

*Asterospicularia laurae*, n. gen. et n. sp.,  
the Type of a New Family of Alcyonarians with Stellate Spicules

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AMONG THOSE SPECIMENS of Alcyonaria obtained during my trip to Formosa in 1938, there is an interesting form which cannot be referred to any known genus of the group. It is represented only by a single specimen obtained on the coral reef at Daijubô, southernmost promontory of Formosa, on June 14, 1938. Superficially it shows a resemblance to the genus *Capnella* in the mode of branching and in the appearance of polyps. Closer examination of the total specimen and sectioned preparations, however, has revealed that the coenenchyma as well as the polyp wall has a honeycombed texture filled with numerous stellate spicules and that the tentacles bear no trace of pinnules. Such characters are entirely unknown in the whole group of Alcyonaria, so I propose to institute for this form a new genus and even a new family.

The following description is based on a perfect specimen which was taken as the type.

EXTERNAL APPEARANCE

The specimen (Fig. 1*a*) is in the form of a small colony of bushy growth and has a yellowish white colour in alcohol. The base of the colony is broadened, flattened, and about 12 mm. in longest diameter. From the flattened upper surface of the short columnar stem arise nine large and small polyp-bearing lappets. Each of the lappets is mushroom-shaped; each consists of a polyp-bearing rounded capitulum and a short wide sterile

stalk, the former being marked off sharply from the latter. In the largest lappet, the capitulum is about 6 mm. in diameter and 5 mm. in height, and the stalk is about 8 mm. in diameter and 5 mm. in height. The total height of the colony is about 13–17 mm.

No polyp dimorphism is found. The autozooids are closely set and rather large, being up to 1 mm. in diameter and 1.5 mm. in height. They are apparently capable of considerable contraction, and they look like papillae provided with a rather large central mouth surrounded by eight-lobed tentacles (Fig. 1*b*). The whole surface of the trunk of the zooid is thickly covered with stellate spicules of sub-equal size which are continued onto the dorsal surface of the tentacles. The spicules are evenly scattered as in the Xenidiidae and do not form any densely packed row or ridge along the intermesenteric area (Fig. 1*c*).

The tentacles, in the contracted state, appear oval in side view and measure about 0.5 mm. long and 0.37 mm. wide (Fig. 1*d*). The pinnules are missing. Careful microscopic examination of serial sections of the tentacle reveals that from 8 to 10 opaque rounded bodies are imbedded slightly beneath the oral surface of the tentacles (Fig. 2*c*). These bodies are scattered here and there in the peripheral layer, but are closely united with one another in the deeper layer; they are continuous with the coelenteric cavity below the mouth. The interior is filled with numerous zooxanthellae and endoderm cells, and there is no connection between this region and the epidermis. Here the epidermis shows no sinus or indentation suggesting the presence of pinnules. Thus I consider this body

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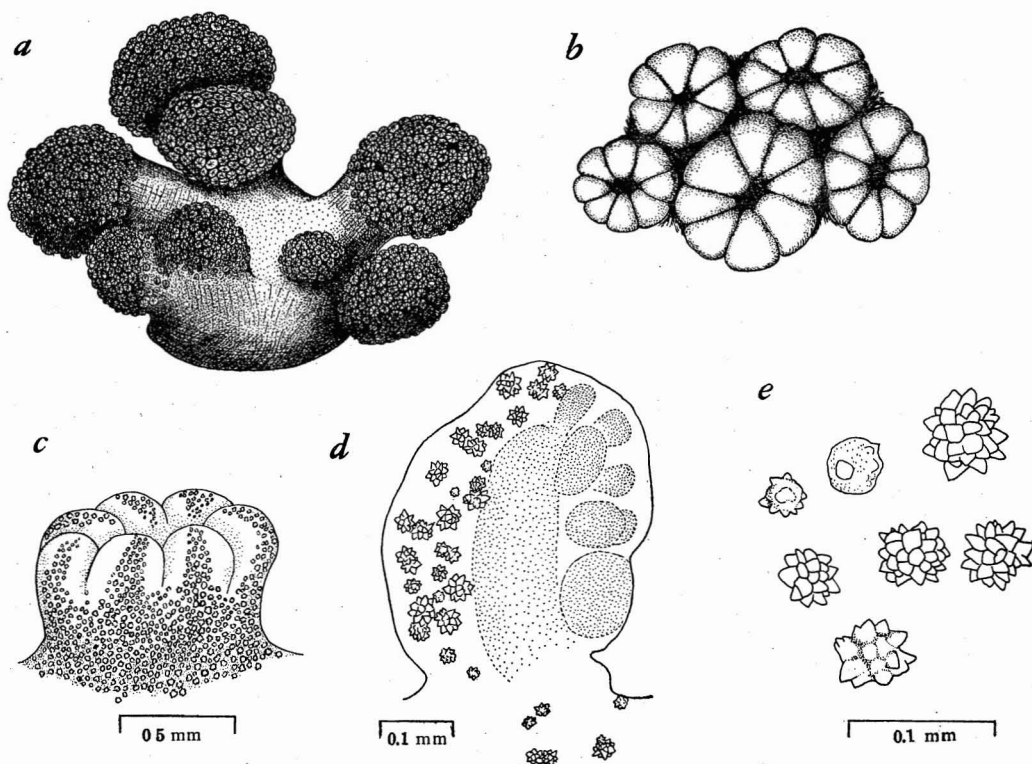


FIG. 1. *Asterospicularia laurae* n. gen. et n. sp.: *a*, holotype; *b*, five polyps, enlarged, showing the crown of contracted tentacles; *c*, lateral view of polyp, showing the arrangement of spicules; *d*, section of tentacle with spicules on aboral side only; *e*, stellate spicules and derivatives.

to be merely the branch of the coelenteron and not the contracted pinnules.

The spicules (Fig. 1*e*) are stellate, exceptionally roughened spherules without any distinct process. They are distributed uniformly in the mesogloea of the coenenchyma, polyp wall, oral disc, and the aboral side of the tentacles. They measure about 0.03–0.05 mm. in average diameter and, as in most alcyonarians, are composed of calcium carbonate with a sparse organic matrix. This stellate spicule, which reminds one of the sphaeraster of the tetraxonid sponges or the stellate spicule of the didemnid ascidians, is unique in the group Alcyonaria, and it is quite different from the spicules found in other forms.

#### INTERNAL ANATOMY

For histological examinations, parts of the specimen were sectioned after decalcification in dilute acids. Because of poor staining, examination of the minor histological details was not possible.

The cross section of the main branch of the colony shows numerous lacunae of various sizes. The large lacunae are the direct continuations of the coelenteron of the principal polyps, while the smaller ones are the mesogloea lacunae in the coenenchyma. The majority of the coenenchyma between the polyp bodies is strongly honeycombed by mesogloea lacunae, which harbor spicules.

These honeycombed lacunae formed in the mesogloea are distinctly circumscribed and

are mostly circular or oval to oblong in outline, as shown in Figures 2*a-d*. Each of these lacunae is beset with 1 to 8, rarely up to 10, stellate spicules, the number varying according to the size of each lacuna. In most other alcyonarians, however, the mesogloea is more or less compact and is beset, either densely or loosely, with spicules. Each spicule originates from a single scleroblast of ectodermal origin, so that the space or cavity for a spicule is closely fitted to the form of the spicule contained in it (Koch, 1878; Hickson, 1895; Woodland, 1905; Bock, 1938). In this alcyonarian, the spicular cavity is constant in form, irrespective of the number of spicules contained. Though I made no actual observations on the development of the spicules, there is no evidence in my preparations of the presence of a number of spicules in a single cavity originating from a single spicule-forming cell or scleroblast.

The body wall of the anthocodia is composed of three layers—an outer rather thick ectodermal layer, a very thick mesogloea layer, and an inner endodermal layer. Of these, the mesogloea is divided into two layers—the outer layer (with large lacunae containing spicules) which lines the epidermis and the inner layer with smaller empty lacunae (Fig. 2*a*). The inner layer surrounding the coelenteric cavity forms a homogeneous fleshy mass scattered with free mesogloea cells which are endodermal in origin. These cells are rather large, measuring 4 to 10 $\mu$  in diameter, and contain darkly stained oval or spindle-shaped nuclei. It is highly probable that these mesogloea cells of endodermal origin are the direct continuations of the endodermal cell-strings or canals (i. e., solenia) or their derivatives. Their function is probably to give nutrition to, and to perform excretion from, the mesogloea, as suggested by Hickson (1895), Pratt (1903, 1905), Bock (1938), and Gohar (1940*b*). No mesogloea cell of ectodermal origin suggesting a nerve plexus could be traced.

The epidermis is coated with a thin outer

cuticle and is rather thick. It occupies the area between the outer cuticle and the outer layer of the spicular cavities of mesogloea. Its basal lining is indistinct, since the outer contour of the superficial mesogloea containing the larger spicular cavities is very irregular. Thus the thickness of the epidermis is considerably varied in different parts of the body. As far as I have observed on the decalcified preparations, the epidermis appears to be formed of more than one layer of ectodermal cells. All these cells are irregularly arranged, and the ordinary supporting and interstitial cell layers cannot be distinguished. Also I have seen no nematocysts or mucous gland cells in the epidermis.

The mouth leads into a very short stomodaeum which penetrates deep into the coelenteron. The stomodaeum is lined internally by a thick columnar epithelium and is provided on the ventral side with the siphonoglyph. In the stomodaeal region, the mesenteries have thickenings (the so-called muscle banners) on the ventral side situated closer to the stomodaeum than to the coelenteric wall. Further details of the structure of the mesenteric filaments could not be traced. All the mesenteries appear very thin and run straight from the lower end of the stomodaeum down to the bottom of the coelenteron.

The endodermal cells of the coelenteric and tentacular cavities, together with zooxanthellae contained within them, are very loosely packed in the whole space and form an undefined mass. The boundaries between the endodermal cells are, however, slightly visible. Apparently these cells do not form any ordinary epithelial lining on the coelenteric walls such as is found commonly in ordinary coelenterates. In the lower part of the coelenteron, however, the endodermal cells are situated close to the wall and mesenteries.

The internal canal system is not so well developed as in the Alcyoniidae. The endodermal cell-strings or canals are seen most clearly near the surface of the coenenchyma; they take a sinuous or zigzag course in the

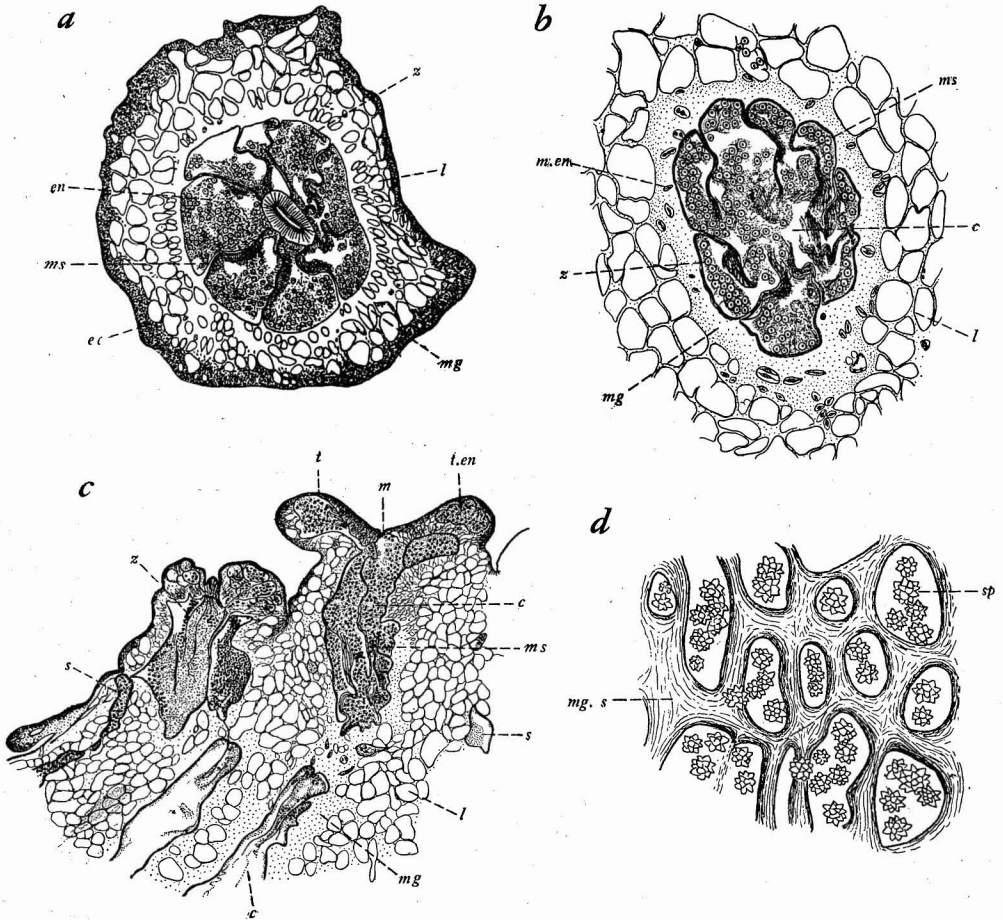


FIG. 2. *Asterospicularia laurae* n. gen. et n. sp.: *a*, transverse section of stomodaeal portion of polyp,  $\times 85$ ; *b*, transverse section of lower portion of polyp,  $\times 135$ ; *c*, longitudinal section of a part of coenenchyma with two polyps,  $\times 50$ ; *d*, superficial view of a part of coenenchyma, showing the arrangement of spicules,  $\times 70$ . *a-c* from decalcified preparations and *d* from perfect specimen. (*c* coelenteron, *ec* ectoderm, *en* endoderm, *l* lacuna containing spicules, namely spicular cavity, *m* mouth, *mg* compact portion of mesogloea, *mg.s* mesogloea partition between spicular cavities, *m.en* mesogloea cell of endodermal origin, *ms* mesentery, *s* solenia, *t* tentacle, *t.en* tentacular branch of coelenteron, *z* zooxanthella.)

mesogloea between the spicular cavities and then communicate with the neighboring cavities. Usually they have no lumen, but contain granular endodermal cells and zooxanthellae similar to those found in the coelentera (Fig. 2*c*).

Zooxanthellae occur only in the endoderm, never in the ectoderm or in the mesogloea. They are most numerous in the tentacles and in the upper part of the coelentera between the mesenteries and solenia; they are found only sparsely in the deeper part. They are

spherical and vary in diameter from 6 to 8  $\mu$ , the majority being 7.5  $\mu$ .

The stellate spicules, as mentioned above, occur only in the sharply circumscribed, rounded cavities of the honeycombed mesogloea. The number of spicules contained in each cavity varies greatly according to the size of the cavity. The mesogloea partitions between these cavities, which are very thin and compact and which appear to be a homogeneous fibrous structure, contain no spicules at all (Fig. 2*d*).

## REMARKS ON SYSTEMATIC POSITION

Before entering into a consideration of the systematic position of this remarkable alcyonarian, some historical remarks may not be amiss. It is interesting to note that there is good evidence that another specimen evidently referable to this form had been obtained and observed by two famous English workers on Alcyonaria 20 years ago. In an elaborate work on the alcyonarians collected by the Siboga Expedition (*Siboga-Expeditie*, XIIIId, p. 219, pl. 21, fig. 8) issued in 1931, we find a short account by Sir Arthur J. Thomson and Miss Laura M. I. Dean (Mrs. L. M. I. Macfadyen) entitled, "Deceptive Fragments," as follows:

Stat. 60. Haingsisi Reef. 1 Ex.

Stat. 81. Sebangkatan, Borneo-Bank. 34M.

Coral bottom and Lithothamnion. Several Ex.

Several badly preserved fragments of a pronounced white colour, with a marked suggestion of shrunken *Alcyonium* or *Lobularia* colonies, and showing on some of the zooids eight tentacles (non-pinnate however), turn out to be compound Tunicates, not far removed from *Sarcodidemnooides*. The calcareous spicules, minute tuberculate spherules, are more refractive than those of Alcyonarians; as an instance of deceptive convergence we have figured a few.

This account and a sketch of spicules show quite decidedly that the so-called "deceptive fragment" was none other than a specimen of the present alcyonarian. It is small wonder that both authorities took it for a didemnid-like tunicate because of the peculiar shape of its spicules alone. In the group Alcyonaria, the form and arrangement of spicules constitute one of the most important characters of the genera and, often, of the species. They are usually represented by discs, rods, clubs, spindles, or capstans, all of which are simple, warty, or more complicatedly tuberculated or ramified. However, such distinctly star-shaped spicules resembling those in certain sponges and tunicates, as found in this

*Asterospicularia*, are yet unknown in the Alcyonaria. In this respect, Hickson's opinion (1930: 230) that "The characters of the spicules are of great value in distinguishing the genera, and often of the species, but they are of little value in the division of the Alcyonaria into groups of higher rank," is not applicable to this case.

In this alcyonarian, the spicules are remarkably constant in form and size and are uniformly distributed in the mesogloea, except on the oral side of the tentacles, and do not form any special polyp armature. In this respect this species resembles more closely members of the Xenidiidae than of any other family. However, it may be distinguished from the Xenidiidae by the presence of spicules in the mesogloecal lacunae; for in the Xenidiidae the spicules are confined to the ectodermal layer. The mesogloecal lacunae containing spicules are better developed than in the Alcyoniidae and Nephthyidae and are constant in form; moreover, the spicules in each lacuna are generally more than one in number. In the latter families, each lacuna is rather ill-defined and contains usually a single spicule almost similar to the outer contour of the lacuna.

In the mode of branching and in having numerous spicules scattered in the thick coenenchyma between the polyp cavities, this alcyonarian seems to be more closely related to the family Alcyoniidae and the genus *Capnella* of the Nephthyidae than to any other form, except that the mesogloea of the coenenchyma shows an unusually honey-combed structure as in that of the polyp body.

The coelenteron, which has scattered endodermal cells and zooxanthellae without forming any ordinary epithelial lining, seems to be rather peculiar. But the endodermal canal system seems to differ little from that of the Alcyoniidae.

The absence of pinnules in the tentacles is also characteristic, and is certainly noteworthy, since the pinnate tentacle is one of

the most important diagnostic characters of the group Alcyonaria, with the one exception of *Acrossota liposclera* (cf. Kükenthal, 1924). A remarkable pinnule-less alcyonarian, first recorded from Amboina by Burchardt (1898) as *Clavularia amboinensis*, was, in fact, an *Anthelia*. A second species, *Acrossota liposclera* described by Bourne (1914) as a new genus and new species, is, according to Thomson and Dean (1931), probably identical with Burchardt's *C. amboinensis*. In some alcyonarians — e.g., *Pachyclavularia erecta*, *Cespitularia stolonifera*, and others — examined by early authors and also by me, there are often found some highly contracted tentacles seemingly devoid of pinnules (cf. Thomson and Dean 1931: 20; Gohar 1940a: 5). It is possible that this condition is the result of bad preservation and contraction. The present *Astero-spicularia* is obviously different from *Pachyclavularia*, *Cespitularia*, and other xeniid specimens, as mentioned above.

Taking into consideration all of the unique features of the specimen described above, it seems certain that it represents a new type of alcyonarian which shows a close affinity with the Alcyoniidae as well as with the Nephythidae; but it cannot be included in either family. Moreover, it also demands a modification of the definition of the group Alcyonaria or Octocorallia generally used in all handbooks and textbooks of zoology. Thus I think it necessary to erect a separate family, ASTEROSPICULARIIDAE, for this specialized form, which I propose to call *Astero-spicularia laurae*,<sup>2</sup> n. gen. et n. sp.

The characteristics of the new family may be put down as follows:

ASTEROSPICULARIIDAE n. fam.

Fleshy Alcyonaria of bushy growth type, with mushroom-like, polyp-bearing lobes and a sterile common stalk. Polyps of similar size non-retractile and protected by uniform spiculation continued from coenenchyma.

<sup>2</sup>The specific name is chosen in honor of Mrs. Laura M. I. Macfadyen, who first recorded this form.

Coenenchyma rather thick between polyp cavities and formed of highly honeycombed mesogloea which contains one or more stellate spicules in each cavity. Polyp cavities united together by means of well-developed endodermal cell-strings or solenia running in mesogloea partitions between spicular cavities. No dimorphism of polyps. Tentacles highly contractile, with no trace of pinnules.

TYPE: *Astero-spicularia laurae*, n. gen. et n. sp.

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