tylasters, with extremely fine rays usually 5–8 in number; in the Palau specimens forms of these spicules occur which grade toward a chiaster by thickening of the rays and even toward an anthaster by these rays becoming rugose; (c) large anthasters, found only in the Palau specimens, and ranging from two- to eight-rayed forms, the triact being particularly common; (d) tylospherasters found only in the Ifaluk sponges, extremely tiny spicules, 4–6 μ in diameter, with a pronounced centrum and up to 16 short rays. In this whole complex of sponges asterose microscleres are relatively rare

and in one specimen (Ifaluk 798) almost entirely absent.

DISCUSSION: Burton (1937) has tabulated the salient characters of ten species of *Ecionemia* from the Indo-Pacific area and demonstrates that all can be referred to *Stelletta bacillifera* Carter. At this time Burton presumably considered *Ecionemia acervus* Bowerbank as distinct from *E. bacillifera*; in 1959, however, he extends the synonymy to include *E. acervus*. This later synonymy is not supported by any additional evidence, but since such species as *Ecionemia agglutinans* Thiele and *Ecionemia cribrosa* Thiele had already been included in the broad view of *E. bacillifera* (Burton, 1937), the inclusion of *E. acervus* with its microsclere complement of tylasters, tylospherasters, and microrhabds is not unreasonable. *E. acervus* Bowerbank is very close in spiculation to the

Ifaluk specimens described above; the Palau specimens and the type of *H. walkeri* are inseparable from *S. truncata* Kieschnick and *E. amboinensis* Lendenfeld. Thus, in these two relatively contiguous localities, we have two populations definitely separable on spicule characteristics. Although Burton's propositions with regard to this complex are adopted here, indications are that further study may reveal two and possibly three species grouped under *E. acervus*.

It is not absolutely clear from the literature that *Ecionemia* Bowerbank (1862) is a synonym of *Ancorina* Schmidt (1862). Sollas (1888) made the first significant contribution to our knowledge of these genera and he clearly understood *Ancorina* Schmidt to possess sanidasters and oxyasters, therefore falling into the Sanidasterina, and *Ecionemia* Bowerbank to possess microrhabds and tylasters to spherasters, thus falling into the Rhabasterina.

Sollas did not state the source of his information as to the microsclere spiculation of *Ancorina cerebrum* Schmidt. There are no figures of microscleres in the type description and reference is made only to "sternchen et kugeln." In the absence of any redescription of Schmidt's material it can only be assumed that Sollas interpreted "kugeln" to mean sanidaster. Dendy (1905, 1916) was aware of the difficulty of separating *Ecionemia* and *Ancorina*, but by 1924 was convinced that sanidasters graded into microrhabds and consequently that *Ecionemia* fell to *Ancorina*. Dendy's conclusion is adopted here, as it is the only clear directive with regard to the relationship of these two genera.

It has been mentioned above that the holotype of *Hezekia walkeri* de Laubenfels contains anthasters and tylasters and certainly belongs to the *Ancorina acervus* complex. The genus *Hezekia* was established by de Laubenfels (1934) for *H. demera* from Puerto Rico. The holotype of the type species (USNM 22206) has been re-examined and found to contain abundant tylospherasters and tylasters, the former 4–6 μ in diameter with short rays, the latter up to 8 μ in diameter with 5–7 long fine rays. *Hezekia* de Laubenfels thus falls to *Ancorina* Schmidt; the species *demera* may or may

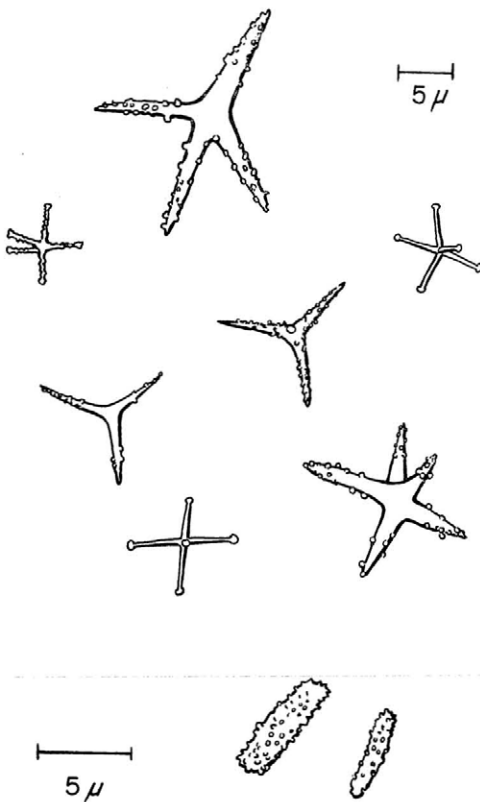


FIG. 31b. *Ancorina acervus* (Bowerbank). Microscleres, drawn from the holotype of *Hezekia walkeri* de Laubenfels.

TABLE 15

SPECIMEN	ENDOSOMAL OXEAS	ORTHOTRIAEINES	PROTRIAEINES (ALWAYS RARE)	ANATRIAEINES	CORTICAL OXEAS	MICRORHABDS	TYLASTERS	ANTHASTERS
<i>Hezekia walkei</i> de Laubenfels, USNM 22925 ¹⁰	(1000-2000) × 20-40μ 1800-(2158)- 2625 × 20- (29)-50μ	(sev. thousand × 40μ) 1150-(1529)- 2287 × 23- (35)-43μ	(1000 × 8μ) 1150-2000 × 8-12μ	(1500 × 15μ or less) 1437-(2171) -2500 × 8- (12.5)-15μ	(240 × 4μ) 200-(237)-275; × 1.5-(2.6)- 3.5μ 1.5-(2.6)-3.5μ	(10.1-13) × 1-1.5μ 8.5-(10.5)-14 × 1.5-(1.9)-3μ	6-(9.5)- 13.5μ	12-28μ
220A Palau Spec. 1	1062-(1932)- 2275 × 6.5- (24)-44.5μ	360-(1419)- 2025 × 6- (28)-46μ	1560-1937 × 7-10μ	1837-(2081) -2437 × 10- (13)-15μ	178-(260)-312 × 2-(2.8)-3.5μ	10-(11)-13 × 1-(2)-3.5μ	6-(9.4)- 14μ	14-30μ
220A Palau Spec. 2	1050-(2023)- 2720 × 7.5- (32)-50μ	712-(1726)- 2562 × 23- (35)-46μ	1650 × 12μ	1075-(2067) -2687 × 8- (13)-16.5μ	212-(248)-287 × 2-(3)-3.5μ	7.5-(10)-13.5 × 1.5-(1.9)-2.5μ	6-(9.9)- 14.9μ	14-46μ

¹⁰ Bracketed dimensions are those given in the type description.

not be distinct from previously described members of *Ancorina* from this area.

Lévi (1958) has described a third species in *Hezekia*, *H. arabica*. It is possible that this sponge does lack asters; certainly it differs markedly from *Ancorina acervus* in details of spiculation. If the opinion that lack of asters warrants generic separation is upheld, then *H. arabica* requires a new generic name.

DISTRIBUTION: Wide Indo-Pacific distribution.

GENUS *Stelletta* Schmidt

Stelletta durissima n. sp.

Fig. 32

OCCURRENCE: Sta. 64 (a single specimen designated as Holotype, USNM 23704).

DESCRIPTION: A small flattened fragment, 1.0 cm high, 1.2 cm wide, 0.5 cm thick, of what was presumably a simple, digitate sponge. The base of attachment is missing and there is no information as to the substrate.

COLOR: In alcohol, grayish-white.

TEXTURE: Crisp.

SURFACE: Uneven, rough with the slightly projecting clads of the outer layer of triaenes. No oscules are visible, but a lateral pore area of approximately 1.0 × 1.5 mm is present on each side of the sponge. In this area the density of surface triaenes is greatly reduced and the skeletal pores are subdivided irregularly by fine whisps of collenchymatous tissue.

SKELETON: The arrangement of the skeleton is typical of *Stelletta*, comprising radially disposed tracts of oxeas, slightly confused internally and diverging toward the surface. There are two ranks of triaenes in both of which plagiotriaenes predominate, although they are accompanied in each case by anatriaenes. The triaenes of the inner rank interdigitate with the endosomal oxeas and are frequently very short plagiotriaenes.

Small cortical oxeas are mingled with the outer rank of triaenes; they are usually radially disposed but can occur scattered between the two triaene zones. The latter are separated by a region of subcortical cavities which marks the boundary between cortex and endosome.

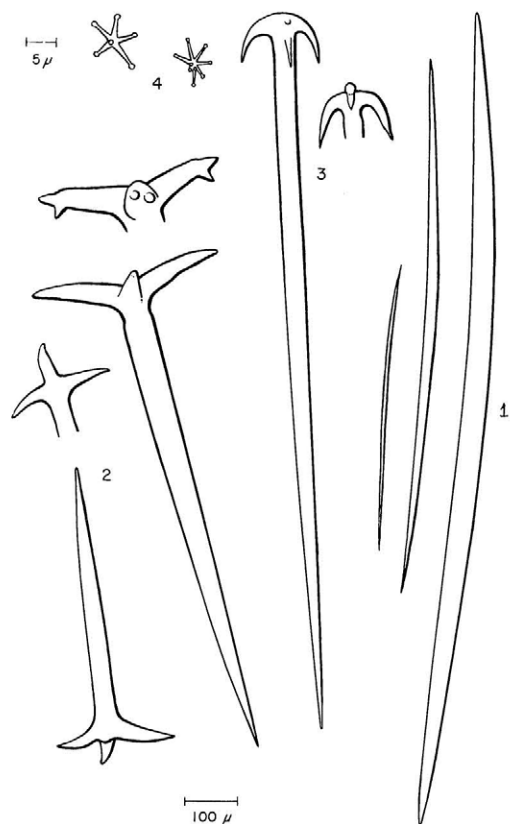


FIG. 32. *Stelletta durissima* n. sp. Sta. 64. Holotype. USNM 23704. Spicules: 1, Oxeas. 2, Plagiotriaenes. 3, Anatriaenes. 4, Tylasters.

Microscleres are distributed sporadically throughout the sponge and are frequent lining the subcortical channels.

SPICULES: Megascleres. (a) **Plagiotriaenes**, often tending toward orthotriaenes, with stout shaft tapering abruptly in the posterior third to a stylote or oxeote termination. Many of the larger triaenes are incipient dichotriaenes; the bifurcation of the axial canals in the clads often can be seen, but dichotriaenes are rarely formed. The tips of the clads are often reflexed at an acute angle to the shaft.

Smaller triaenes often have irregular cladomes; four-branched forms are common and occasionally one or two abbreviated clads project from the shaft below the actual head of the spicule. Frequently the angle between clads is unequal, giving the cladome a two-dimensional appearance.

(b) **Anatriaenes** with strongly recurved and exceedingly stout clads. These spicules rarely have perfect form; the cladome can be slightly subterminal, with the shaft projecting as a nubbin beyond the point from which individual clads diverge, or both the angle between clads and the curvature of the rays may vary greatly on a given spicule.

(c) **Oxeas**, which are frequently stronglyloxeote; these spicules make up the entire endosomal skeleton.

(d) Fine, spindle-shaped cortical oxeas, not sufficiently abundant to form a distinct layer.

Microscleres. Tylasters, with 5–10 long fine rays.

DIMENSIONS: Plagiotriaenes: 500–(835)–1398 \times 19–(38)–70 μ ; cladome: 60–487 μ . Anatriaenes: 787–(1134)–1375 \times 23–(32)–37 μ ; cladome: 125–150 μ . Oxeas: 587–(1009)–1460 \times 16–(32)–50 μ . Cortical oxeas: 200–(223)–240 \times 2–(2.8)–4 μ . Tylasters: 8–(9.7)–10.5 μ .

HISTOLOGY: The cortex is a distinct layer, 125–175 μ deep, composed of a dense collenchymatous matrix in which spindle-shaped cells are relatively abundant. The inner boundary of this layer is marked by a zone of cells with coarsely granular cytoplasm; these line the roof of subcortical channels but are also dispersed between and below them. The fleshy tissue of the endosome is granular.

DISCUSSION: *Stelletta durissima* is closest in spiculation and morphology to *Stelletta clavosa* Ridley and particularly to *S. (Myriastria) clavosa* var. *quadrata* Sollas, which has similar anatriaenes.

The chief differences are that *S. durissima* has incomplete, malformed dichotriaenes where *S. clavosa* has normal dichotriaenes as the surface spicules; plagiotriaenes are present in *S. durissima* and absent from *S. clavosa*; anatriaenes are often irregular in form in *S. durissima* and all megascleres are substantially shorter and stouter in this species than in *S. clavosa*. The single, circular, depressed osculum described for *S. clavosa* by all authors has not been observed in *S. durissima*. The latter is further distinguished by the presence of a double layer of triaenes.

The decision taken by Dendy (1905) and de Laubenfels (1936) to separate *Stelletta*

Schmidt and *Myriastr* Sollas on the grounds that species of *Myriastr* possess only one type of aster, a chiaster or tylaster, was admittedly arbitrary; the opposite view has been taken by Burton (1926). It is not consistent to limit stellettid genera by the possession of a single and widespread type of aster. Species such as *Myriastr debilis* Thiele have only oxyasters. Such a sponge is not, in Dendy's view, a *Myriastr*. If the generic diagnosis is to be widened to admit it, then the argument that a genus can be limited by the possession of a single microsclere category when a closely related genus exhibits a variety of microscleres, including this type, obviously cannot be upheld. It would lead to the establishment of individual genera for every stellettid with only one type of microsclere. Both tylasters and oxyasters are common among species which have been referred to *Stelletta* and it is preferred here, following Burton, to regard all species possessing only a single microsclere category as belonging to this genus.

FAMILY TETILLIDAE Sollas

GENUS *Tetilla* Schmidt

Tetilla microxea n. sp.

Fig. 33a, b

OCCURRENCE: Sta. 53 (one specimen, the Holotype, USNM 23700).

DESCRIPTION: A small, hemispherical sponge growing upon a coral fragment; unfortunately

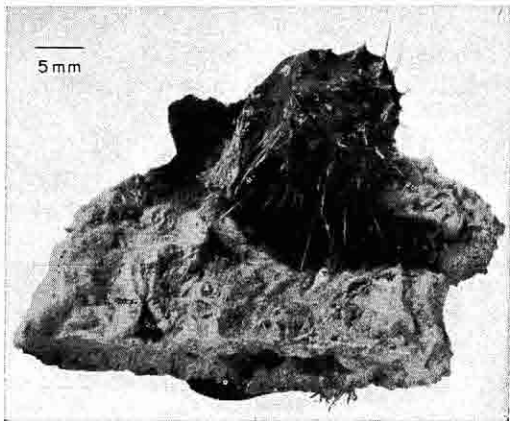


FIG. 33a. *Tetilla microxea* n. sp. Sta. 53. Holotype. USNM 23700.

the specimen is damaged and approximately half remains attached. The characteristic feature of the specimen is the presence of long projecting surface spines each made up of one to twelve stout oxeas.

The sponge is 1.9 cm high, 1.6 cm wide, and the surface spines range from 2.5 to 7.0 mm. Basal rooting tufts, frequently well-developed in species of *Tetilla*, are only just indicated at the base of this specimen.

COLOR: In alcohol, reddish-brown (YR 5/4) externally, pale brown internally (approximately yY-R 7/4).

TEXTURE: Firm, compressible.

SURFACE: Conulose, spiny, and granular. Each projecting radial tract raises the skin-like ectosome into a marked conule and the tissue surrounding the spicules may extend up to 2.5 mm beyond the level of the sponge surface. Conules are spaced relatively regularly over the surface, approximately 1–3 mm apart. The actual surface tissue of the sponge appears granular, contains abundant sigmas and microxeas, and has a considerable amount of detritus and large foraminiferans adhering to it. No pores or oscules are apparent.

SKELETON: Tracts of large oxeas radiate from the center of the sponge to the surface; occasional megascleres occur between these tracts but the predominant spicules in this position are microxeas. Both protriaenes and anatriaenes are present in addition to the oxeas in the endosomal skeleton; these spicules are, however, extremely rare. There is no layer of radially disposed cortical oxeas and no special disposition of the triaenes. The sigmaspirae are extremely abundant in the dermal region and in the outer half of the endosome; microxeas have a similar distribution.

SPICULES: *Megascleres*. (a) Oxeas, large straight spicules frequently stair-stepped, tapering to sharp points. (b) Anatriaenes, with flattened cladome, very slightly recurved rays and long lash-like rhabdome. These spicules are rare overall but seem to occur in groups associated with the endosomal oxeas, not, as in many tetillids, concentrated toward the base of the sponge. (c) Prottriaenes. Only two spicules were found, one with stout straight shaft and irregular cladi, the other a fine prodiaene, with

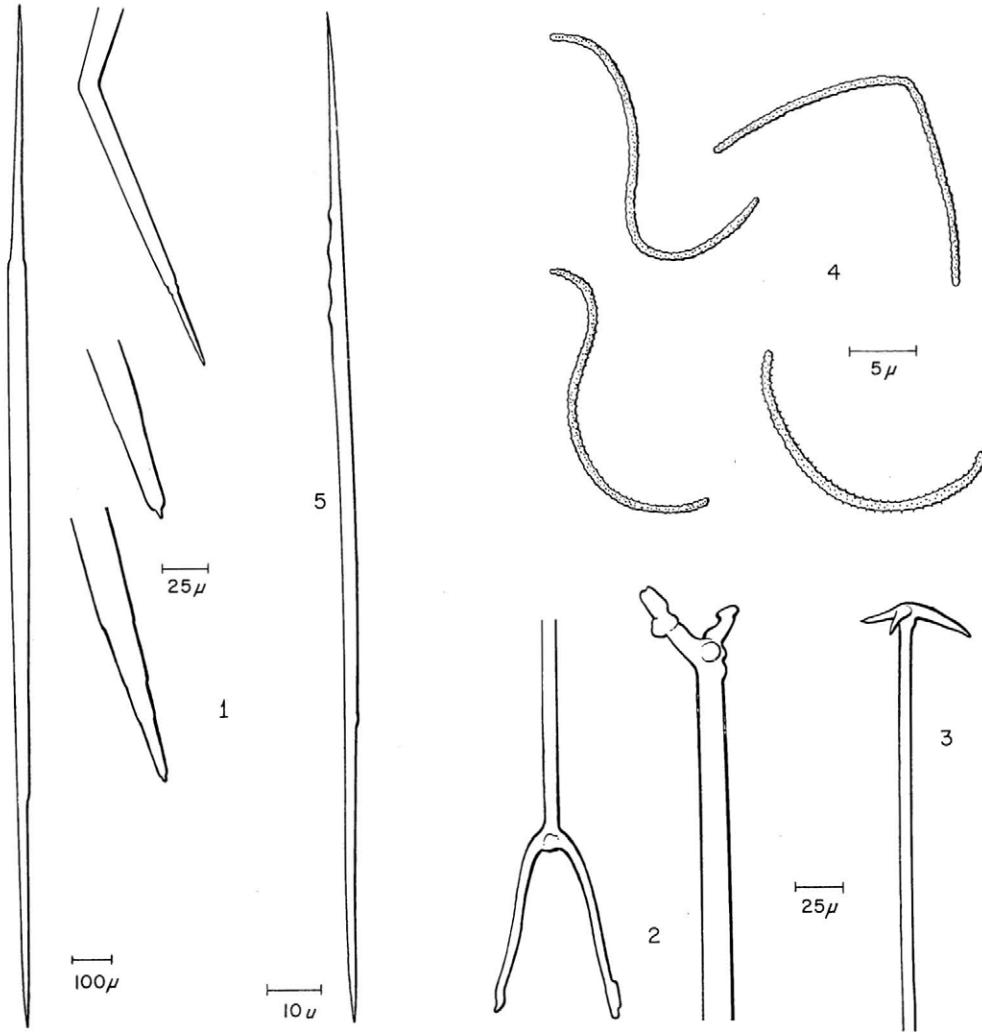


FIG. 33b. *Tetilla microxea* n. sp. Spicules: 1, Oxeas. 2, Prodiaenes. 3, Anatriaene. 4, Sigmaspirae. 5, Microxea.

the cladome head just below the sponge surface.

Microscleres. (a) Microxeas, fine, spindle-shaped spicules which are distributed tangentially in the dermis and in confusion in the endosome. (b) Sigmaspirae of typical tetillid form but apparently quite smooth.

Spicule dimensions (in μ).

Oxeas: 587–(2000)–2875 \times 4–(30)–50.
 Anatriaenes: at least 3400 \times 3–8 (all spicules incomplete), cladome 33. Protriaenes: 3125 \times 8.5 cladi, 16–40 \times 2.5–3.5, cladome 13–50.
 Microxeas: 150–(184)–230 \times 1.5–(2.3)–3.5.
 Sigmas: 10–(18)–32.

HISTOLOGY: The ectosome is not a clearly differentiated region; the dermis is a slightly collenchymatous, lightly pigmented layer which grades imperceptibly into the endosomal sarcoenchyma.

DISCUSSION: *Tetilla microxea* can be compared with *Tetilla monodi* Burton from West Africa and *Tetilla oxedata* Burton from south Arabia. These three species are, as far as can be ascertained, the only other members of this genus which possess small oxeas and have them scattered throughout the sponge rather than arranged in a definite cortical layer. *Tetilla*

microxea differs from *T. monodi* and *T. oxeata* in that the supplementary oxeas are small and have the same distribution as the microscleres, in the great rarity of triaenes, and in details of body shape, color, and surface. *Tetilla rubra* Kieschnick differs in lacking the spiny surface, in having abundant triaenes and in having calthrops in the basal rooting tufts, the latter characteristic suggesting that this species belongs in *Paratetilla*.

The genus *Tetilla* is understood here in the sense of Sollas (1888) and Wilson (1925). The synonymy of *Craniella* Schmidt with *Tetilla* Schmidt has not been satisfactorily demonstrated, neither have good reasons been produced to uphold the use of two separate families, Craniellidae and Tetillidae as de Laubenfels (1936) proposed.

GENUS *Paratetilla* Dendy

Paratetilla bacca (Selenka)

Fig. 34

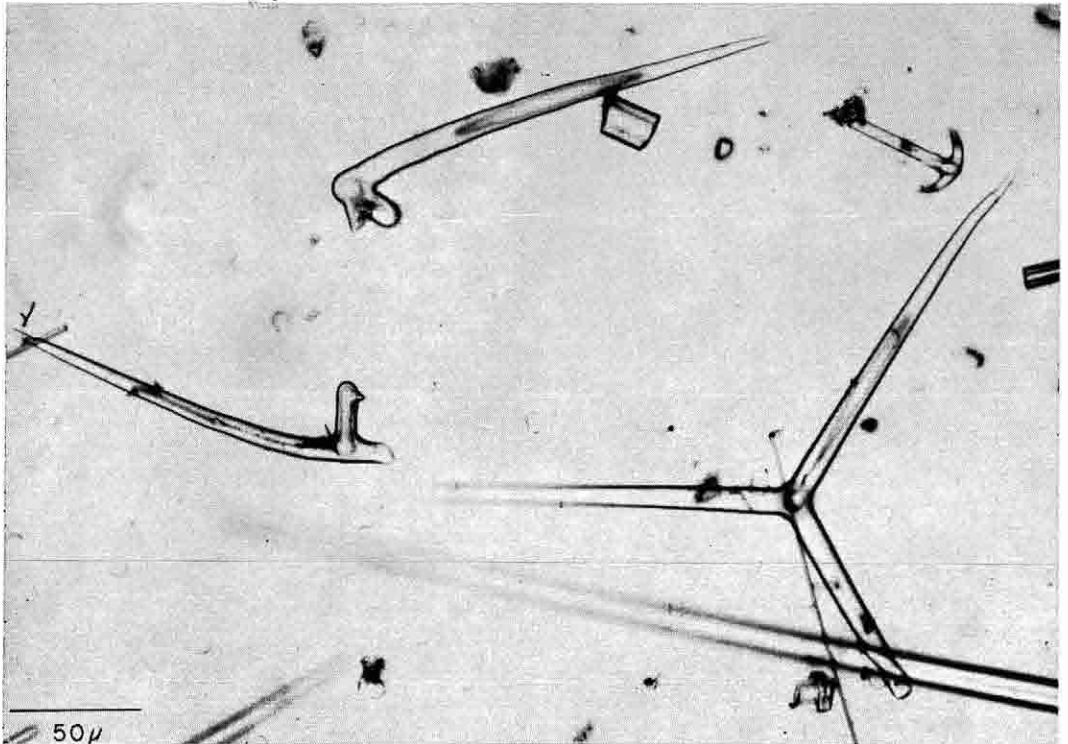


FIG. 34. *Paratetilla bacca* (Selenka). Sta. 47. Malformed orthotriaenes.

RESTRICTED SYNONYMY:

Stelletta bacca Selenka, 1867, p. 569, pl. 35, fig. 14, 15.

Tethya merguensis Carter, 1883, p. 366, pl. 15, figs. 6-8.

non *Tetilla merguensis* Topsent, 1897, p. 437.

Tetilla bacca Lindgren, 1898, p. 328.

Paratetilla bacca Dendy, 1905, p. 97.

Paratetilla bacca Dendy, 1921, p. 21.

Paratetilla bacca Kumar, 1925, p. 217.

Paratetilla bacca Burton, 1959, p. 200.

OCCURRENCE: Sta. 47.

DISCUSSION: The single specimen in this collection is extremely close to *Paratetilla cineriformis* Dendy from Ceylon and *P. eccentrica* Row from the Red Sea in features of general morphology and spiculation. Dendy (1921) has referred *P. cineriformis*, with many other forms, to *P. (Stelletta) bacca* Selenka and there is little that need be said to supplement his work. Those points which can be criticized have been dealt with by Wilson (1925). It is

agreed that the removal of *Tetilla merguensis* Topsent 1897 to *Amphitethya* as suggested by Wilson is desirable, but Dendy's view as to the presence of poriferous pits in *Stelletta bacca* Selenka is well reasoned and is upheld. Further, Wilson questions the synonymy of *P. eccentrica* Row with *P. bacca*, claiming that the great irregularity of the triaenes justifies the separation of this species. Malformed triaenes are the rule in the Palau specimen and all modifications described by Row for *P. eccentrica* can be observed. *P. cineriformis* Dendy also possesses malformed triaenes. In view of this the separation of *P. eccentrica* cannot be maintained. The status of *Paratetilla lipotriaena* de Laubenfels (1954:244) is uncertain. The holotype (USNM 23049) has been re-examined and has been found to possess occasional prodiaenes, promonaenes, and anatriaenes with reduced rays. The calthrops or orthotriaenes are identical with those of the specimen assigned here to *P. bacca*; other skeletal elements, color, and general morphology also agree with the Palau specimen. In view of the abundance of triaenes in my specimen and their scarcity and reduced form in *P. lipotriaena*, this species is retained as a valid one for the present.

DISTRIBUTION: Indian Ocean and western Pacific.

GENUS *Cinachyra* Sollas

Cinachyra australiensis (Carter) (complex of species)

RESTRICTED SYNONYMY (for extensive synonymy refer to Burton, 1934):

Tethya cranium var. *australiensis* Carter, 1886, p. 127.

Cinachyra australiensis Burton, 1934, p. 523.

Cinachyra australiensis de Laubenfels, 1954, p. 242, fig. 166.

OCCURRENCE: Sta. 47, 125, 200 (2 specimens).

DISCUSSION: The four hemispherical specimens in the collection are not identical in spiculation but are very similar in external form. There is variation in the size and degree of torsion of the sigmaspires, those in specimen Sta. 47 being small and tightly curved while

those of the remainder are larger and more open. Microxeas are variable in their number and degree of spination; they are rare and occasionally roughened in the specimen from Sta. 220, relatively abundant and roughened in that from Sta. 125, relatively abundant and smooth in that from Sta. 47.

Prototriaenes and anatriaenes are present in all specimens.

DISTRIBUTION: Australia, Malay area, Indian Ocean.

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