The Sponges of Kaneohe Bay, Oahu[1]

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THE HAWAIIAN ISLANDS lie near the center of the north tropical Pacific Ocean. The island of Oahu is in the midst of these islands. Kaneohe Bay is near the middle of the windward side of Oahu, which side extends from northwest to southeast. The whole bay extends slightly over 11 kilometers along the coast, but is only some 3 kilometers (2 miles) deep. It is sheltered by extensive off-shore coral reefs, however, so that the water in it is much calmer than that of the open ocean. The southeast end of the bay is further sheltered by Mokapu peninsula so that it is here three-fourths landlocked; a roughly circular area some 3 kilometers in diameter is thus especially sheltered. The present study is based upon collections within this latter area which includes the junction of latitude 21° 26′ N. and longitude 157° 48′ W.

The deeper portions of Kaneohe Bay have a sand bottom; practically no sponges occur on sand. There are many patches of coral scattered throughout the bay, coming up to extreme low tide level, thus nearly but not quite 1 meter below the high tide surface. Such masses are often more than 100 meters in diameter, and have a vertical measurement above the floor of the bay of 10 to 15 meters. Much of the outer or fringing area of each is living coral, but the bulk of each mass is dead coral. There are innumerable interstices, and these are teeming with invertebrate life, including sponges. To collect and study this fauna, large armful-sized masses of coral were broken off, hauled to the surface, and placed on a boat where they were broken into small bits by means of hammers and crowbars. It is common to find that 5 to 10 per cent of the surface of the dead coral, down in these narrow crevices, is covered with living sponges. These are, however, always thin, often as thin as paper. Such incrustations are difficult to detach, or to study in any other way.

Much of the study of Kaneohe Bay was conducted at or near the island that has long been known by the Hawaiian name of Moku O Loe, but which has lately been termed Coconut Island. It is less than a kilometer in greatest dimension. Several man-made lagoons about 20 to 80 meters in length and connected to each other, and to the ocean, by channels that are 2 to 8 meters wide, have been constructed. In the channels sponges grow luxuriantly, and an individual sponge colony may quadruple its mass in 1 year's growth. In the calmer waters of the lagoons a few scattered sponges occur, some of rather large size (10 to 20 cm. high), but it is evident that there they grow very slowly; individual colonies showed so little growth in a year's time that it could not be measured. Doubtless there was some growth, but probably less than 10 per cent increase. These larger lagoon specimens are probably several years old, perhaps even 10 years old. Larger sponges in the channels may be only 10 months old.

Field investigation was carried out approximately once a month from September, 1947, to May, 1948 (9 months), and again in

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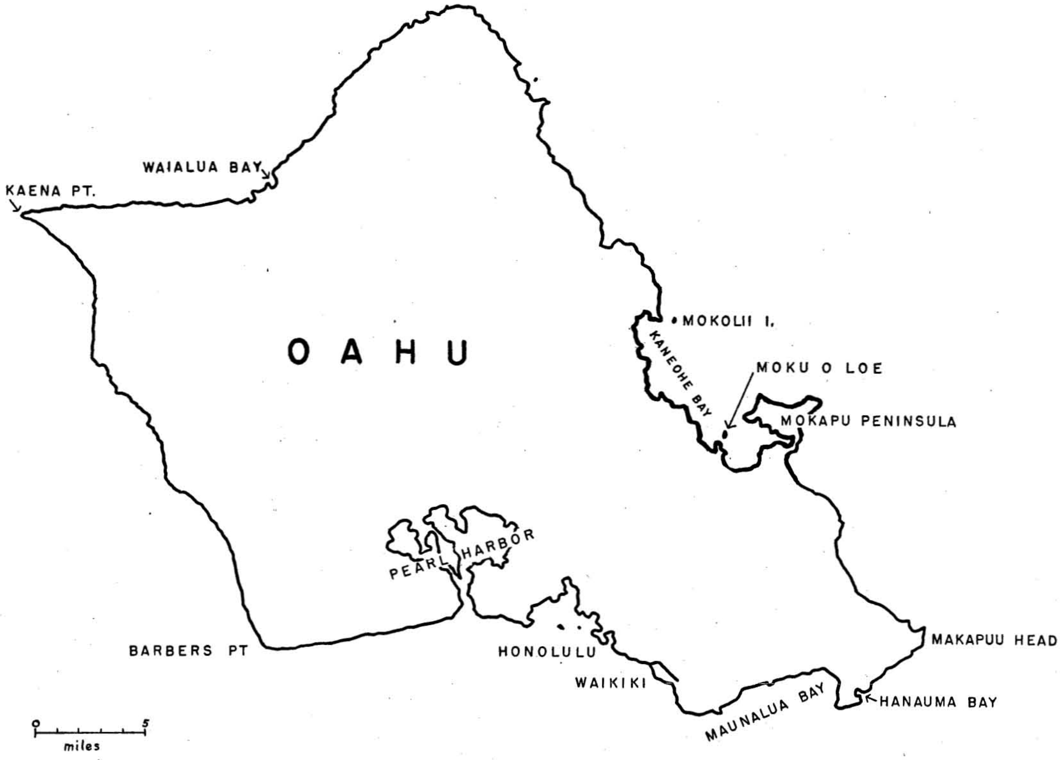

FIG. 1. Map of the island of Oahu showing Kaneohe Bay and Moku O Loe.

October, 1948. About a dozen species of sponge were found to be fairly common or regular in occurrence in accessible locations, and a second dozen were found, but were rather rare and uncommon. It is certain that continued search would gradually but steadily build up this latter category to a total of at least 2 or 3 dozen. The same amount of effort and time expended on the Pacific coast of the United States, for areas of similar size and placement, would yield just about the same number and average size of specimens. The same may also be said for the coasts of England in particular and northwest Europe in general. In contrast, the Atlantic coast of the United States yields only half as many species, but typical regions in the Mediterranean and in the West Indies yield half again as many species, and the individual colonies are many times larger.

The possible faunal relationships of Hawaiian species to those of other parts of the world are interesting. Of the 23 species here discussed, 12 (or more than half) are new species. Of the 12, 7 (or more than half) are new genera. This is not unexpected in view of the insular location. Of the species that are here identified with previously named forms, four are circumtropical—almost to be called cosmopolitan—two are East Indian, two are from the Pacific coast of Panama, the others are from scattered localities. The two Panamanian forms conceivably may have been brought to Hawaii on ship bottoms; at least one of them is abundant on those that are dry-docked at Pearl Harbor. Conversely, they may have been taken to Panama from Hawaii.

The study of sponges in the field is complicated nearly everywhere by the occurrence of certain species of ascidians of the family Diademnidae which closely resemble encrust-

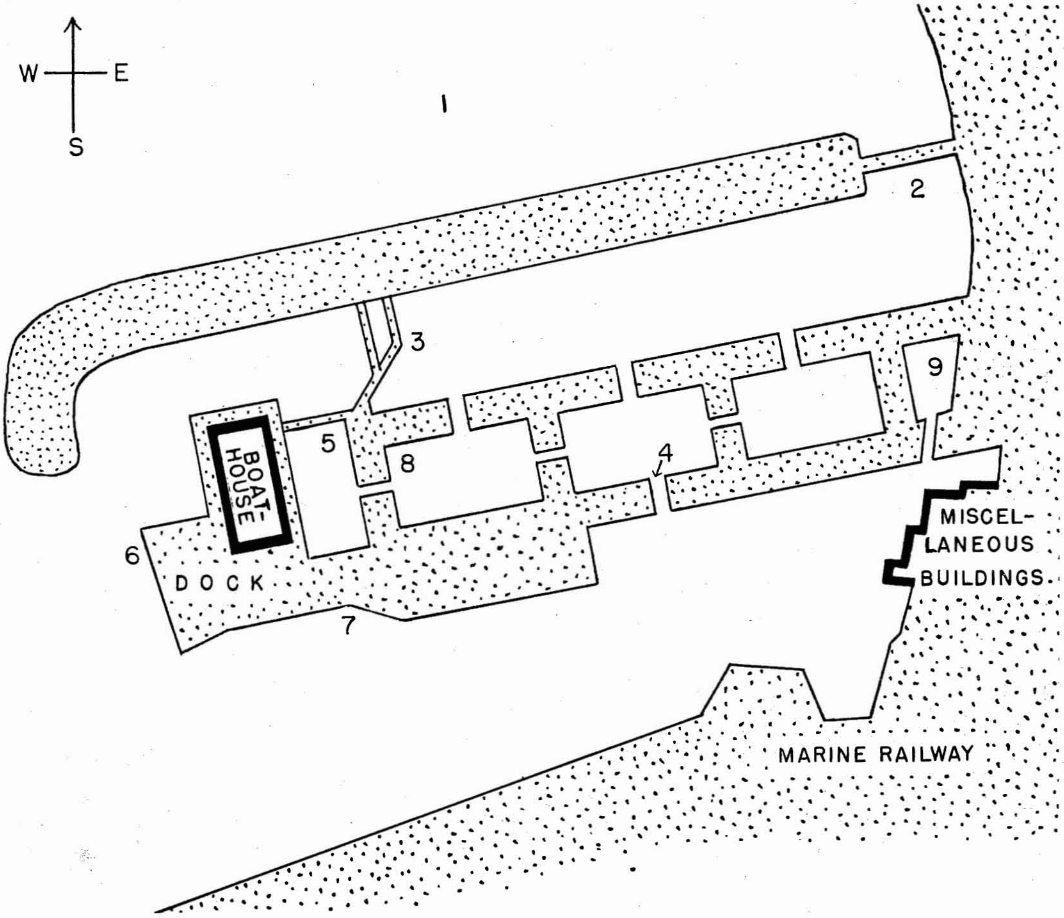

FIG. 2. Map of the vicinity of the Hawaii Marine Laboratory at Moku O Loe, showing by number six locations that are referred to, and three others for future reference.

ing sponges in all respects that are visible to the naked eye. Massive or branching sponges are easily discriminated, but such thin crusts as characterize the coral patches of Kaneohe Bay are perplexing. This locality furthermore contains especially numerous examples of the sponge-mimicking ascidians. The latter even contain spicules of the sort known as spherasters (a central ball, covered with outward projecting, conical, spines). Quite a few sponges contain spicules of just this shape, but these are always siliceous in sponges, always calcareous in the ascidians. Some sponges have calcareous spicules, but these are never spherasters.

A probable identification of the commoner sponges of Kaneohe Bay and vicinity may be made in the field by the key which is furnished below. Positive identification can only be made after microscopical study. Permanent mounts to show structure should be sectioned and preserved in balsam; but there are simpler methods available if permanent mounts are not required. Much structure can be ascertained by use of a dissecting-type stereoscopic microscope. One may slice the sponge in various directions and tease out small bits, using such a microscope. For spicule study one may take bits of the sponge, some from the surface and others from the interior, each bit about 3 mm. in diameter, put a few drops of concentrated fresh sodium hypochlorite solution on the sample, add a cover slip and study, pressing on the cover slip with a dissecting needle to move the gas bubbles. Commercial bleaching solutions such as Clorox and Purex will do, but a more concentrated solution is preferable. Such a solution destroys the protoplasm and leaves the spicules obscured only by the myriad bubbles. These latter may be moved about so that the isolated spicules are revealed. For permanent mounts one may boil out a sample (on a slide) with about six drops of fuming nitric acid, later adding balsam and cover slip.

A few words about spicule nomenclature may be in order. Megascleres typically make up the framework of the sponges in which they occur and are always comparatively large, sometimes even visible to the unaided eye. Microscleres never make up the framework of a sponge and are almost always minute. Some have a distinctive shape, and when such a shape is found to be large, that spicule is still regarded as being a microsclere in spite of its size. Megascleres may have three or more rays diverging from a central point (triaxon, tetraxon, etc.) or, instead, may be monaxon. The latter may be sharp at both ends (oxeas) or at only one end (style). If rounded at both ends they are called strongyles; if swollen at both ends they are called tylotes. A tylostyle is swollen at one end, pointed at the other. The prefix "acantho" means spiny. Microscleres may be very thin rods (raphides), S- or C-shaped (sigmas), or archer's-bow-shaped (toxas). Some are asters, covered with long rays. These are termed euasters if all radiate from a point, but are called streptasters if the rays radiate from a rod or bar. Amphidisks or birotulates have a circular pattern at each end of a rod. Related forms called chelas are so elaborate that they require illustration; some resemble anchors. If both ends are alike, it is an isochela, but if the ends differ it is an anisochela.

KEY TO GENERA

The commoner species occur in the genera marked with an asterisk.

1. No proper spicules present . . . 2
Proper spicules present 5

2. Spongin network present 3
Spongin network absent 4

3. Fibers almost always clear . . . . **Spongia*** p. 7
Fibers full of debris . . **Dysidea** p. 9

4. A few fibers present, no network . . . . **Pleraplysilla** p. 9
No fibers present, dermal spongin present . . . . **Hexadella** p. 10

5. Spicules of silica present 6
Spicules of calcium carbonate present 24

6. Spicules rare, skeleton chiefly sand . . . . **Kaneohea** p. 23
Spicules common 7

7. Astrose spicules present 8
Astrose spicules absent 9

8. Sponge spherical, no twice-bent oxeas . . . . **Tethya*** p. 30
Sponge not spherical, twice-bent oxeas present . . **Zaplethea** p. 32

9. Some spicules triaxon . **Plakortis** p. 33
No spicules triaxon 10

10. Ectosomal spicules the same as those of endosome 11
Ectosomal spicules different from those of endosome 20

11. Larger spicules diactinal 12
Larger spicules monactinal 15

12. Diacts are strongyles . . . . **Xytopsiphum** p. 11
Diacts are oxeas 13

13. A fine-mesh dermal network present . . . . . . **Callyspongia*** p. 12
No such dermal net present . . . 14

14. Spicules oxeas and small toxas . . . . **Toxadocia*** p. 16
Spicules oxeas and raphides . . . . **Neoadocia** p. 15

15. Monacts chiefly styles (a few may have a slight "head") 16
Practically all monacts clear-cut tylostyles 18
16. No spicules except styles . . . . **Hymeniacidon*** p. 27
Other spicules also present 17
17. Anisochelas and sigmas also present . . . . **Mycale*** p. 24
Styles, isochelas, anisochelas, sigmas, toxas, and raphides present . . . . **Zygomycale*** p. 25
18. Spicules only tylostyles; sponge never boring into $CaCO_3$. **Terpios*** p. 28
19. Oxeas and acanthomicrostrongyles also present; sponge usually confined to galleries in $CaCO_3$ . . . . **Cliona*** p. 30
20. Dermal spicules spiny . **Naniupi** p. 18
Dermal spicules smooth 21
21. Endosomal spicules spiny . . . . **Myxilla** p. 17
Endosomal spicules smooth . . . 22
22. Microscleres only raphides . . . . **Tedania*** p. 21
Other microscleres present 23
23. Microscleres are isochelas . . . . **Damiriana*** p. 13
Microscleres are amphidiscs . . . . **Hiattrochota** p. 19
24. Spicules chiefly calcareous triaxons . . . . **Leucetta*** p. 34

DESCRIPTIONS OF SPECIES

Spongia oceania new species

Figs. 3, 4

The holotype of this species is designated as a dried specimen, U. S. National Museum, Register Number 22755. It was collected February 14, 1948, just north of the entrance to Hanauma Bay, from a depth of 8 meters. Further data as to the abundance of this sponge are given after the description.

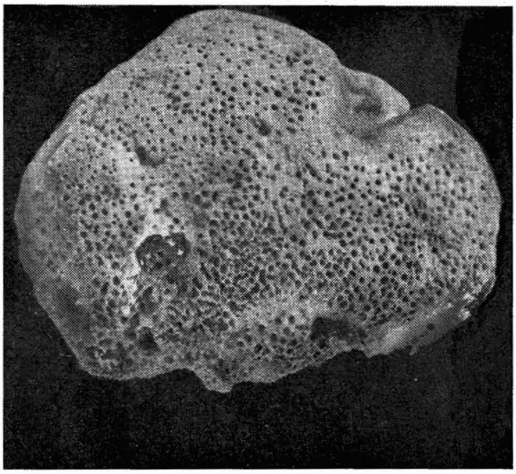

FIG. 3. Holotype of *Spongia oceania,* × ½.

The shape of *Spongia oceania* is irregularly massive. Its size is often greater than 10 cm. in diameter. As is the rule in this genus, the exterior is normally jet black, the interior brown. Specimens that grow in the shade, however, fail to reveal the black color. The first ones that I found, from Moku O Loe, were dull brown externally, turning gray in alcohol. The consistency is very spongy as compared to other genera, but *oceania* is definitely less spongy than are most other species of the genus *Spongia.*

Its surface is most distinctive. Large areas are completely devoid of conules, and where these protrusions do occur they are only 0.1 to 0.2 mm. high, 4 to 6 mm. apart, and are vague. The oscules are 1 to 2 mm. in diameter. In a typical area of 10 square cm. I count 138 oscules; the average will certainly be close to 14 per square cm. on the upper surface of the sponge. There are, of course, very few on the sides, and none below. Many are only 2 mm. apart, center to center. These oscules in life are subject to at least partial sphinctrate closure, as are also the pores. The pores in spirit-preserved specimens are abundant, 40 μ in diameter, but may have been slightly larger when fully opened in life.

The ectosome of *oceania* is a typical *Spongia* dermis about 15 μ thick, full of heavily pigmented cells. The endosome is the usual dense reticulation. The flagellate chambers are spherical, about 25 μ in diameter. The abundant fibers consist of nearly opaque, typically rather granular spongin without foreign inclusions. They are 15 to 30 μ in diameter and enclose meshes often about 50 by 200 μ. The scarce ascending fibers are about 60 μ in diameter, and contain a core of fragments of spicules from neighboring sponges.

FIG. 4. Fibers of *Spongia oceania* from a camera lucida drawing, × 100. A, principal or ascending ing fiber; B, common fibers.

No other species of *Spongia* has such numerous oscules of such small average size. A few such small ones may occur here and there in other species but as a rule the oscules are large, often nearly 10 mm. in diameter, and many centimeters apart. Only a few other *Spongia* specimens are as hard as *oceania,* and in each such case it appears decidedly possible that the hardness is due to some local environmental condition. The hardness of *oceania* may be a specific character. It would be interesting, however, to see if soft varieties, imported from elsewhere, would continue to grow soft in Hawaii. The commercial possibilities of *oceania* do not appear great, but they do exist.

The species name is given in respect to the location of this sponge near the center of the world's largest ocean.

The abundance of this species calls for special attention because it is almost, or perhaps could be, a commercial sponge. It is recorded that the ancient Hawaiians collected and used dried specimens, but to only a slight extent. Wet specimens feel somewhat like the usual commercial sponges, and I have used a locally collected sponge in a very practical way in my laboratory. Yet even when wet it is somewhat difficult to compress, and when dry it is almost as stiff as wood. The commercial sponge *Spongia officinalis* variety *dura* from the West Indian region, known in the market as "hardhead," is much like *oceania* in consistency. The best Hawaiian sponges are scarcely third-grade by market criteria, but their ability to absorb and hold water (which may then be readily squeezed out) is quite good. They have a fairly small ratio of gross cavities, so that their chief fault is the unpleasant stiffness.

I first collected this species in Kaneohe Bay (at Moku O Loe) on December 22, 1947, but the specimens from this vicinity were all small, thin encrusting forms, ill suited to reveal the typical characteristics. Mr. Vernon Brock collected the type specimen by "skin diving" and reported that at the type locality the bottom for perhaps as much as several acres was thick with spongias, scarcely a meter apart, and many of them were much larger than human head size. He brought up one specimen over 40 cm. in diameter. It is curious to note that there is probably a greater bulk of this species in the Hawaiian Archipelago than the total bulk of all other shallow-water Hawaiian sponges. Reports came to me of vast windrows of this sponge cast on the beach after storms. On January 24 to 26, 1947, an unusually severe gale struck Hawaii and on January 28, I went almost entirely around the island of Oahu, examining beaches along the south, east (windward), and north shores. I found only a few small fist-size spongias cast up. Almost nothing else was cast up, however, so presumably the wave action of this storm was of some peculiar nature so that it scoured material off the beach rather than depositing it. Extra big deposits of storm-dislodged sponges are reported from the windward side of the island of Molokai, even masses 2 feet deep extending far along the beach. Reports came to me of large beds of *Spongia* north of the island of Maui and just north of, and also just south of, Kaneohe Bay. Dredging at the latter locality failed, however, to yield a single specimen. During May, 1948, I made a reconnaissance of the large island of Hawaii and found this species rather common along the south and west coasts, but did not similarly explore the turbulent, windward, northeast coast.

Dysidea avara (Schmidt) de Laubenfels

This species is represented to date by only a single specimen collected at Moku O Loe on January 10, 1948. This is now deposited in the U. S. National Museum, Register Number 22749. It was growing on the east side of the dock, near the concrete bridge which connects the dock with the island. It was at a depth of about 2 meters. This is location number 5 on the map.

This specimen is 6 by 7 by 9 cm., massive, and in life it was dull purple outside, brown inside. Its consistency is very spongy, but if dry it would doubtless, like others of the same species, become hard and brittle.

The surface is beset with conules about 2 mm. high and 1 to 8 mm. apart, usually 3 to 4 mm. apart. The oscules are 3 mm. in diameter and 2 to 3 cm. apart. The pores are 50 μ in diameter; about 10 or 14 such occur in each of numerous surface areas. Each such area is about 0.5 mm. in diameter, and represents a mesh in a subdermal reticulation of spongin fiber.

The ectosome consists of a thin dermis much perforated by pores as described. The endosome is fibro-reticulate. The flagellate chambers are 60 μ in diameter, sack-shaped (eurypylous). Both primary or ascending fibers and secondary fibers are loaded with foreign material, but a few fibers in the subdermal reticulation are free from detritus. These latter are 20 to 40 μ in diameter. In the main fibers a few short spaces that are free of inclusions are 100μ in diameter, but the abundant inclusions are often sand grains of 250 μ in diameter.

The species name *avara* was first used as *Spongelia avara* by Schmidt (1862: 29) for a Mediterranean species very much like this one from Hawaii. That *Spongelia* falls in synonymy to the earlier *Dysidea* is made clear by de Laubenfels (1932: 124) if not sooner; earlier authors had speculated that such might be the case. Very similar sponges are recorded from Australia by Lendenfeld (1889: 668) as *Spongelia distans* and are recorded from the Philippines, first by Wilson (1925: 476) as *Spongelia fragilis* and subsequently by de Laubenfels (1935: 327) as *Dysidea pallescens.* Burton (1934: 583) placed many species, including *pallescens, distans,* and *avara,* in synonymy with *fragilis.* In a monograph of the keratose sponges (de Laubenfels 1948: 142) I maintain the specific distinctness of *avara* as compared to *fragilis,* including *distans* with *avara.* The species *avara* is never as pale or grayish as *fragilis,* and consistently has a much coarser surface. In addition *fragilis* tends to have larger oscules, often at the distal ends of cylindrical branches. Occasional deformed specimens of *avara* may resemble equally rare deformed specimens of *fragilis,* thus leading to the belief that all are conspecific. *D. avara* appears to be common throughout the Old World, Europe to Australia, and is now recorded in mid-Pacific. *D. fragilis* is world-wide, being found even into the near Arctic.

Pleraplysilla hyalina new species

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22754. It was collected January 10, 1948, in Kaneohe Bay at a depth between 1 and 2 meters, growing on dead coral.

This species formed an extremely thin encrustation, bare'y 100 μ thick at the thickest unless measured directly at the conules. It spread laterally for distances of several centimeters on the exceedingly irregular surfaces of the coral. It was possible to dislodge postage-stamp-sized pieces with some difficulty. In life the color was blue-gray, and the transparency of the whole sponge was noteworthy. The consistency of the flesh was softly colloidal, scarcely more firm than raw egg white. The fibers were stiffly elastic.

The surface of this sponge was decidedly conulose, with conules 3 to 7 mm. apart and about 2 mm. high. Neither oscules nor pores could be found in the preserved specimen. Doubtless they were almost or quite microscopic in life, and completely contracted in the alcohol or while the encrustation was being scraped off. The whole is so thin that no distinction can be drawn between ectosome and endosome; specifically there was no evident dermis or dermal specialization, merely the surface of the protoplasm.

Doubtless there was a basal plate of spongin. Certainly at intervals spongin fibers rose upward, perpendicular to the base. These fibers are of clear amber-yellow spongin with a central region that is densely packed with spicule fragments and fine sand.

This appears to be the third time that anyone has found this genus, which is separated from the somewhat more common *Aplysilla* by the occurrence of a central region in the fiber filled with foreign detritus. The first was on the north coast of France, as recorded by Topsent (1905: clxxxiv). He described his discovery as *Pleraplysilla minchini.* It differed from the Hawaiian specimen in being opaque and chocolate-brown in color. The second occurrence of the genus was recorded by George and Wilson (1919: 165) at Beaufort, North Carolina. This species, *Pleraplysilla latens,* was described as colorless, conules less than 1 mm. high; the distance between conules was not given. In 1946, I spent the summer at Beaufort, but was unable to find a trace of *Pleraplysilla.* Of course it is an exceptionally inconspicuous sponge. The Hawaiian species is set off by color from *minchini* and in color and conule size from *latens.* The specific name selected refers to its transparency.

Hexadella pleochromata new species

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22748. It was collected January 10, 1948, in Kaneohe Bay at a depth of between 1 and 2 meters, growing on dead coral. It was also collected by dredging at 50 meters depth on the opposite side of Oahu, in the ocean south of Pearl Harbor, on February 19, 1948.

This species forms a thin encrustation not quite 1 mm. thick. In life the color is sulfur-yellow, but upon dying it turns purple. The consistency is fleshy, modified by the tough dermis.

The surface of this sponge was smooth, with scattered openings 25 to 60 μ in diameter. No distinction between exhalant and inhalant openings could be made.

The ectosome is a tough organic cuticle, giving no evidence of cellular nature but instead is almost certainly suitably called spongin. The endosome is completely askeletal, comprising only the protoplasmic sponge structures. The flagellate chambers are large, sack-shaped (eurypylous), 30 by 60 μ in size.

Hexadella was established by Topsent (1896: 119), like the preceding genus, for thin encrustations found on the north coast of France. He used two species names, *racovitzai* (the type) and *pruvoti.* Both were yellow, the only difference being that the former had rose-red tints. The two have long been regarded as conspecific but to clarify the literature, such reduction to synonymy is definitely made here. It is noteworthy that *racovitzai* does not turn purple on dying. The critical diagnosis of *Hexadella* concerns the lack of mineral or fibrous skeleton but the presence of a tough spongin dermis.

Dendy (1905: 61) established *Hexadella indica* from India. This was red when alive, lamellate and folded, with peculiar surface openings called "chones." Burton (1926: 2) described *Hexadella kirkpatricki* from South Africa. This was gray, with papillate oscules, and erect habitus. Burton (1937: 43) described *Hexadella purpurea* from India. This was purple in life, not at all folded like *indica,* and the endosome contained much foreign detritus.

Hexadella pleochromata is sharply set off from the other species in the genus by its change of color from yellow to purple upon dying. On the other hand, exactly such a change is exhibited by one species of *Aplysilla,* one or two species of *Ianthella,* one undescribed species of *Thorectopsamma,* one undescribed species of *Hippiospongia,* and several species in *Verongia.* Thus it is a trait that is widespread in the families of the order Keratosa. It is clearly based on the occurrence of a pigment that has the properties of an indicator. It may be regarded as practically certain that in a sufficiently acid medium this pigment is yellow, whereas in a sufficiently alkaline medium it is dark purple. The chemistry involved is being worked out at Yale University for the related pigments in *Aplysilla* and *Ianthella.*

XYTOPSIPHUM new genus

This genus is erected in the family Desmacidonidae with the following species, *Xytopsiphum kaneohe,* as genotype. It should be emphasized that this is a genus with strongyles as megascleres and arcuate chelas for microscleres. In the type, the latter are peculiar, with greatly reduced clads.

The genus *Xytopsihis* de Laubenfels (1936: 54) has a description essentially like this one, and there are some sound reasons for arguing that the species *kaneohe* should be put in it. On the other hand, the type of *Xytopsihis* was emphasized as being the sponge which Bowerbank (1875: 287) described as *Halichondria aspera,* from a specimen from the Malayan region. This might be considered fairly close to the Hawaiian faunal region, too. Were Bowerbank's description accurate, the matter would be simple. On May 26, 1948, however, Dr. Maurice Burton of the British Museum (Natural History) wrote me a personal letter stating that the type specimen of *aspera* was in his museum, a dried specimen, and that it is not at all as Bowerbank described it; instead it is a *Tedania.*

One might argue that because *aspera* does not fit the diagnosis of *Xytopsihis* it cannot go into that genus, is not and cannot be the type thereof, hence, that the following new species which does fit the diagnosis must become the type of *Xytopsihis.* Against this I will set the following considerations. The original generic designation said "*Xytopsihis* is established for genotype *Halichondria aspera* Bowerbank"; furthermore, the description mentioned chelas of two sizes, so that the Hawaiian sponge does not fit perfectly. It is here considered that *Xytopsihis* falls, with *aspera,* into synonymy to *Tedania.*

Xytopsiphum is not secure in its allocation to the Desmacidonidae. This family contains many genera that may be discovered, if adequate data about surface structure become available, to resemble more the Adociidae, or perhaps a new family between the older two. *Xytopsiphum* may go into this still hypothetical new family. Its closest relatives are now in the Desmacidonidae; these are *Plumocolumella* (megascleres oxeas, microscleres perhaps really like those of *kaneohe,* but the surface structure hispid) and closer still, *Xytopsaga,* whose megascleres are hastate tornotes, and whose microscleres are arcuate chelas. They are rather commonplace chelas whereas those of *kaneohe* are peculiar, with minute clads, as in *Plumocolumella.* On the island of Hawaii there occurs an undescribed species of sponge which I regard as congeneric with *kaneohe*; it is definitely closely related. Yet this undescribed sponge has somewhat commonplace arcuate chelas as its chief point of separation from *kaneohe*, and therefore it approaches the genus *Xytopsaga*. On the other hand, *Xytopsaga* has much coarser structure and seems to be confined to the Antarctic region.

The generic name is based upon a modification of the older name *Xytopsihis*.

Xytopsiphum kaneohe new species
Fig. 5

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22742. It was collected January 10, 1948, at Moku O Loe, in the shadow of the walk along the south side of the series of small artificial lagoons, east of the dock, depth about 1 meter, location number 4 on the map. Another specimen was collected on September 27, 1947, in Waialua Bay, Oahu, at a depth of about 6 meters, on dead coral.

Both specimens were thin encrustations, 1 to 5 mm. thick, covering areas of between 10 and 20 square cm. The type was very dark, almost black, but the color promptly dissolved out (and disappeared) in alcohol, leaving a pale grayish-pink specimen. Many sponges have a melanotic pigment, but it is quite resistant to alcohol. It may be that the dark hue of this specimen was due to some foreign material on the surface. The other specimen was reddish-brown, mottled. In alcohol it has become the same dull color as the type. The consistency is soft.

The surface of this species is relatively smooth, and the pores are not evident, probably due to rapid closing. On the Waialua specimen there is a surface hole, 0.5 mm. in diameter, with slightly raised rim, that may or may not be an oscule. Otherwise (and chiefly) the species is lipostomous, as are many thin encrusting sponges.

The ectosome is semidetachable, rendering family allocation of the genus difficult. There are many spicules tangentially placed in the dermis, but these are the same as the megascleres of the interior. The endosome is dense, with spicule tracts that range up to 50μ in diameter, 150 spicules per cross section, spongin dubiously present.

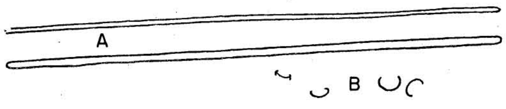

FIG. 5. *Xytopsiphum kaneohe*, spicules, from a camera lucida drawing, × 400. A, strongyles; B, sigmoid microscleres, probably reduced arcuate isochelas.

The megascleres are straight strongyles, 3 to 4 μ thick, 200 to 210 μ long. In one place in the Waialua specimen there are deformed but otherwise commonplace arcuate chelas; their absence from the rest of the specimen would indicate that they are foreign. In both specimens there are very abundant peculiar microscleres that are to be regarded as arcuate chelas, but the clads are so small that one obtains a first impression that these are sigmas. On the other hand, they are not at all contorted, as most sigmas are, but lie in one plane. These distinctive microscleres have a chord length of 15 μ in the Waialua specimen, but of only 10 μ in the type specimen.

The species name given refers to the type locality.

Callyspongia diffusa (Ridley) Burton
Fig. 6

This species was first studied in Hawaii on September 10, 1947, at the dock at Moku O Loe (location 6, Fig. 2). This specimen is deposited in the U. S. National Museum Register Number 22741. The species was found again on September 27, 1947, at Waialua Bay, and thereafter several times in various places in Kaneohe Bay, where it is moderately common. The shape is typically ramose, but juvenile specimens are temporarily encrusting. The branches are about 6 mm. in diameter, and often more than 12 cm. high. Three to five branches occur in the average mass. The color, in life, is dull drab with more or less lavender tinges; the more the sponge was exposed to light, the more lavender it shows. The consistency is very spongy.

The surface is superficially smooth. The pores in the protoplasmic dermis are often 40 μ in diameter. The oscules are 4 to 6 mm. in diameter, with raised rims often 3 mm. high.

The surface is covered by a network of fibers which are smaller than the fibers of the endosome and form smaller meshes. This is quite typical of *Callyspongia.* There is some ground for regarding the Hawaiian specimens as representing a new species, because unlike any other *Callyspongia* there is no coarser dermal net to include the finer one in its meshes; this is offset by the fact that there is such a net just below the surface. The endosome is a typical callyspongoid fibroreticulation.

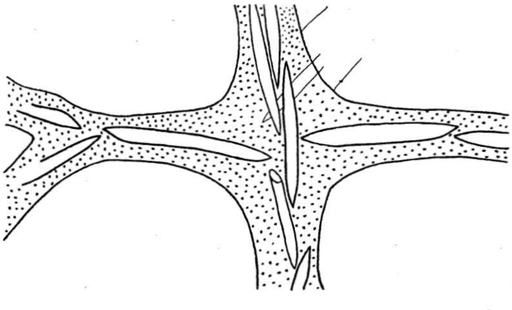

FIG. 6. *Callyspongia diffusa,* bit of the endoskeleton, × 320, showing spicules (oxeas) in spongin fibers. From a camera lucida drawing.

The dermal fibers are 10 to 15 μ in diameter, contain a single row of spicules, and form meshes that are 60 to 100 μ in diameter, usually about 75 μ. The protoplasmic dermis is in this same plane. The endosomal fibers are 25 to 35 μ in diameter in the Kaneohe specimen, about 40 μ in diameter in the one from Waialua Bay. In the latter there are several rows of spicules in some ascending fibers; in the Kaneohe specimen all the fibers have only the uniserial core of spicules. The endosomal meshes are 50 to 500 μ, often about 200 μ, in diameter, more or less rectangular. The spicules are oxeas, rather hastate; typical sizes are 4 by 100, 5 by 90, 6 by 75 μ. In one specimen I found one toxa 25 μ long. This is probably accidental, but is thought provoking in view of the similar color and shape of *Toxadocia* (p. 16) which has many toxas. *Toxadocia,* however, has a different sort of ectosome from *Callyspongia.*

Many species of *Callyspongia* are tubular in shape, with thin walls around the central hollow, which has a large distal opening. The type of the genus, *C. fallax,* is solid cylindrical, however. The species *diffusa* is perhaps best characterized by its relatively thick spicules. It was first described as *Cladochalina diffusa* by Ridley (1884: 183) from the Indian Ocean. It was subsequently recorded as *Cladochalina elegans* by Lendenfeld (1887: 770) from South Australia, as *Chalina pulvinatus* by Lindgren (1897: 481) from the Malay region, as *Ceraochalina retiarmata* by Dendy (1905: 152) from India. It is discussed, with synonymy, by Burton (1934: 541).

DAMIRIANA new genus

This genus is erected in the family Phorbasidae with the following species, *Damiriana hawaiiana,* as genotype. It should be emphasized that this is a genus with a special dermal skeleton of tylotes over an endosomal skeleton of oxeas, with arcuate chelas among the microscleres.

Within this family the genus *Damiriella* seems fairly close to *Damiriana*; all the other genera are widely different. None of the others has dermal tylotes, although such spiculation is common in the family Myxillidae.

All the others, with the dubious exception of *Iophonota,* do have echinating spicules. *Damiriella* has principal spicules that are strongyles whereas *Damiriana* has oxeas, otherwise the two are close. *Damiriella* is a rare genus, with only one species, itself rather rare, reported only from the Mediterranean coast of France.

The name *Damiriana* is selected to show plainly the resemblance to *Damiriella.*

Damiriana hawaiiana new species

Fig. 7

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22737. It was collected September 10, 1947, at Moku O Loe, in shallow water near the pier. It has been common at location 3 (Fig. 2), just inshore of the bridge over the long lagoon. It seems to grow very slowly. Several times during 1947 and 1948 bits were removed for study, and by just that much the total quantity present seems to be semipermanently reduced. In the fall of 1948 what might be a total of one or two handfuls remained.

In August, 1945, R. W. Hiatt carried out an extensive ecological survey on the south shore of the island of Hawaii, at a nearly inaccessible and therefore relatively natural and undisturbed region called Halape. He found at least one specimen of *Damiriana* growing on coral in a very exposed situation, quite in contrast to the quiet lagoon in Kaneohe Bay.

On May 19, 1948, at Kailua on the north Kona coast (west side) of the island of Hawaii I found a small, somewhat aberrant specimen of this species growing just barely below low tide.

Damiriana hawaiiana comprises first an amorphous basal region, often about the size of a hen's egg. From this, one or a few branches arise, little-finger size and shape. The color is a brilliant vermilion-red, and the consistency is soft, easily torn. The Kailua specimen was dull orange rather than flame-colored.

The surface is superficially smooth. The oscules may be terminal or lateral, may number six or more per specimen, and open as wide as 6 mm. They are conspicuously closable by a membrane which is pulled inward from all sides, maintaining the circular outline of the shrinking aperture. At least 5 minutes are required for complete oscular closure. The surface is perforate with gross pores, which in some places almost touch each other, elsewhere are far apart. Each of these, about 1 mm. in diameter, is in turn filled with a finer network, the meshes of which are barely 150 μ in diameter, 20 to 30 such openings per sieve. In places there are scattered pores, not so grouped, each about 40 μ in diameter.

The ectosome is a definite dermis, less than 100 μ thick, with its special spicules tangentially placed. The endosome is somewhat like "crumb of bread," with its special spicules chiefly in confusion, or in vague tracts about 100 μ in diameter. They often are placed so as to outline chambers, as in the genus *Myxilla.* The flagellate chambers are spherical, 25 to 40 μ in diameter. There is abundant colloidal material present.

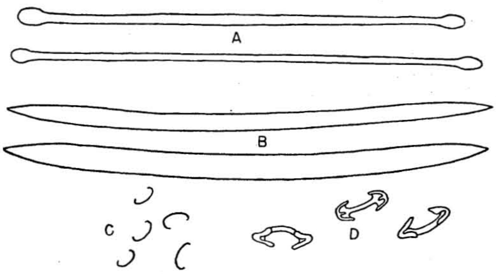

FIG. 7. *Damiriana hawaiiana,* spicules, from a camera lucida drawing, × 333. A, dermal tylotes. B, endosomal oxeas. C, sigmas. D, arcuate isochelas.

The ectosomal megascleres are tylotes, usually about 5 by 200 μ, although in one specimen, otherwise typical, they were only 4 by 170 μ. This is a minor difference. The endosomal megascleres are oxeas, usually about

8 by 200 μ, but sometimes 9 by 230. A few thicker, shorter ones, 12 by 180 μ, may be found, for example. The microscleres are of two sorts. There are abundant, commonplace, arcuate isochelas, 27 μ long. In the aberrant Kailua specimen there were also some only 15 μ long. A second category of microscleres appears to be a sort of sigma. It is C-shaped rather than S-shaped, is in one plane, not contorted. This suggests that it might be a reduced chela, and accordingly a search was made with immersion microscopy for traces of clads. At least one inward pointing clad is certainly present, perhaps three. The difficulty of being sure is due to the size of this spicule. Its chord length is 13 μ, its diameter 1 μ, the clad or clads are less than 1 μ in length, and at the widest about a third or a fourth of a micron in diameter, tapering to a point.

The species name is given in honor of Hawaii.

NEOADOCIA new genus

This genus is here erected in the family Adociidae, with the following species, *Neoadocia mokuoloea,* as genotype. It should be emphasized that this is a genus with an ectosomal skeleton of tangentially placed oxeas. overlying an endosomal skeleton of oxeas, with raphides as microscleres. This is like *Adocia* except for the addition of raphides; it is set off from all other genera in the family by the possession of these microscleres.

The generic name is selected to show the close relationship to the genus *Adocia.*

Neoadocia mokuoloea new species

Fig. 8

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22745. It was collected September 10, 1947, at a depth of about 2 meters, near the dock at Moku O Loe (location 6, Fig. 2). Only the single specimen was found. I have repeatedly searched for others but without success.

The specimen is a mass 2 by 3 by 3 cm. Two holes go right through it, perhaps caused by foreign objects about which it grew; one of these is 3 mm. and the other is 9 mm. in diameter. The color in life was golden-yellow for all the interior and much of the exterior, but externally there were rosy-red patches. The consistency is very soft.

The surface is exceptionally punctiform. It is liberally perforated by apertures 1 mm. in diameter, more than 20 per square cm. of surface, on all surfaces except the surface of attachment. It is not clear which of these apertures are inhalant and which exhalant, unless it may be that all are pores, and the two large openings mentioned above may be the oscules. It would be interesting to have additional specimens and so be able to ascertain more of the structure of this species.

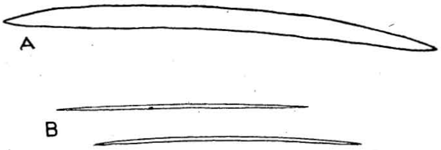

FIG. 8. *Neoadocia mokuoloea,* spicules, from a camera lucida drawing, × 444. A, megasclere (oxea). B, microscleres (microxeas), or raphides.

The ectosome contains a tangent dermal skeleton of smooth diacts, over subdermal spaces. The endosome is cavernous, with an isodictyal reticulation of smooth diacts and few or no spicule tracts at all. The megascleres are all smooth oxeas, 6 by 120 to 6 by 135 μ. The microscleres are commonplace raphides, about 0.5 μ thick, but upwards of 100 μ long.

Adocia baeri occurs in the Philippine Islands. It was first described as *Reniera implexa* variety *baeri* by Wilson (1925: 398) and made a species by de Laubenfels (1936: 328). This *Adocia* is very different from *mokuoloea* in appearance, being nearly black. It contains a few very thin spicules, but these may merely have been juvenile forms of the megascleres, inasmuch as they are uncommon. There seems to be no way to discriminate between such immature forms and clear-cut raphides, unless the latter are so numerous that it is unlikely that they are juveniles. If it should happen, as I believe unlikely, that *baeri* has genuine raphides, then it should be transferred from *Adocia* to *Neoadocia.* This transfer is not here made.

The name of this new species is derived from its type locality, the island of Moku Ō Loe.

Toxadocia violacea new species

Fig. 9

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22752. It was collected November 3, 1947, at Moku O Loe, at a depth of 1 meter, in the long pool near location number 3 in Figure 2. This species was also found growing in numerous places on dead coral throughout Kaneohe Bay, but not on the leeward side of Oahu. On the island of Hawaii I found it in at least two places near Hilo, which is on the windward side of that island.

This species is basically encrusting, but the numerous oscules are raised on little hillocks about 1 cm. high. Some projections are so long (15 mm.) but so narrow (3 mm.) as to resemble fistules. Few colonies reach the size of the palm of the hand or a basic thickness of as much as 1 cm. The color is a vivid violet and the consistency is soft and fragile.

The surface of *Toxadocia violacea* is smooth, provided with a translucent dermis over extensive subdermal cavities. The pores in this dermis are abundant, contractile, about 30 μ in diameter. The openings that lead down from the floor of the subdermal cavity are rather more conspicuous than those in the dermis, being readily visible through it. They are less numerous and are about 150 μ in diameter. The oscules are about 3 mm. in diameter, and are often raised 8 to 16 mm. above the surface on rounded projections.

The dermal membrane is full of spicules tangentially arranged, but in little more than one single layer. The endosome is microcavernous, permeated by an isodictyal reticulation of spicules.

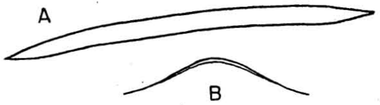

FIG. 9. *Toxadocia violacea,* spicules, from a camera lucida drawing, × 444. A, oxea. B, toxa.

All the megascleres are smooth oxeas, about 4 by 120 μ. A few are larger, especially in the specimens from Hilo, where a size of 7 by 140 μ is sometimes reached The microscleres are toxas, 1 by 60 μ. Some thin, straight spicules may be raphides, or juvenile megascleres, or merely edgewise views of toxas; they are not regarded as worthy of emphasis.

There are seven other species which have been assigned to the genus *Toxadocia.* Two, *toxius* and *toxophorus,* are East Indian, and one might expect them to be the most like this Hawaiian species, but such is not the case. Each has, for example, a very peculiar type of toxa which differs from those of all others in the genus. Two species from the tropical Atlantic, *abbreviatus* and *tener,* have megascleres that are many times larger than those of the Pacific species. One from Great Britain, *fallax,* has large spicules, but not nearly so large as those from farther south. There are two Arctic species, *primitivus* and *proximus,* and these have still smaller megascleres, and approach closest of all to the Hawaiian *Toxadocia.* Their toxas are much larger, however, and they and all other hitherto described members of this genus are recorded as yellow in color. Emphasis is laid here on the spicule differences and, particularly, on the color. The species name *violacea* is derived from the violet hue of this sponge.

Myxilla rosacea (Lieberkühn) Schmidt

Fig. 10

This species is represented in the fauna of Hawaii by only two known specimens; both were collected at Moku O Loe in Kaneohe Bay. The first specimen was taken September 10, 1947, at a depth of 1 or 2 meters, on pilings at the dock (location 6, Fig. 2). This is deposited in the U. S. National Museum, Register Number 22734. A second was found January 10, 1948, in the sluice-way from one of the small lagoons (location 4, Fig. 2).

This sponge is massive. Our specimens are each fist-size, but much of the bulk is due to contained lumps of dead coral. The color in life is bright orange-red, paler in the interior. The consistency is slightly spongy, not especially remarkable. The surface is slightly and irregularly lumpy. There is a conspicuous translucent dermis pierced by microscopic contractile pores; through it the larger canals that lead into the sponge from the floor of the subdermal space are easily seen. These openings are about 0.3 mm. in diameter and 1.2 mm. apart. The oscules are few and scattered, about 6 mm. in diameter, and closable by very thin membranes.

The ectosome is packed with special dermal spicules arranged tangentially. The endosome is cavernous, "crumb of bread" type, with the skeleton in "log cabin" or modified isodictyal arrangement about small gross chambers.

The ectosomal spicules are smooth-shafted tornotes; their ends are just faintly microspined, their size about 3 by 160 μ. The endosomal spicules are acanthostyles, 8 by 140 μ. The microscleres include anchorate isochelas, approaching the unguiferate type but only 15 μ in total length, and also commonplace sigmas, 18 to 30 μ in chord length.

This species was first described from Europe, as *Halichondria rosacea,* by Lieberkühn (1859: 521). It was transferred to *Myxilla* (genotype) by Schmidt (1862: 71). It is abundant throughout Europe, on both the Mediterranean and Atlantic coasts, but appears to be absent from the Americas.

The European specimens and these from Hawaii agree rather closely. The former have isochelas that are often nearly twice as large as those of the latter, but this is scarcely a specific difference in view of the other similarities.

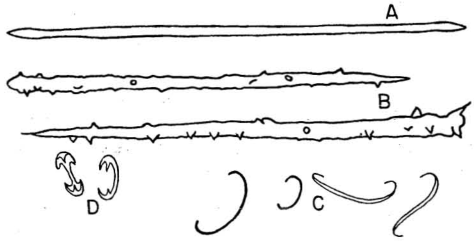

FIG. 10. *Myxilla rosacea,* spicules, from a camera lucida drawing, × 444. A, dermal tornotes. B, endosomal acanthostyles. C, sigmas. D, anchorate isochelas.

In reviewing the very numerous species of the genus *Myxilla* with a view to identifying the Hawaiian specimen, various items become noteworthy. The genus *Burtonanchora* de Laubenfels (1936: 94) was established for certain species formerly in *Myxilla* but differing chiefly in that they have only smooth spicules, and thus passing over into the family Tedaniidae. Perplexing intermediate forms, having spicules that are only very slightly spined, exist; yet for convenience, if nothing else, the division is worth maintaining. The following additional species are now taken out of *Myxilla* to go into *Burtonanchora: M. acribria* de Laubenfels, *M. cribrigera* Ridley and Dendy, *M. mollis* Ridley and Dendy, and *M. novaezealandiae* Dendy. Two species, *D. inaequalis* and *D. simplex,* first put in *Dendoryx* by Baer, are also placed in *Burtonanchora.*

Four others appear to require transfer from *Myxilla* into the related genus *Lissodendoryx*. They are *M. behringensis* Lambe, *M. cratera* Row, *M. firma* Lambe, and *M. pygmaea* Burton.

Topsent (1893: xxiv) described a sponge from the Mediterranean coast of France as *Myxilla arcitenens.* The megascleres and chelas are like *Myxilla,* but unlike this genus there are not (as usual) sigmas, and there are (as never in *Myxilla*) raphides and toxas. This is clearly not *Myxilla.* If there were no chelas it would fit *Achiliderma.* Because there is no genus now set up for this sponge, a new one is required, and is established as:

QUINTOXILLA new genus

This genus is assigned to the family Myxillidae, genotype *Myxilla arcitenens* Topsent. The holotype location is unknown to me; Professor Topsent told me personally that he rarely kept or deposited specimens. This is a genus with smooth dermal diactinal or sometimes inequiended spicules, and a principal skeleton of acanthostyles. The microscleres are isoschelas (presumably, but not certainly, anchorate) and toxas. Raphides may be among the microscleres, but this is not emphasized here. The name is arbitrary, not descriptive, suggested however by the emphasis upon the toxas of the spiculation.

NANIUPI new genus

This genus is erected in the family Myxillidae, subfamily Grayellinae, with the new species *Naniupi ula* as genotype. It should be emphasized that this is a genus with ectosomal acanthoxeas, endosomal smooth styles, and echinating acanthostyles. The microscleres include arcuate chelas. The genotype also has peculiar sigmoid microscleres. The genus name is derived from the native Hawaiian language, "nani" meaning beautiful and "upi" meaning sponge.

The subfamily Grayellinae is characterized by spiny diacts over smooth monacts. The type genus, *Grayella,* has similar ectosomal acanthoxeas to those of *Naniupi,* as very few sponges do, but the endosomal spicules of *Grayella* are smooth tylostyles with no echinating spicules or microscleres. Brøndsted (1932: 14) described a sponge from east of Iceland as *Grayella akraleitae.* This has a spiculation of lumpy styles echinated by acanthostyles, with arcuate chelas as microscleres. This cannot be a *Grayella,* but belongs in the family Microcionidae in which, however, a new genus is required for its reception, and is here established as:

RAMOSICHELA new genus

This genus is assigned to the family Microcionidae, genotype *Grayella akraleitae* Brøndsted. The location of the holotype is not known to me. This is a genus for sponges with a principal spiculation of styles not smooth, in tracts that are echinated by acanthostyles; there are also arcuate isochelas. Within this family all the other genera have one or more categories of smooth megascleres except the genus *Ramoses,* which has no microscleres but is otherwise much like *Ramosichela. Ramoses* is exclusively Antarctic and sub-Antarctic whereas *Ramosichela* is Arctic or sub-Arctic. The genus name is derived from that of this related genus, *Ramoses.*

To continue with an analysis of the subfamily Grayellinae, de Laubenfels (1936: 88) puts *Crellomyxilla* here, but upon further consideration it is thought preferable to transfer this genus to the family Microcionidae, subfamily Yvesiinae. *Tethyspira* has been put in the Grayellinae with some doubt, and is, still doubtfully, left there. It has small acanthostrongyles that may be regarded as dermal; its main spicules are large smooth styles. A fourth genus belongs in this subfamily, on the basis of published descriptions, but as it too is unnamed it is here named as follows:

QUINDESMIA new genus

This genus is assigned to the family Myxillidae, subfamily Grayellinae, genotype *Hymedesmia inflata* Bowerbank (1874: 245, pl. 79). The holotype is probably in the British Museum of Natural History. This is a genus for sponges with special ectosomal acanthoxeas and endosomal smooth monaxons echinated by acanthostyles, but without microscleres. It is reported only from Great Britain and is evidently quite rare. The name is arbitrary rather than descriptive.

Thus it appears that there are now four genera in the Grayellinae, of which *Naniupi* is the only one to have microscleres.

Naniupi ula new species

Fig. 11

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22740. It was collected January 10, 1948, in Kaneohe Bay, at a depth of about 2 meters, growing on dead coral. On February 19, 1948, a similar specimen was dredged from a depth of about 50 meters, in the open ocean about 3 kilometers south of Pearl Harbor, on the opposite side of Oahu from Kaneohe Bay.

This rather uncommon sponge is a paper-thin encrustation, spreading indefinitely laterally. The type specimen came from a colony that covered an area about as large as a human hand, of very irregular outline due to the deeply sculptured mass of dead coral on which it grew. The color in life is a distinctive vivid carmine-red. The consistency is obscured by the extremely thin habitus.

The surface of *Naniupi ula* is smooth and lipostomous. The ectosome is a well-marked dermis, packed with a felted mass of tangentially arranged acanthoxeas. The endosome is dense, with its spicules in some confusion.

The special dermal acanthoxeas are about 4 by 110 μ. The endosomal megascleres are chiefly smooth styles about 4 by 190 μ. A few of these are pseudoxeas. In the deepest portions are a few echinate spicules, acanthostyles 7 by 130 μ. The principal or only microscleres are abundant, rather typical arcuate isochelas, 21 μ in total length. At least in the type specimen a few other spicules occur that seem, at first glimpse, to be microscleres. They are only about 1.5 μ thick, 80 μ long, very faintly microspined, and four times curved like two S-shaped sigmas end to end. There are, however, other similar spicules that are nearly straight, and these latter give evidence of being juvenile forms of the dermal acanthoxeas. The much curved spicules may be malformed examples of the same juvenile sort, but their occurrence is noteworthy. As additional specimens are found, this type of spicule should be looked for. I do not find them in the specimen collected south of Oahu.

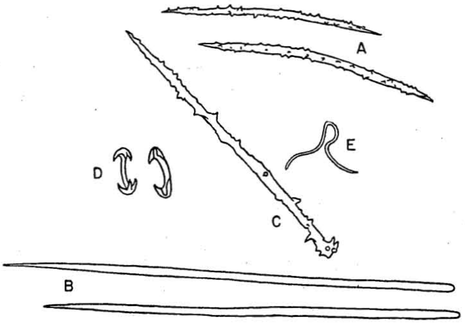

FIG. 11. *Naniupi ula,* spicules, from a camera lucida drawing, × 333. A, dermal acanthoxeas. B, endosomal styles. C, echinating acanthostyle. D, arcuate isochelas. E, peculiar contort microsclere.

The species name is derived from the native Hawaiian word for red, because of the brilliant color of this species.

HIATTROCHOTA new genus

This genus is erected in the family Tedaniidae with the following species, *Hiattrochota protea,* as genotype. It should be emphasized that this is a genus with smooth strongyles as special ectosomal spicules, smooth styles as endosomal megascleres, and birotulates or amphidiscs among the microscleres, without chelas.

The genus *Iotrochota* may be regarded as a sort of nomenclatorial parent for all the marine Demospongiae having amphidiscs. Such spicules are common in the fresh water sponges (subfamily Meyeniinae) and in the order Amphidiscophora of the Hyalospongiae. As more and more species were put in *Iotrochota* for this reason, it became evident from their other characteristics that they actually belonged to several families. The type of *Iotrochota (birotulata)* is in the Desmacidonidae. In 1936 de Laubenfels took out many species, establishing from them the genera *Hymetrochota* and *Iotroata* in the Myxillidae, and *Iotaota* in the Tedaniidae. *Hiattrochota* is also in this latter family. The two myxillids have megascleres typical of that family; *Hymetrochota* has only amphidiscs for microscleres, *Iotroata* also has unguiferate chelas. Of the tedaniids, *Iotaota* matches the latter, with both amphidiscs and unguiferate chelas as well as megascleres typical of the family. *Hiattrochota* matches *Hymetrochota,* with only amphidiscs as microscleres, but megascleres typical of Tedaniidae.

The terminus of the new generic name follows the pattern as used for the comparable genera, but the distinctive prefix is given in honor of the eminent zoologist, Robert W. Hiatt.

Hiattrochota protea new species

Fig. 12

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22750. It was collected December 22, 1947, at Moku O Loe, at a depth of about 1 meter, in a sluiceway (location number 4, Fig. 2). Another specimen was collected May 16, 1948, at Kaalualu, near the south end of the island of Hawaii. Yet a third slightly different specimen was collected May 17, 1948, at Honaunau on the Kona coast of the island of Hawaii.

This species is massive, about fist-size, and in life is velvety black. The spirits in which it is preserved are stained dark brown, but the sponge retains its hue. The consistency is somewhat elastic, not remarkable.

The surface is rather smooth, most of the pores having quickly contracted. A few openings about 1 mm. in diameter are dubiously regarded as unclosed pores. The oscules are 1 to 3 mm. in diameter and characteristically each is situated at the summit of a rounded dome or lobe, more than 1 cm. in diameter, but only about half as high.

The ectosome consists of a definite dermis over subdermal spaces, but is much less flesh-

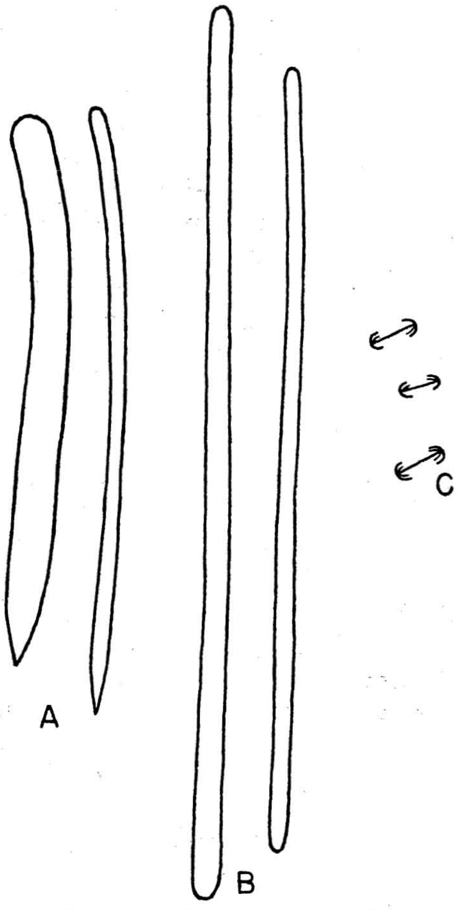

FIG. 12. *Hiattrochota protea,* spicules, from a camera lucida drawing, × 666. A, endosomal styles. B, ectosomal strongyles. C, amphidisc or birotulate microscleres.

like than that of *Iotrochota.* The endosome is microcavernous with a skeleton that approaches the isodictyal condition, very much as in *Tedania.* There are a few vague spicular tracts, about 50 μ in diameter in the type specimen but somewhat more than twice as thick in the second specimen. The latter grew on the beach of the open ocean, whereas the type was in calm water; this probably accounts for the difference.

The ectosomal spicules are smooth strongyles 3 by 140 to 6 by 205 μ in size. The endosomal spicules are smooth styles 7 by 135 to 10 by 180 μ in size. Both sorts are consistently a little larger in the Kaalualu specimen. Both sorts are somewhat thicker, up to 12 μ, in the Honaunau specimen. The microscleres are amphidiscs. Their length is 12 to 13 μ in the type specimen, 15 μ in both others. There are often only four clads at each end in those of the type specimen, usually more clads in the corresponding spicules of the other two specimens. In the type specimen the clads are less strongly recurved. In the Honaunau specimen, as in many hyalospongoid amphidiscs, the shaft is visibly spiny.

The species name is given because this is the first of the genus.

Tedania ignis (Duchassaing and Michelotti) Verrill

Fig. 13

This species is very common throughout the shallow waters of Hawaii including Kaneohe Bay. It is represented by a specimen collected at Moku O Loe from coral, near the pier (location number 6, Fig. 2). This specimen is deposited in the U. S. National Museum, Register Number 22744.

This species is basically encrusting, with the oscules often so elevated that chimneys as tall as 4 to 7 cm. result, yet these chimneys are usually less than 1 cm. in diameter, hollow, and thin-walled. Specimens are sometimes as large as a hand, more often somewhat smaller. The color is bright vermilion where the sponge tissue grew in brilliant illumination, but more orange, even to yellow, in proportion to the amount of shade in which the sponge grew. The consistency is soft and the sponge easily torn or compressed.

The surface is smooth, with abundant, very contractile pores. The oscules are from 2 to 7 mm. in diameter, often raised in the form of tubes. The ectosome is a definite dermis, over subdermal spaces, and is packed with special spicules, not always horizontal but instead in many orientations; some clusters are actually perpendicular to the surface. The endosome is finely cavernous, somewhat "crumb of bread" style, with its spicules in quite confused arrangement.

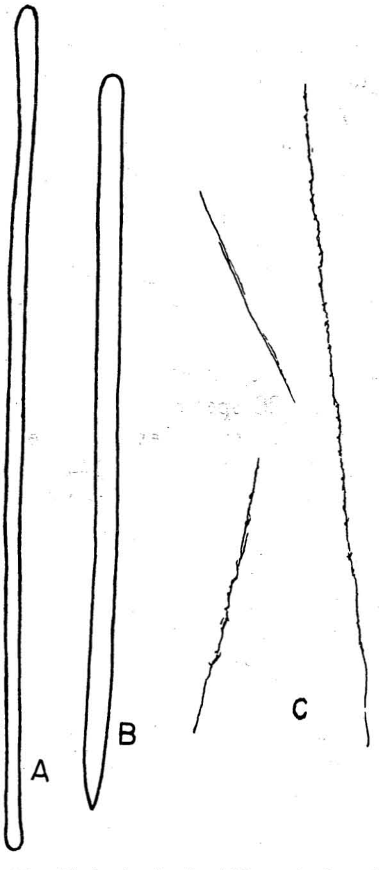

FIG. 13. *Tedania ignis* (?), spicules, from a camera lucida drawing, × 666. A, dermal tornote. B, endosomal style. C, microspined raphides.

The special dermal spicules are usually regarded as tylotes, but the ends are so minutely enlarged that the spicule at first seems to be a strongyle and often really is a strongyle. It is rather that there is a very slight constriction near the end of each spicule than that the end is actually swollen. On each extreme tip of these spicules there are a number of very fine spines. These spicules nearly all range in size between 3 by 180 and 4 by 210 μ. The principal spicules are smooth styles, often curved a little, and range from 6 by 160 to 8 by 210 μ. The abundant microscleres are peculiar microspined raphides, usually less than 1 μ in diameter, but occasionally as thick as 2 μ with total lengths up to at least 200 μ.

Within the genus *Tedania* there are some 45 names, besides others that have been transferred to other genera. Some of the 45 are clearly synonyms, but others arouse serious questioning. There are some well-marked differences. One group of three or four species has two distinct categories of microscleres. On the west coast of North America two species (or is it all one?) have tylostyles instead of styles for principal spicules. Some deep-water species have enormous spicules and distinctive, symmetrical habitus. There remain about 20 species that differ in color and in having spicules a little larger or smaller. Burton (1932: 344) and also Burton and Rao (1932: 353 and following) argue that all these are conspecific and call them all *Tedania nigrescens*, which then would become an amazingly cosmopolitan species. Perhaps some further analysis is in order, and, in particular, color may be quite significant.

The genus *Tedania* was established by Gray (1867: 52) for *Reniera digitata* Schmidt (1862: 75) and *Reniera ambigua* Schmidt (1864: 39). The former was shown to be a synonym of *Reniera nigrescens* Schmidt (1862: 74) and the type is assumed by Burton and others to be called *nigrescens*. This designation was made official by de Laubenfels (1936: 89). Topsent (1939: 5) pointed out, however, that *digitata* and *nigrescens* both fall to the earlier *Halichondria anhelans* Lieberkühn (1859: 522). This species, under various names, is well known from the Mediterranean, where it seems to be the only *Tedania*. It is regularly and consistently described by the various authors as being black or nearly so; some say very dark blue, some say very dark green. I have not found these colors in the field or in the literature from other parts of the world. It may be that the Mediterranean form is well characterized by color. Burton and Rao have implied, but without actual data, that it has similar spiculation to West Indian *Tedania*. On the other hand, published descriptions show that the Mediterranean *Tedania* has the endosomal styles two to seven times as thick as the ectosomal tornotes. I find, in very numerous specimens, no such difference in West Indian *Tedania*, in which the thickness varies from the same to one and one-half times that of the tornotes.

The West Indian form, which I am convinced is specifically distinct from *anhelans*, was first named *Thalysias ignis* by Duchassaing and Michelotti (1864: 83) and transferred to *Tedania* by Verrill (1907: 339). It is regularly brilliant red, almost spectral red, but tending a little toward vermilion. I have examined thousands of specimens, and found extreme uniformity.

Numerous species names for *Tedania* have been established for forms occurring in the East Indian region. These all have spicules thicker than those of *ignis*; they vary from slightly longer to one and one-half times as long. The colors are usually cited as yellow, in a few cases tending toward red.

The allocation of the Hawaiian *Tedania* must be regarded as provisional; I do not feel that its position can be settled at present. If the attitude of Burton and Rao is adopted, it is *Tedania anhelans*, and so are a score of other forms. In color it is like the East Indian species, unlike typical *Tedania ignis*; but in spiculation it is indistinguishable from *ignis*.

Tedania ignis gives a pronounced irritation to most people who touch it (those with very calloused hands are safe). This irritation includes a reddening of the skin, swelling, extreme tenderness to the touch, and lasts 3 to 7 days. I obtained such an irritation from the Hawaiian *Tedania*, and this has influenced me in making my provisional identification.

The correct name of the East Indian species is doubtful too—an additional reason for hesitating to synonymize on the basis of a dubious resemblance. The oldest name that may possibly be available is *Spongia macrodactyla* Lamarck (1814: 458), but its use is beset with difficulties. Its locality is not certainly known; Lamarck himself was not sure, but thought it might be East Indian. Topsent (1933: 13) redescribes Lamarck's material, showing a spiculation like *Tedania*, but he adds that the skeleton is mostly keratose, and his photograph shows a general appearance that might well be that of a keratose sponge. Such forms often contain foreign spicules. If this one had no spiculiferous neighbors except *Tedania*, it might contain only *Tedania* spicules. If the spicules are proper, this is a peculiar *Tedania* because of its large spongin content.

Thiele in 1903 described four species of *Tedania* from the East Indies (Ternate, in the Molucca Sea). These are *reticulata* (p. 946), *coralliophila* (p. 946), *meandrica* (p. 947), and *brevispiculata* (p. 947). The differences in spicule size which Thiele emphasizes are within the range of individual variation and we may be confident that these, all from the one locality, are conspecific, to be known as *Tedania reticulata*. I wish to record at this time, that further studies in the East Indian region may bring about a decision to include the Hawaiian *Tedania* with *reticulata*, rather than with *ignis*. Undoubtedly some authors would designate the Hawaiian form as a new species and perhaps this may ultimately prove to be necessary.

KANEOHEA new genus

This genus is erected in the family Psammascidae with the following species, *Kaneohea poni*, as genotype. It should be emphasized that this is a genus (like all in the family) with a principal skeleton of foreign material, to which are added strongyles, oxeas, styles, and raphides. The genus which is most similar is *Holopsamma*, which has strongyles and styles but not the oxeas and raphides. Oxeas and raphides are each quite unusual in this family.

The generic name is given in honor of Kaneohe Bay.

Kaneohea poni new species

Fig. 14

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22751. It was collected January 10, 1948, at a depth of 1 meter, growing on dead coral in Kaneohe Bay. Only the one small specimen has so far been found, but it might be sought in the future with some interest.

This specimen is a thin encrustation, about the size and thickness of a shilling or quarter-dollar. The color in life was a brilliant, gaudy purple, one of the most conspicuous color notes one may hope to find. The consistency is mediocre. The surface is smooth, and, as might be expected, the specimen is lipostomous.

There is just the thinnest of fleshy ectosomes, less than 10 μ thick, which is very easily destroyed by handling. The endosome is packed with sand grains that are about 30 to 60 μ in diameter—so small that they would easily be swept about and carried in water currents. In among these grains there is an isodictyal proper skeleton, with some uniserial spicule tracts.

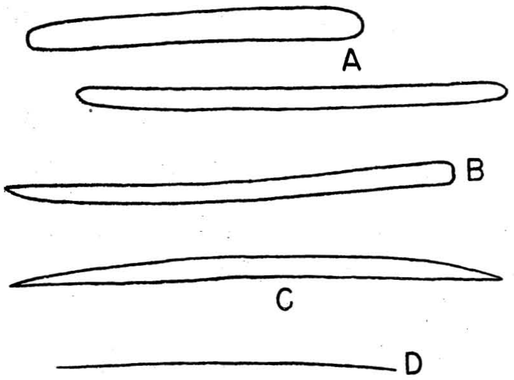

FIG. 14. *Kaneohea poni,* spicules, from a camera lucida drawing, × 666. A, strongyles. B, styles. C, oxea. D, raphide.

The spicules show little or no localization, but all three kinds of megascleres make up the reticulation, well mixed. The strongyles are about 5 by 90 μ, the styles 4 or 5 by 120 μ, the oxeas also 5 by 120 μ. The raphides are about 0.5 by 90 μ.

The species name is derived from the Hawaiian word for purple.

Mycale cecilia de Laubenfels

Fig. 15

This species is very common in Hawaii, widely scattered in shallow water locations. Its greatest abundance, however, seems to be in Honolulu Harbor and in Pearl Harbor. The first specimen that I found in Kaneohe Bay was at Moku O Loe, November 3, 1947; this is deposited in the U. S. National Museum, Register Number 22747. It occurred as a large encrustation on a mangrove shoot at location 2 in Figure 2. By December 22, 1947, the whole sponge had disappeared, although I had carefully left most of it *in situ,* and the location was one that would be most easily kept track of and found again. Nor have I been able to find it in that vicinity since. This may have some connection with a reproductive cycle.

This species is encrusting, often about 0.5 to 1 cm. thick. The above mentioned Moku O Loe specimen covered a mangrove shoot that was some 40 cm. long. The multitude of colors of this species requires further discussion below. The consistency is softly spongy.

The surface is fairly smooth, with many minute, contractile pores. The oscules are about 200 μ in diameter, but they too are difficult to measure because of their contractility and small size at greatest opening.

The ectosome is a definite dermis over extensive subdermal cavities. The endosome is a reticulation of spicular tracts 30 to 120 μ in diameter, often about 65 μ in diameter. Each is packed with spicules, and may possibly, but not certainly, contain spongin. Distally, each ends in a tuft or brush. There are astonishingly few interstitial megascleres.

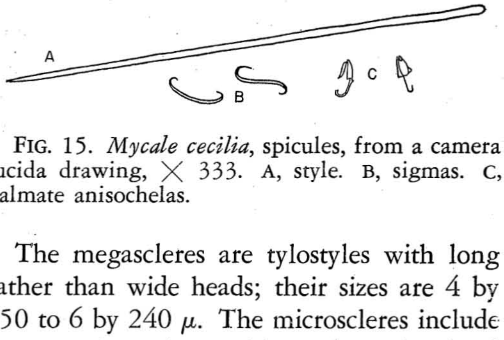

FIG. 15. *Mycale cecilia,* spicules, from a camera lucida drawing, × 333. A, style. B, sigmas. C, palmate anisochelas.

The megascleres are tylostyles with long rather than wide heads; their sizes are 4 by 250 to 6 by 240 μ. The microscleres include commonplace sigmas 30 to 42 μ in chord length, and palmate anisochelas. These latter are very narrow, so that in boiled-out spicule preparations all lie on their sides. Profile views are thus common but what one may call "face views" are rare and difficult to find. In most specimens these spicules are only 15 μ long, but in some specimens they range to at least 24 μ. I found none in rosettes.

There are close to a hundred species names left in *Mycale,* even after the partitioning of the genus undertaken previously (de Laubenfels, 1936: 118). Only about 25 of these, however, have tylostyles rather than the usual styles as megascleres. The additional factor of very narrow anisochelas reduces the number still further.

Duchassaing and Michelotti (1864: 89) described *Pandaros angulosa,* and de Laubenfels (1936: 116) shows that it is a *Mycale.* This is a common West Indian species, and its spiculation is practically identical with that of the specimens which are now under consideration. It is, however, one of the fairly numerous species of *Mycale* that have the following distinctive characteristics: they are extremely coarse with gross chambers upwards of a centimeter in diameter; the flesh and skeleton are largely restricted to the trabeculate partitions. Upon handling a specimen, there is copious production of colloidal slime. I have observed a head-size specimen literally fill a tub with its exudate within 12 hours. *Mycale angulosa* itself has a pronounced tendency to assume a hollow or vasiform habitus.

In a study of the sponges of Panama, de Laubenfels (1936: 447) reported from the Pacific side, at Panama City, intertidal, the new species *cecilia.* This has a spiculation like that of *angulosa* and like our Hawaiian *Mycale,* but this species is encrusting, fine-grained, with few or no gross cavities even as much as 1 mm. in diameter, and scarcely a bit of colloidal exudate upon handling. But for the spicules, one would not consider *cecilia* and *angulosa* to be even in the same family.

The identification of the *Mycale* from Hawaii is complicated by the peculiar color situation. The Panama specimens of *cecilia* were all green, one of the few colors never shown by the Hawaiian specimens. Furthermore, in July and August, 1933 (when I studied it in the field), it was thickly beset with bright red embryos about 200 μ in diameter. These showed plainly in a specimen held 2 meters away—a bright green but red-speckled and thus curiously conspicuous sponge. In contrast, the Kaneohe specimen above described was a mottled patchwork of pink and lavender. In November, 1947, it was loaded with yellow embryos, 600 μ in diameter, and these did not show at all from the surface, but were all in a layer at the base of the sponge and adjacent to the mangrove tissue upon which it was growing. May not such differences in size and color of embryo and color of adult tissue indicate specific difference? Yet this is further complicated by the finding in October and also in March of yellow to orange colored specimens devoid of embryos.

Just as a surmise, a hypothesis to be checked by later field observation, one may wonder if the young embryos are red, changing to orange and then yellow as they enlarge, and if perhaps the young sponge is yellow, then pale orange, then pink, and at last lavender just when reproducing. It may die after giving off a large number of embryos, at an age between 1 and 2 years. This is not groundless surmise, as it is also partially confirmed by some observations of mine upon related species at Bermuda. The green color found at Panama might well be due to the presence of algal symbionts.

Zygomycale parishii (Bowerbank) Topsent

Fig. 16

This species was first collected from Kaneohe Bay at Moku O Loe, on the shore of the harbor, north of location 6 (Fig. 2) at a depth of 2 meters. This specimen is deposited in the U. S. National Museum, Register Number 22735. It is one of the commonest species at Moku O Loe, but rare or absent elsewhere in Kaneohe Bay. It is extremely abundant as a growth on vessels that remain for a year or so at harbor on the lee side of Oahu, as revealed by study of ship bottoms in the dry-docks at Pearl Harbor.

This is a somewhat ramose sponge; there is an amorphous basal mass from which long processes arise. These processes are extremely irregular in cross section and in long section, too. This is another species of many colors. Probably the commonest is a dull reddish or brownish-purple. Individual specimens are often polychrome, gradually shading into different hues here and there without apparent relationship to ecological factors or anything else. A few specimens are bluish-violet to gray. The first collected was definitely orange. I found no green, yellow, black, white, or any brilliantly colored specimens of this sponge. One might say that the color ranged from dull orange through mahogany-brown to dull lavender. The consistency is spongy. If any considerable quantity is available, say a good handful, one may discover that this species has a definite odor. I have never found a similar fragrance in any other sponge, nor failed to find it in *Zygomycale*—some half a dozen times that a large quantity was at hand. This odor is strongly reminiscent of linseed oil, also faintly suggestive of fresh-cut grass, not like phosgene, but much more like old, oxidizing linseed oil.

The surface of this species is rather smooth but not level, and has a very characteristic speckled or punctiform appearance by which one soon comes to recognize it. This is due to a dermal network of fibers. The latter are minute, only about 5 to 10 μ thick, and the meshes are 65 to 100 μ in size. However, even when the unaided eye cannot resolve the individual pores or fibers, the over-all appearance can be recognized. The oscules are about 2 or 3 mm. in diameter, often provided with thin, raised rims. They are uncommon and rather difficult to find among obviously accidental surface openings.

The ectosome is a definite dermis over extremely widespread, nearly omnipresent subdermal spaces which may be as much as 0.5 mm. high. It contains the special network already mentioned. The endosome contains a coarser, but still rather fine-grained, network of fibers; these fibers are upwards of 50 μ in diameter and contain about 15 spicules per transverse section. At their distal terminations they splay out into dermal brushes or tufts.

The megascleres of *Zygomycale* are of one

FIG. 16. *Zygomycale parishii,* spicules, from a camera lucida drawing, × 666. A, styles. B, larger sigma. C, smaller sigmas. D, toxas. E, raphides. F, larger palmate anisochelas. G, smaller palmate anisochelas. H, palmate isochelas.

kind only, a subtylostyle with such a vague neck constriction that it is barely perceptible; therefore they often give a first impression of being styles. The microscleres are extremely diversified. Only the genus *Acarnus* can match this one for diversity of small spicules. There are large palmate anisochelas, 40 to (more usually) 48 μ long, and often grouped in rosettes, small ends together in the center of a spherical arrangement of the larger ends. There are medium-sized palmate anisochelas, 18 to 20 μ long. There are minute palmate isochelas only 10 μ long. There are two sizes of sigmas—the larger, 5 μ in diameter and from 75 to as much as 90 μ in chord length; the smaller, 25 to 30 μ in chord length, and only 1 or 2 μ thick like most sigmas. There are toxas 30 μ long, and, rarely, also raphides barely 10 to 15 μ long. They may be more common than first appears, but often overlooked because of their minute size—they are hardly as much as 1 light-wave in diameter.

The genus *Zygomycale* was established by Topsent (1930: 431). The genotype is here designated as the sponge which was first described as *Raphiodesma parishii* by Bowerbank (1875: 283), the name here selected with some misgivings for the Hawaiian *Zygomycale.* Topsent transferred three other species names to his new genus, but two additional ones still require such transfer. They are the species first described as *Esperella ridleyi* by Lendenfeld (1888: 211) and that described as *Esperella crassissima* by Dendy (1905: 160). The original description of *parishii* by Bowerbank is utterly inadequate, and its use here rests entirely upon this circumstance. Burton and Rao (1932: 328) state that it is their opinion that *parishii* and several others now in *Zygomycale* are all conspecific. It is probable that Bowerbank's specimen of *parishii* is in the British Museum; therefore it is probable that Dr. Burton examined it. It is further probable that he really did find it to be conspecific with the others because of his treatment thereof, above mentioned. If so, *Zygomycale* is monospecific. All the records have been from the eastern part of the Indian Ocean, the East Indies, and Australia; therefore the possibility of conspecificity is great. Thus there may be a link between the East Indian fauna and that of Hawaii, evidenced by the occurrence here of *Zygomycale parishii.*

Hymeniacidon chloris new species

Fig. 17

The holotype of this species is here designated as spirit-preserved specimen, U. S. National Museum, Register Number 22738. It was collected September 11, 1947, at Moku O Loe, from a depth of 1 meter (location number 1, Fig. 2). It is fairly common at that one locality but has not been found anywhere else as yet.

This species forms masses ranging from the size of a hen's egg to that of a small fist. Numerous tapering projections 1 to 2 cm. high and 6 to 14 mm. thick occur. The color is a medium dark green; the consistency is soft, somewhat spongy, but also rather fragile.

The surface is minutely tuberculate. The oscules are 1 to 2 mm. in diameter, usually at the summit of one of the above-described processes, and are readily closed by the sponge within less than 5 minutes after removal from the water. The pores are even more rapidly closed. They are often in groups of 8 to 12, separated by only very thin strands; these groups are about 200 μ in total diameter.

The ectosome is fleshy, contractile, a true dermis, perhaps 15 μ thick. The endosome is rather dense, and is packed with spicules. The latter are sometimes loosely organized into strands; more have their points toward

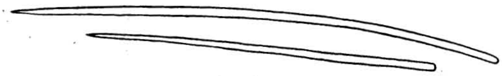

FIG. 17. *Hymeniacidon chloris,* spicules (styles), from a camera lucida drawing, × 296.

the surface than any other orientation, but many are strewn in confusion.

The spicules are exclusively styles, chiefly 5 by 300 to 7 by 400 μ in size. A few that are much smaller may be immature.

One hesitates to erect a new species in a genus that, like this one, has fifty names in it already, especially since these are all so much alike in description. On the other hand, this genus has only a few of those traits to which we look for specific separation; were we to consider others, such as chemical composition, serological reaction, and physiological processes, we might find that there really are more diverse species within it than are now suspected. The emphasis is here laid on the green color. Bowerbank (1874: 191) established the name *Hymeniacidon plumiger* for two British specimens that he said were green in preservative; what they were in life is unknown. He may have overlooked microscleres; therefore we are not sure that these specimens were even of the genus *Hymeniacidon.* Their styles were only 4 by 234 μ. Since Bowerbank's report, no one seems to have found any further specimens to match his description; therefore *plumiger* is not an important species name, and, except for this dubious record, the color is unique in the group. Except for the color, *chloris* is much like *Hymeniacidon heliophila,* which is abundan on the Atlantic coast of North America. It must be realized that green color may be due to contained algal symbionta; even so, that a species should specialize in symbiosis may be a valid criterion.

It appears that there are the following valid species of *Hymeniacidon* in the world: a yellow one, *caruncula,* in the Mediterranean and north to England; a deep red one, *sanguinea,* from England on north (some experts would synonymize these, but I found them both at Plymouth, England, and definitely decided they were not conspecific); an orange species, *heliophila,* from the Arctic to the West Indies in the West Atlantic; a yellow species, *sinapeum,* which is practically undistinguishable from *caruncula,* on the west coast of North America; in the same locality also occurs *ungodon* with a peculiar mahogany colored ectosome. In the West Indies *amphilecta* has a curious brown color and corky consistency. Five species names occur in the Indian Ocean and East Indies; all have extremely thick spicules (20 to 40 μ) and may all be conspecific. A yellow species, *fernandezi,* from both coasts of South America, is also close to *caruncula,* but *paucispiculus* from Argentina is not certainly of this genus; it is a fan with few spicules and those are of two size ranges. Three species names have been used in this group for New Zealand forms; all three are much alike and may be conspecific; minute differences separate them from *caruncula.* Four Antarctic species each have some distinctive peculiarity, such as centrostyle spicules, or verrucose surface. Many other named species are unrecognizable or are already known to fall in synonymy. Assuming *chloris* to be a good species, I opine that there are 14 valid species in the genus.

The species name *chloris* refers to the green color of this sponge.

Terpios zeteki (de Laubenfels)

Fig. 18

This species is one of the two or three most abundant sponges in Hawaii. My first specimen from this region was collected September 10, 1947, at Moku O Loe at a depth of 1 meter, near the pier (location number 6, Fig. 2). This one is deposited in the U. S. National Museum, Register Number 22739.

This species is sub-ramose. There is a basal mass from which rounded projections arise, often scarcely more than hemispherical, at other places digitate. These projections are usually between 1 and 2 cm. in diameter, from 0 to 5 cm. long. Some masses reach head size. The interior of *zeteki* is consistently an ochre-yellow, but the exterior is contrastingly colored. In the type of the genus, *fugax,* the yellow shows over more or less of the surface, the rest being a dark prussian blue. In *zeteki* the yellow never shows and the whole exterior is of one uniform color. This color in nearly 50 per cent of all specimens is a turquoise or robin's-egg blue, in as many other specimens it is rosy-red. This was the color of the above-mentioned U. S. National Museum specimen. After a long search, out of scores of specimens, I began finding an occasional one that was violet—clearly a hybrid of the other two colors. I never found a parti-colored colony but always the entire sponge of the same hue. The consistency is spongy.

The surface of *Terpios zeteki* is tuberculate, almost like the skin condition called "goose pimples." The elevations are less than 1 mm. high and about 3 or 4 mm. apart. The pores are extremely contractile, and so are the oscules, but in life the latter certainly open to as much as 2 mm. in diameter. Their closure is by a sphinctrate contraction involving rather typical muscle cells instead of by the pulling of a membrane across the opening as in some sponges. This muscular closing is quite typical, however, of the order Hadromerina, in which this genus belongs.

The ectosome of this species is very thin, not the usual thick cortex of this order; in fact, it is usually less than 50 μ thick, and chiefly organic. The endosome is so densely organic as to resemble cheese; the gross chambers carry out the similarity. There is no segregation of spicule sorts nor any conspicuous tracts. Most of the spicules are in confusion but more have their points toward the surface than with any other one orientation. There are vague ascending tracts, and these end in relatively large, very definite dermal tufts or brushes; in these tufts the spicules bristle, all the points being directed toward the surface or slightly divergent.

The spicules are exclusively tylostyles, of great variation in size. Many are about 4 by 300 μ, but 14 by 700 may be expected; many are only 2 (or less) by 200 μ. An interesting shape is often found in the slender, unfinished spicules of this species, especially if the whole colony be small and evidently young. In such spicules it can be seen that the head is not just one single swelling, but is due to the existence of four short arms at right angles to each other and to the rhabd or shaft. Such a spicule could be called an orthotetraene; in the Hyalospongiae it is called a pentact. These four arms in *Terpios* do not continue to grow; they stop when only about 1 μ long and are then buried by successive layers of the opaline silica. When the mass of the head reaches a diameter of about 4 or 5 μ, the arms are so thoroughly covered that they can no longer be observed. The genus *Terpios* was based upon the occurrence of these pentactinal spicules; the larger, older specimens were put in a later genus *Laxosuberites.* In a manuscript on the sponge fauna of Bermuda I show the synonymy of the two, and review the genus *Terpios*; that manuscript may be published before this one.

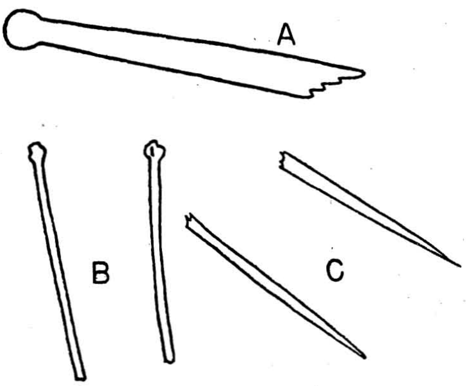

FIG. 18. *Terpios zeteki,* spicules, from a camera lucida drawing, × 666. A, the head of one of the common spicules, which are tylostyles. The pointed end, not shown, is commonplace. B, heads of some smaller (juvenile?) tylostyles, which show the hexactinellid pattern. C, pointed ends of the spicules shown at "B"; the mid-regions of them are not shown.

The present species was first described as *Laxosuberites zeteki* by de Laubenfels (1936:

450) from the vicinity of the Panama Canal, especially the Pacific end. The amazing color situation was evident there, half of all the specimens being red, the remaining ones blue-green. In Panama I found no intermediates. Dickinson (1943: 37) records the species from the Pacific coast of Mexico. This species and *Mycale cecilia* afford links between the Hawaiian fauna and that of the tropical Americas.

Cliona vastifica Hancock

Fig. 19

This species was first studied in Hawaii on September 27, 1947, in Waialua Bay (northwest of Kaneohe Bay), at a depth of about 3 meters. This specimen is deposited in the U. S. National Museum, Register Number 22743. The species is common throughout the shallow waters of Hawaii, but is always inconspicuous. If one breaks up almost any long-submerged calcareous material, such as shells or dead coral, one will find this boring sponge. It is very common throughout Kaneohe Bay.

Cliona vastifica excavates galleries in calcium carbonate. These are roughly circular in cross section and about 1 mm. in diameter. Each gallery meanders rather than extends in a straight line, and may reach a total length of 5 to 10 cm. Old coral may be so riddled by *Cliona* that it crumbles as one handles it, but this is not common experience in Kaneohe Bay, where usually a crowbar or hammer is required to break up the coral. The sponge is orange in color, and of mediocre consistency. The pores and oscules are minute, and are located at the small inconspicuous openings to the galleries (1 mm. in diameter). Obviously one can say little about ectosome as compared to endosome as long as the sponge lives thus buried. *Cliona* specimens may grow out of their burrows into plain view, but I have not yet found any such in Hawaii. The principal skeleton of *Cliona vastifica* consists of tylostyles 4 by 300 to 7 by 240 μ in size. Fairly numerous microspined oxeas, 4 by 85 to 5 by 75 μ, are also present. There are distinctive microscleres, heavily microspined and probably to be regarded as microstrongyles, but the ends are cut off so sharply that they are more like little cylinders. Some are as small as 2 by 8 μ, others as large as 3 by 18 μ, with 10 μ as a common length.

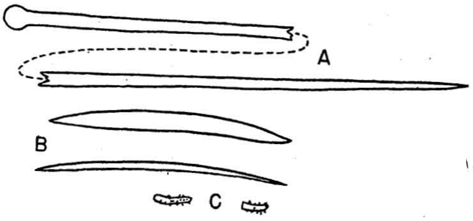

FIG. 19. *Cliona vastifica,* spicules, from a camera lucida drawing, × 444. A, tylostyles. B, oxeas. C, microacanthostrongyles.

This species was first described by Hancock (1849: 342) from Great Britain. It is an abundant species throughout the Old World, but quite uncommon (although present) in the New World. In the Americas the boring sponges are nearly always *Cliona celata*; this species is also common in the Old World, but from Norway, to Turkey, to Ceylon, to New Zealand, *vastifica* is a close rival to *celata.* Is *vastifica* perhaps a recent immigrant to North America, carried by barnacles on ship bottoms? Did it reach Hawaii in that same way too?

Tethya diploderma Schmidt

Fig. 20

This species is very common throughout the shallow waters of Hawaii, including Kaneohe Bay. It is represented by some specimens collected November 22, 1947, at Moku O Loe, at a depth of 1 meter, in the long lagoon (location number 3, Fig. 2). These are deposited in the U. S. National Museum, Register Number 22751.

This species is nearly spherical in shape and may become as large as a hen's egg; more often it is about half this size. The interior is regularly ochre-yellow. The exterior is extremely pale, almost white for specimens that grow in the shade, but a mahogany-brown for specimens which grow in relatively bright illumination. This was true of most of the Moku O Loe specimens. Among the brown tethyas, however, were a few that in life appeared black. In alcohol these promptly bleached to about the brown color that the others had in life, but the brown ones in alcohol bleached very pale indeed. The black specimens had identical spiculation, and in all respects, save for color, appeared to be identical with the brown ones. No difference in their ecological placement could be found to account for the difference in hue. The hypothesis here favored is that the black ones had a symbiont of some sort in or on their dermis, which symbiont was lacking from the brown tethyas. The consistency of this sponge is cartilaginous.

The surface of *Tethya* changes with the reproductive cycle, but is always more or less verrucose. The protrusions are at the distal terminations of spicular fascicles, and are about 2 mm. in diameter. Their height varies during the reproductive cycle from nearly 0 to more than 3 mm. so that they may actually depart from the parent as slowly motile buds. The pores and oscules are very contractile but the latter may open to as much as 2 mm. in diameter. There is seldom more than one oscule per sponge, and it is usually apical.

Schmidt's name *diploderma* is well deserved by the remarkable ectosome of this sponge. The outer cortex is about 650 μ thick, and may contain symbionts, reproductive tissue, and protective tissue including microscleres. The inner cortex is about as thick or a little thicker, is pale, full of strong smooth muscle tissue, and very contractile. Not only may the pores and oscules be closed promptly, but the whole sponge seems to grow smaller when these muscle fibers contract.

The endosome is rather dense, and is permeated by radiating columns or tracts of megascleres; each tract is about 200 μ in diameter. There is one column for each dermal protrusion.

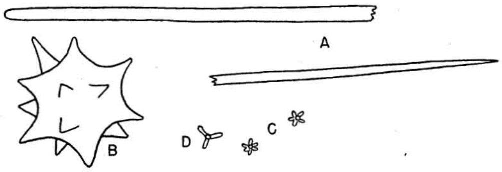

FIG. 20. *Tethya diploderma,* spicules, from a camera lucida drawing, × 333. A, style or fusiform strongyle. B, spheraster. C, small tylasters, common shape. D, euaster, less common shape.

The megascleres are inequiended, fusiform strongyles. The small end is usually pointed toward the surface of the sponge and is so small that the spicule almost becomes a style. Indeed, some actually appear to be genuine styles. They range in size from 8 by 500 μ up to at least 20 by 1500 and 25 by 1250 μ. There are two sorts of microscleres. First, there are large spherasters, 25 to 75 μ in diameter, more often near the larger size. These are chiefly localized just under the cortex. Second, there are myriads of small tylasters with microspined rays. The total diameter of the asters is only 5 to 11 μ. They are abundant both in the outer cortex and throughout the endosome.

This species was first described by Schmidt (1870: 52) from the West Indies, but has since been shown, especially by Burton (1924: 1039), to be practically cosmopolitan. A very interesting article by Edmondson (1946: 271 and following) discusses the asexual reproduction of this species as it occurs in Hawaii, but uses the name *Donatia deformis.* The name *Donatia* is a later synonym for *Tethya* but was used for a while on the unwarranted assumption that the still earlier name *Tethys* (for a mollusk) preoccupied Lamarck's (1814: 69) establishment of *Tethya.* The two names are, of course, quite different. The species *deformis* is much like *diploderma* but less elaborate as to dermis, and its micrasters each have a centrum. It is a western Pacific species, from Japan through the East Indies to New Zealand. The species *diploderma* is circum-equatorial. If the two should be determined to be conspecific, as is possible, the name *diploderma* has a 28-year priority.

ZAPLETHEA new genus

This genus is erected with the following species, *Zaplethea digonoxea,* as genotype. It is placed provisionally in the family Halinidae, subfamily Corticiinae. It should be emphasized that this is a genus of sponges with extremely abundant microscleres, but very few megascleres, those that are present being oxeas. The microscleres are of two sorts, euasters and twice-bent microxeas.

Twice-bent spicules are exceedingly rare in the phylum Porifera. There is at least one other case, however. This is the record by de Laubenfels (1930: 26; or better, 1932: 35) of *Penares cortius,* a sponge with two kinds of microscleres: euasters and twice-bent microstrongyles. It had a few oxeate megascleres, so that if the twice-bent spicules were oxeate, there would be agreement to this extent. However *Penares* has a principal spiculation of large tetraxons; thus it goes in the order Choristida. *Penares cortius,* from California, was a large sponge with a conspicuous leathery dermis, very different in appearance from *Zaplethea digonoxea.*

In the order Choristida there is a family Jaspidae. Its type genus, *Jaspis,* has a spiculation of oxeas and euasters, but no twice-bent microscleres; the oxeas are the principal spicules, and are radiately arranged. These are large, significant differences from *Zaplethea.*

The order Carnosa is established especially to receive sponges that have few or no megascleres, and has even been called "Microsclerophora." Thus it seems clearly to be the best order to receive the genus *Zaplethea.* Yet the family situation in this order is still perplexing; there are now four families in the Carnosa, and none quite fits *Zaplethea.*

The Chondrosiidae have no spicules at all.

The Chondrillidae have only euasters.

The Plakinastrellidae have a few megascleres, as no others in the order do, and thus are intermediate. But the megascleres that are present are tetraxons, so that the intermediate condition obtains as between the Carnosa and the Choristida. For lack of tetraxons, *Zaplethea* seems utterly out of place in the Plakinastrellidae.

The fourth family is the Halinidae, here selected by elimination. Yet all the genera of this family (there are about a dozen) have a peculiar microsclere known as calthrops. Other than this, these genera are divided into two subfamilies; the Halininae have asters that are streptasters, while the Corticiinae have asters that are euasters.

If we focus attention on the above-mentioned fact that every other genus in this family has calthrops, and regard this as a reason for excluding *Zaplethea,* we are thrown into the embarrassing situation of needing a new family to receive this genus. I do not want to erect any more families in the Porifera, because I believe there is a large enough number already.

The genus name is derived from the Greek "zaplethes," meaning very full, because the sponge is so packed with spicules. The exact Greek is not available, having been used in 1868 in Hymenoptera, also in 1920 in Pisces.

Zaplethea digonoxea new species

Fig. 21

The holotype of this species is designated as spirit-preserved specimen, U. S. National Museum, Register Number 22746. It was collected September 27, 1947, in Waialua Bay, at a depth of between 4 and 8 meters, growing on dead coral. A second specimen was collected in Kaneohe Bay on January 10, 1948, at a depth of 2 meters, also on dead coral.

This species is encrusting, about 3 to 5 mm. thick. The color is pale, dull, and may be termed drab, or yellowish-gray. The consistency is firm, somewhat like cartilage. The surface is smooth and lipostomous. There is no sharply defined cortical region. The interior is exceedingly dense, with few cavities larger than 40 μ in diameter. The flagellate chambers are about 25 μ in diameter.

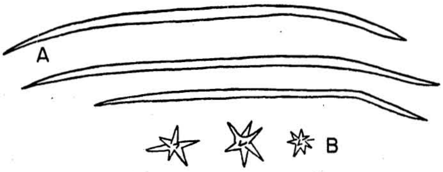

FIG. 21. *Zaplethea digonoxea,* spicules, from a camera lucida drawing, × 444. A, microxeas. B, euasters. The larger oxeas are not shown.

There are a few scattered oxeas, 7 by 400 to 12 by 520 μ in size. They are so rare that while I had only the one specimen I considered them accidental, foreign inclusions. But they were not only present in the second specimen, they were a little more nearly common in it. The whole sponge is densely packed with millions of microscleres. They are of two sorts, about equally abundant. One kind is an oxyeuaster, usually 10 μ, but ranging on up to 20 μ, in diameter. The other very distinctive kind is a twice-bent microxea. The three straight regions make obtuse angles and are not quite equal in length; instead the middle piece is a little longer than the others. The over-all length is about 105 μ and the thickness 3 μ or less.

The species name stresses the twice-bent microxea; in fact, this novel sort of spicule itself may suitably be named digonoxea.

Plakortis simplex Schulze

Fig. 22

This species was found in Hawaii on January 10, 1948, in Kaneohe Bay, at a depth of about 2 meters, growing on dead coral. Another specimen was found on May 15, 1948, at Keaukaha near Hilo on the island of Hawaii, just below low tide mark.

This is a thin, encrusting sponge, seldom much more than 2 mm. thick. The two specimens covered about 10 square cm. each. The first was dull olive-brown, the second dull gray—this species is usually brown, but dull or drab. The consistency is rather like that of cheese.

The surface is smooth but not level, being often elevated into low tubercles. As usual in such thin sponges, it is lipostomous. There is a paper-thin fleshy dermis; the rest of the sponge is also very dense. It is astonishingly full of flagellate chambers which are round and are 30 to 40 μ in diameter. The spicules are crowded throughout the flesh in confusion. Much of the skeleton is merely the usual interstitial jelly.

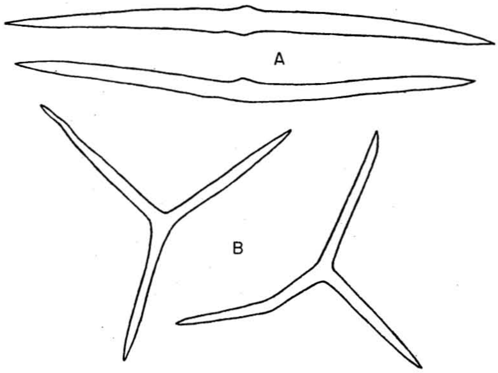

FIG. 22. *Plakortis simplex,* spicules, from a camera lucida drawing, × 380. A, oxeas (?). B, triaxons.

The spicules of *Plakortis* are chiefly to be regarded as triacts, and about one in twenty is indeed a neat, symmetrical triact as in calcareous sponges. The rays are often about 5 to 7 by 100 μ. More common are spicules that show signs of being a triact with one ray missing, so that the result is V-shaped. Very much the commonest of all are spicules that seem at a casual glance to be oxeas, but which have a central swelling or series of kinks, so that they are probably triacts with one ray lost and the other two brought into nearly the same line.

This species was first discovered by Schulze in the Mediterranean (1880: 430). Someone (Dendy, I believe) found it again in an East Indian collection. I have found it in the West Indies (Tortugas) and in Bermuda, and now in two places here. It is probable that it is not so rare as it is simply overlooked because of being dull, drab, and thin; one might say it is camouflaged on the rocks that it normally inhabits.

Leucetta solida (Schmidt) Dendy and Row

Fig. 23

In Kaneohe Bay in particular, and throughout the Hawaiian Archipelago in general, small fragmentary calcareous sponges are very commonly found, usually growing on dead coral in shallow water, but also down to at least 50 meters depth (in my experience). These fragments are chiefly of a species that is clearly a *Leucetta.* A few calcareous sponges that are of other genera have been found in the Archipelago, but not yet in Kaneohe Bay.

The genus *Leucetta* is outstanding in the class Calcispongiae for its morphological resemblance to those sponges that are typical of the class Demospongiae. Most calcareous sponges have symmetrical, cylindrical shapes, with large central cloacal hollows, so that they are somewhat like the sponges of the class Hyalospongiae. It is common to find *Leucetta* species that are taken for Demospongiae until the acid test is applied to the (calcareous) spicules.

The genus *Leucetta* is cosmopolitan, especially common in the Antarctic and also in equatorial waters around the world. Some 18 species are commonly recognized. Of these, a few are unique; a new genus may indeed be needed for *Leucetta trigona.* Many others are separated by very small differences and may eventually prove to be conspecific.

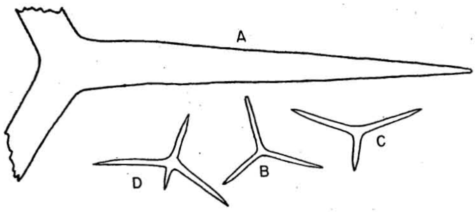

FIG. 23. *Leucetta solida* (?), spicules, from a camera lucida drawing, × 333. A, portion of one of the larger triaxons. B, common triaxons of smaller size. C, alate triaxon. D, tetraxon.

I do not yet have material adequate for a proper evaluation of the Hawaiian *Leucetta,* unless it be a specific characteristic that it should always seem to be just a fragment of a sponge. These specimens are usually amorphous, about as large as beans, white, fragile, and full of triaxon spicules of two size ranges. These traits are true of practically all species in the genus. The larger spicules have rays 100 to 120 μ thick and 660 to 960 μ long and thus are visible to the unaided eye. The smaller ones have rays 6 to 10 μ thick and 70 to 110 μ long. A few intermediates are probably developmental forms of the larger size range. I found one lone tetraxon, of the smaller size range. This may have been an accidental malformation, or an accidental (foreign) inclusion. Again, one must note that many calcispongias have such spicules in the lining of a cloaca, but not elsewhere. I have not yet found a cloaca in a specimen which is for certain one that occurs in Kaneohe Bay; however, it may be that a cloaca is part of this sponge's full complement of traits, and will be discovered later. On March 29, 1948, I found a calcisponge on the bottom of a barge in dry dock at Pearl Harbor. It had a cloaca lined with small tetraxons. It may or may not be the *Leucetta* that is locally widespread; more study is required.

Of all the species names available in the genus *Leucetta,* the oldest is *solida.* Schmidt (1862: 18) described *Grantia solida* from the Mediterranean. Dendy and Row (1913:

734) correctly transferred this to *Leucetta.* Schmidt's description is so generalized that many other *Leucetta* species could be put with it, and thus our Hawaiian *Leucetta* may be tentatively identified. It is here left an open question whether or not several later species names should be dropped in synonymy to *solida.*

Needless to say, this Hawaiian calcisponge does not help in determining faunal relationships to others parts of the world.

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