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## THE STYLASTERINE CORAL *ALLOPORA STELLULATA* (STEWART)

by

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With Plates III-VI and 4 textfigures

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The description of *Stylaster stellulatus* Stewart was based on a specimen obtained at Tahiti, the coral was stated to be extremely rare, and only found at one small island in the neighbourhood. The description contains all the peculiarities for a specific definition of the coral, the salient points of this description are here mentioned, partly in Stewart's own words (1878, pp. 41-43).

"The corallum is of a bright rose colour, especially in the younger branches, the older parts being often more pale. The branches are usually quite cylindrical, though occasionally flattened at their tips; the general appearance being much like that of *S. sanguineus*, but it has a bluer rose tint, and is at once distinguished by the minute size of its calicles ( $\frac{1}{67}$  of an inch) which are usually uniformly and densely scattered over the branches, a few of which only show them to be more abundant at the contiguous edges". Each cyclo-system consists "of a central cup-shaped calyx, . . . having an opening in its floor from which a large tube passes towards the interior of the corallum: running throughout the whole length of the tube is a minutely spined style-like columella whose point may be seen in the centre of the hole at the bottom of the calyx". The cyclo-systems have from ten to fourteen dactylo-tomes. In the description of the cyclo-systems Stewart remarks that their outer border is often raised around them so as to resemble the theca of an ordinary coral. "The edge of this false theca is sometimes more raised on the proximal side (nearest fixed end of corallum), at other times on opposite sides corresponding with the plane of the branches, but is absent or slightly developed on the larger branches where the axis of the group of zooids is at a right angle to the surface". The dactylo-styles are described as "small,

rounded, brightly glittering, and nearly colourless sphaerules", while of other sphaerules is noted: "much smaller, but otherwise similar ones, stud the larger canals, and are especially evident around the opening through which the style projects". The ampullae are described as small rounded or conical elevations.

Stewart further observes that occasionally there are cyclo systems with two gastrostyles and a larger number of dactylotomes than generally; he is inclined to regard this as brought about by fission though admitting the possibility of fusion of two originally separated cyclo systems.

Of Stewart's figures of *Stylaster stellulatus* (copied in fig. 1 of the present paper) the first shows a top of a branch with numerous cyclo systems, two of which have two gastrostyles each (fig. 1a); some rounded or conical elevations on the surface between the cyclo systems to all appearances represent male ampullae. The second figure (fig. 1c) shows a part of a branch with subspherical female ampullae. The third figure (fig. 1b) is a more strongly enlarged view of a cyclo system, distinctly showing the gastrostyle and the dactylo styles. The fourth figure (fig. 1d) represents a longitudinal section of a cyclo system, showing the cup-shaped distal part and the much narrower cylindrical part of the gastropore; in the figured gastropore the top part of the gastrostyle is not separated from its lower parts by a transverse wall as usually.

Moseley (1880, p. 88) mentions *Stylaster stellulatus* as the 23rd of the described species of this genus, and adds: "From the neighbourhood of Tahiti. I received a specimen of the same at Tahiti said to have come from the Paumotu Islands". Quelch (1884, p. 114) again remarks that hitherto the species has been recorded only from the Society and Paumotu Islands.

Hickson & England (1905) keep the species *Stylaster stellulatus* in the genus *Stylaster*, in the group of species in which the cyclo systems are evenly distributed over the surfaces of the branches (thereby practically indicating that the species should find a place in the genus *Allopora*); they list the species among those that have a shallow water or littoral distribution.

In a previous paper (Boschma, 1951, p. 39) I characterized *Stylaster stellulatus* as a species of the subgenus *Allopora*, and copied a part of Stewart's figure of a lateral branch showing two cyclo systems with two gastrostyles each. In another paper (Boschma, 1953) I used the name *Allopora stellulata* for the coral described and figured by Stewart, as it distinctly shows the generic characters of *Allopora*. The coral appeared again under this name in a following paper (Boschma, 1957), with the references compiled from the literature. The distribution is here recorded as "Society Islands, Tuamotu Islands (?)" ; the query should have been omitted because Moseley's remark on its occurrence in the Tuamotu (Paumotu) Islands is sufficiently distinct.

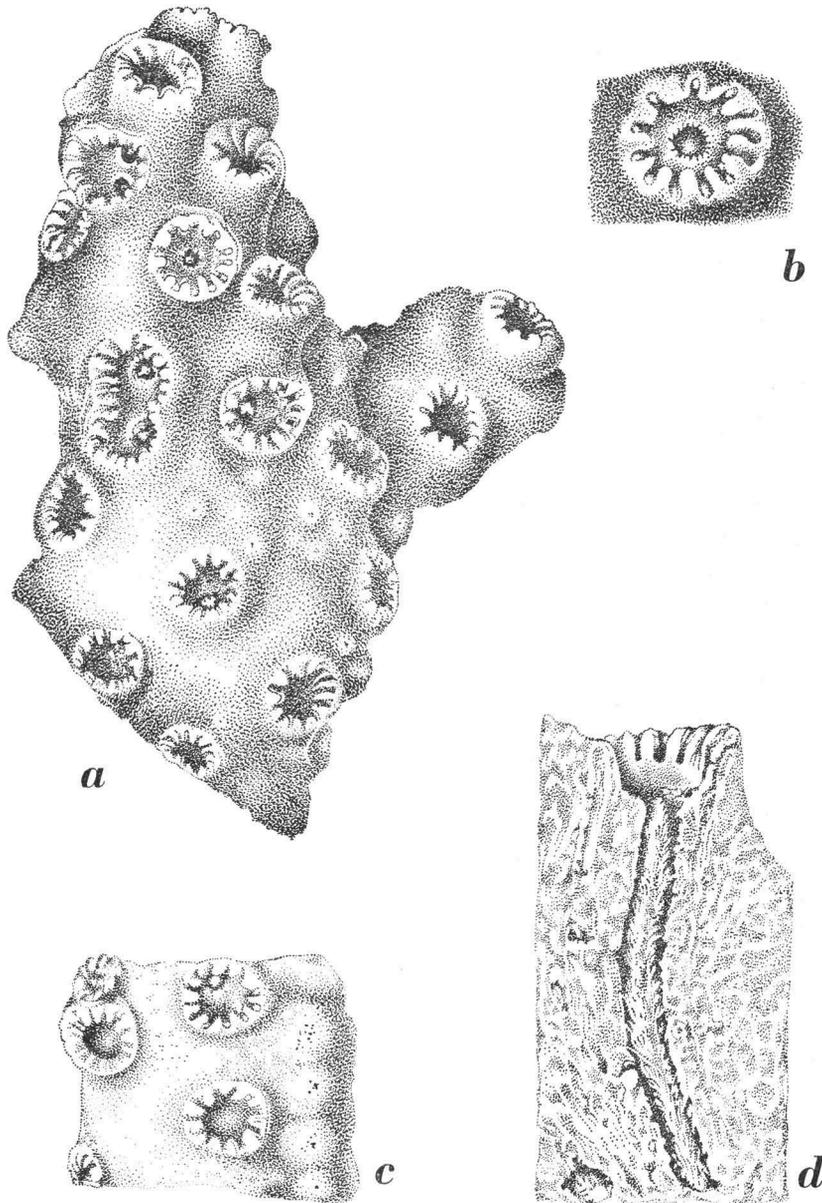


Fig. 1. — *a*, lateral branch of *S. stellulatus*, showing crowded calices, some undergoing division.  $\times 25$  diam. — *b*, orifice of calice.  $\times 40$  diam. — *c*, fragment of branch, showing ampullae.  $\times 25$  diam. — *d*, vertical section of calice, showing canals and style.  $\times 40$  diam. — Copied from Stewart (1878, Pl. III); the explanation of the figures also after Stewart.

I had the opportunity to examine several specimens of *Allopora stellulata* (Stewart), with the following data.

British Museum (Natural History), type specimen of *Stylaster stellulatus* Stewart, Tahiti, reg. no. 78. 2. 28. 1.

Muséum National d'Histoire Naturelle, Paris, several specimens from unknown locality, together with several specimens of an unidentified *Stylaster* of an ochre-yellow colour.

Zoologisk Museum, København, three fairly large specimens and some fragments from Tahiti, presented by Consul Schmidt, 4. 3. 75.

Zoologisk Museum, København, two specimens and some fragments (together with some specimens of an ochre-yellow *Stylaster*, apparently belonging to the same species as those from the Paris Museum), Tuamotu Atolls, don. Crossland, 1939; legit (Hickson?). The last statement is erroneous as Hickson did not visit the Tuamotu Islands.

Thanks are due to Dr. H. W. Parker and Dr. W. J. Rees (British Museum), Dr. G. Ranson (Paris Museum), and Dr. F. Jensenius Madsen (Copenhagen Museum), for the opportunity to examine the specimens from their collections.

Stewart (1878) describes the colour of the type specimen as bright rose, especially in the younger branches, the older parts being often more pale, and remarks that it has a bluer rose tint than *Stylaster sanguineus*. The colour of the specimens in the Paris and in the Copenhagen Museums might be described in the same manner, perhaps with the restriction that it is not much different from the colour of *S. sanguineus*. Generally the specimens show a striking difference in the intensity of the colour of the smaller branches and that of the main stems and larger branches, the younger parts of the colony having a deep carmine colour, the older parts being of a much paler tint, a faint pink strongly contrasting with the pronouncedly crimson smaller branches (cf. especially Pl. IV). In Ridgway's (1912) Colour Nomenclature the tint of the stems comes nearest to Rose Pink, that of the small branches to Spinel Red.

Eight colonies from the Paris collections are shown on Pl. III. All of these have the branches extending in one plane, sometimes rather widely spreading (Pl. III fig. 2), generally more crowded (Pl. III figs. 6-8). As a rule the main stems have a thickness of not over 3 or 4 mm, the height of the figured colonies varies from 27 to 54 mm, their breadth from 32 to 52 mm. In most of the specimens the tops of the branches are slightly bent to one side, resulting into a somewhat concave anterior surface and a posterior surface with a corresponding convexity. Sometimes the anterior surface has a greater number of cyclo-systems than the posterior surface, while the ampullae often occur in greater abundance on the posterior surface.

The three specimens from Tahiti in the collections of the Copenhagen Museum differ from those of the Paris Museum by having a larger number of main branches of greater thickness (about 6 to 8 mm at the base). The largest specimen (Pl. IV fig. 1) has a height of 55 mm and a spreading of 96 mm; apparently it originally had a larger size but of nearly all the branches the top parts are now broken off. The figure represents the concave, anterior surface of the colony. The second specimen (Pl. IV fig. 2)

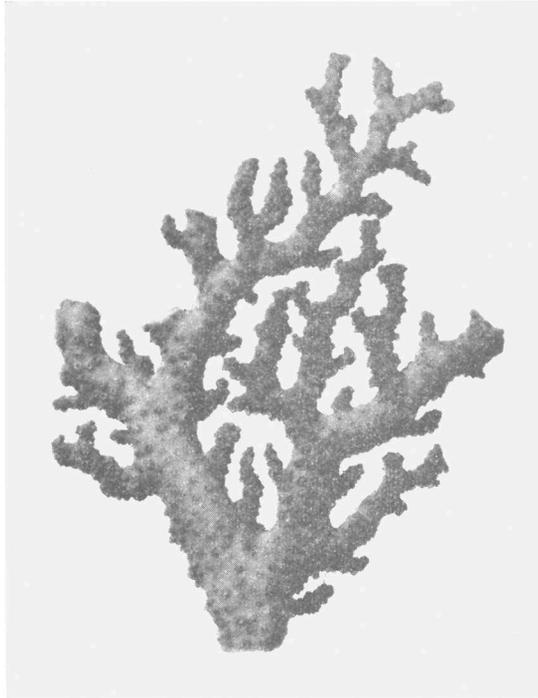


Fig. 2. *Allopورا stellulata* (Stewart), type specimen, one of the flabellar surfaces.  $\times 2$ . Photo British Museum (Natural History).

has a height of 74 mm and a breadth of 48 mm, it has two main stems with a great number of side branches. The figure represents the slightly concave, anterior surface of the colony. The third specimen (not figured) has a height of 54 mm and a breadth of 78 mm, it consists of a number of flabellar growths next to each other, with more or less parallel or slightly diverging surfaces. In its general appearance this complex of flabellar growths closely corresponds with the other specimens from the same locality.

One of the specimens from the Tuamotu Islands in the collections of the Copenhagen Museum is a twisted stem with a number of side branches, the

colony having a height of 47 mm and a breadth of 36 mm. The other specimen from the same locality (Pl. IV fig. 3) is a beautiful flabellar colony with a height of 34 mm and a breadth of 42 mm; the figure shows the slightly convex posterior surface.

The type specimen (text-fig. 2) is a rather stout branch with a basal diameter of about 5 mm, divided into several smaller branches. In its general appearance it is more or less intermediate between the specimens from Tahiti and those in the collections of the Paris Museum. Its height is 39 mm, its breadth 29 mm.

The surface of the colonies is finely granular, the granules often uniting to form a vermiculate pattern.

Generally almost the whole of the surface of the colonies is densely beset with cyclo systems, all in complete shape, their marginal parts distinctly rising over the surface. In some of the colonies of slender shape the cyclo systems occur more sparsely (Pl. V fig. 1). In most of the colonies the marginal parts of the cyclo systems are of equal height on all sides (Pl. VI fig. 1), in some specimens the upper part of the margin is somewhat higher than the lower part (Pl. VI fig. 2), the cyclo systems thereby slightly turning towards the basal part of the colony, a peculiarity already observed in the species by Stewart.

According to Stewart (1878) the cyclo systems of *Allopora stellulata* have a diameter of  $\frac{1}{67}$  of an inch, or 0.38 mm. When measured in his figures (cf. fig. 1) the diameter of the cyclo systems appears to be about 0.5 mm. In the specimens from the Paris Museum and from the Copenhagen Museum the diameter of the cyclo systems varies from 0.38 to 0.66 mm, values corresponding with those obtained from Stewart's data.

The number of dactylo pores was counted in 50 cyclo systems of the type specimen, in 100 cyclo systems of various colonies from the Paris Museum, in 100 cyclo systems of each of the two figured specimens from Tahiti, and in 100 cyclo systems of the specimens from the Tuamotu Islands. The results are given in the table on next page.

Among each other the average values show slight differences; on the whole the averages are somewhat higher than Broch's (1936, p. 34) data concerning *Stylaster sanguineus* Valenciennes (an average of 11.42 for a colony from Fiji, an average of 12.72 for a colony from Jaluit, Marshall Islands).

Longitudinal sections of cyclo systems of *Allopora stellulata* show that the gastropores consist of two parts, of about equal length; the lower part forms a cylindrical tube, its wall is covered with numerous blunt spines, while the interior of the tube is largely filled with the gastrostyle; the upper part widens to a cup-shaped cavity, at its upper rim at least twice the width of the cylindrical tube.

In the original description of the species (Stewart, 1878) the upper part of the gastropores was already described as a "cup-shaped calyx". The blunt spines covering the wall of the cylindrical part of the gastropore are the "smaller sphaerules", which "stud the larger canals, and are especially evident around the opening through which the style projects" as mentioned by

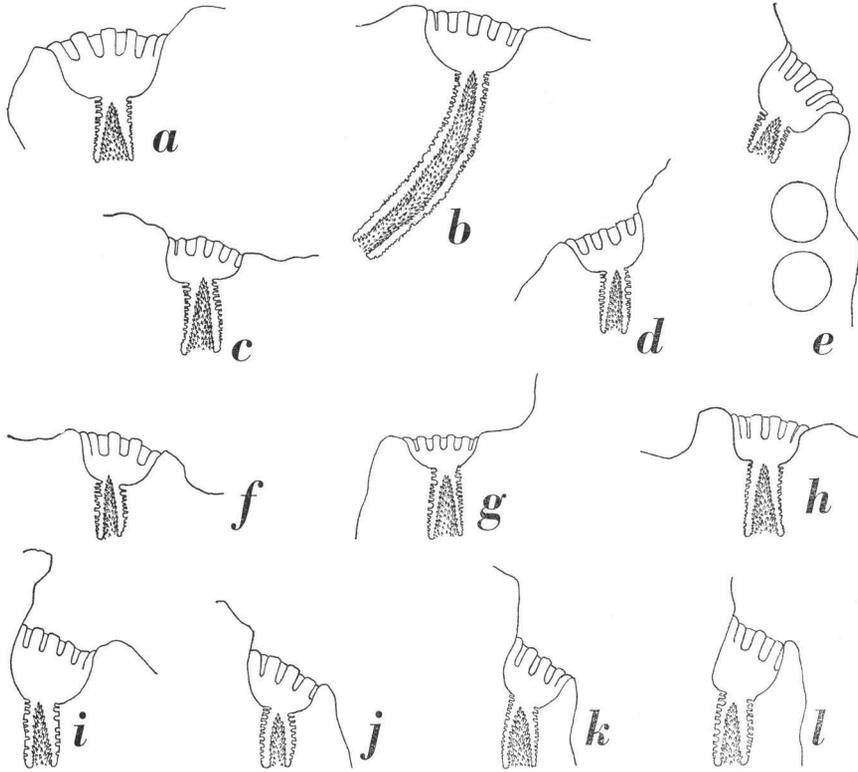


Fig. 3. *Allopora stellulata* (Stewart), specimens from unknown locality in the Paris Museum; longitudinal sections of gastropores, showing the gastrostyles.  $\times 30$ .

Number of dactylopores in a cyclosystem	9	10	11	12	13	14	15	16	17	18	Average
Type specimen, British Museum (50)		2	8	7	16	11	5	1			12.90
Locality unknown, Paris Museum (100)	2	6	9	31	22	21	5	4			12.68
Tahiti, first colony, Copenhagen Museum (100)		2	3	16	29	27	19	4			13.49
Tahiti, second colony, Copenhagen Museum (100)	1	7	18	31	22	12	8	1			12.39
Tuamotu Islands, Copenhagen Museum (100)	1	1	6	19	19	25	17	7	3	2	13.54

Stewart (1878, p. 42). Owing to the wide cup-like upper part of the gastropores the tops of the gastrostyles are easily visible when examined in surface view with a lens.

In the sections of specimens from the Paris Museum (fig. 3) the depth of the gastropores (from the upper margin of the cup-shaped part to the bottom of the cylindrical part) varies from 0.44 to 0.58 mm, the length of the gastrostyles varies from 0.19 to 0.33 mm, their thickness from 0.05 to 0.13 mm. The shape of the gastrostyles is slightly variable, some are slender, almost cylindrical (fig. 3 *d, f, j*), others are more pronouncedly conical (fig. 3 *a, c, e, g, h*). In some of the gastropores the style appears to be exceptionally long (fig. 2 *b*), then the upper part of the style has not been partitioned off from the rest by the formation of a transverse wall, and the filling up of the deeper parts of the gastropore with calcareous matter has not taken place. A gastropore with a gastrostyle of this kind was figured by Stewart (1878, Pl. 3 fig. 4, cf. text-fig. 1 *d* in the present paper). One of the figures (fig. 3 *e*) shows two ampullae, of a diameter of 0.24 and 0.27 mm, apparently from a male colony.

The gastropores of the specimens from Tahiti in the Copenhagen Museum correspond in every detail with those in the Paris Museum. Here again the gastropore is divided into an upper cup-shaped part with wide opening and a lower cylindrical part containing the gastrostyle (fig. 4). In the figured longitudinal sections the depth of the entire gastropore varies from 0.41 to 0.59 mm, the length of the gastrostyles is from 0.22 to 0.35 mm, their thickness from 0.07 to 0.13 mm. Here again there are gastrostyles of a nearly cylindrical shape (fig. 4 *a, e, i*) and gastrostyles of conical appearance (fig. 4 *b, d, g*).

The gastropores of the specimens from the Tuamotu Islands in the Copenhagen Museum closely correspond with those of the corals from Tahiti and from unknown locality dealt with above.

The dactylopores of *Allopora stellulata* have well-developed dactylostyles. These structures were already described and figured by Stewart (1878, "small, rounded, brightly glittering, and nearly colourless sphaerules"). The dactylopores are united with the gastropores by distinct dactylotomes.

Stewart (l. c.) describes the ampullae as small rounded or conical elevations; in the explanation of his figures (cf. fig. 1 in the present paper) the only reference to ampullae is to those in the part of the branch here reproduced as fig. 1 *c*. Here are drawn four subspherical elevations in a longitudinal row, which have, when measured in the figure, a diameter of 0.28 to 0.36 mm; they evidently represent female ampullae. Though not mentioning them, Stewart also figured the male ampullae of the species, the top of a branch reproduced in fig. 1 *a* of the present paper shows, on the surface

between the cyclo systems, some small conical elevations which often have a minute opening at their top; they have a diameter of 0.12 to 0.15 mm, and undoubtedly are the top parts of male ampullae, the larger part of which is imbedded in the coenosteum. When examining the type specimen of *Stylaster stellulatus* in the British Museum (Natural History) I could ascertain that a great number of small branches are covered with male ampullae in dense masses, while a few female ampullae are to be found widely scattered on the larger branches or sometimes in small groups.

The two large colonies of *Allopora stellulata* from Tahiti (Pl. IV figs. 1 and 2) have numerous male ampullae, chiefly on the small branchlets, the other colony from the same locality has several female ampullae. The figured colony from the Tuamotu Islands (Pl. IV fig. 3) shows a great number of

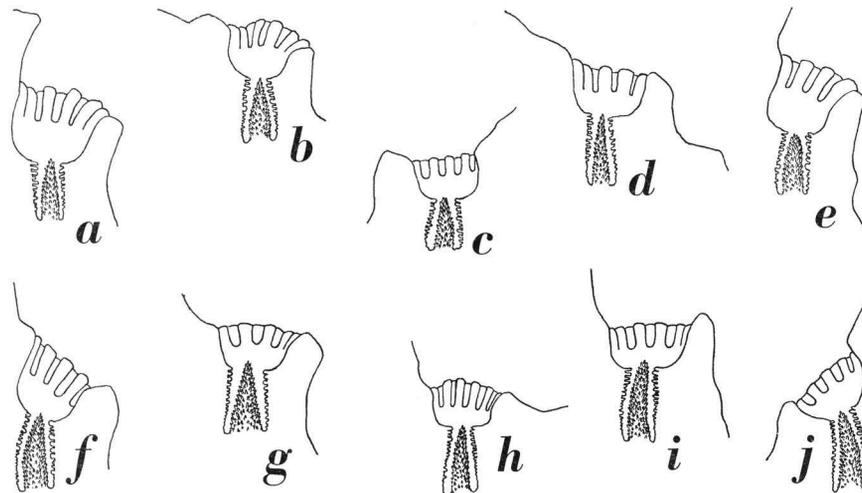


Fig. 4. *Allopora stellulata* (Stewart), specimens from Tahiti in the Copenhagen Museum; longitudinal sections of gastropores, showing the gastrostyles.  $\times 30$ .

male ampullae and a few scattered female ampullae. Of the colonies from unknown locality in the Paris Museum, which differ from the Tahiti specimens by their smaller size (Pl. III) many have male ampullae only, many others have female ampullae only, while in some colonies there are male ampullae on the smaller branches and female ampullae on some parts of the larger branches. The occurrence of the ampullae of either sex therefore does not show a correlation with the size of the colonies.

The female ampullae are of globular shape, their upper half rising as a hemispherical elevation above the surface (Pl. V fig. 1). As a rule the surface of the female ampullae is smooth, without any spines or ridges. In some specimens, however, the female ampullae are covered with small blunt spines

or warts, often of elongate shape and more or less radially arranged on the surface (Pl. V fig. 2). The diameter of the female ampullae is from 0.33 to 0.58 mm, when the top parts are filed off the internal diameter is from 0.36 to 0.42 mm (measured in a few instances only).

Male ampullae are visible in the parts of two colonies represented on Pl. VI, as straight or curved rows of fine white points or small patches of these in the parts of the surface between the cyclo systems. As in Stewart's figure they often show a small opening at their top. The diameter of the conical parts rising over the surface is about 0.1 to 0.15 mm, when filed off their cavities prove to have a diameter of 0.2 to 0.3 mm (0.24 and 0.27 mm in the male ampullae shown in fig. 3 e).

In its form of growth and in the colour of its coenosteum the species *Allopora stellulata* shows a strong resemblance to *Stylaster sanguineus* Valenciennes. In the description of the species, Stewart (1878) already remarked that the general appearance is much like that of *S. sanguineus*, but it has a bluer rose tint and differs by having cyclo systems of minute size. I have seen several specimens of *S. sanguineus* of a colour corresponding with that of the specimens of *A. stellulata* dealt with in the present paper. As far as the size of the cyclo systems is concerned the specimens of *A. stellulata* show values of 0.38 to 0.66 mm; Broch (1936, p. 33) states that in *S. sanguineus* the diameter of the cyclo systems is from 0.4 to 0.7 mm; I examined a colony of *S. sanguineus* from Australia with cyclo systems varying in size from 0.6 to 0.8 mm, while in specimens of the same species reported to come from Hawaii (in all probability originally from another locality) the cyclo systems have a diameter of 0.4 to 0.65 mm. When comparing these data it appears that only in one specimen of *S. sanguineus* (from Australia) the cyclo systems are appreciably larger than those of *A. stellulata*; in the other specimens they are of about the same size. If, therefore, the cyclo systems of *A. stellulata* are considered minute, they do not markedly differ in this respect from those of *S. sanguineus*. The chief difference between the two species is that in *A. stellulata* the gastropore has a rather wide cup-shaped upper part, in the centre of which the top of the gastrostyle is easily to be seen in surface view, while in *S. sanguineus* the upper part of the gastropore is much narrower, not so clearly exposing the top of the gastrostyle, the whole of the gastropore being somewhat narrowly funnel-shaped.

As the two species are placed in two different genera they also show the generic characters, at least to a certain degree. Without any doubt the species *stellulata* must find a place in the genus *Allopora*, for the cyclo systems occur in great abundance on the anterior and the posterior surfaces of the branches and even on the main stems. Moreover, as a rule the youngest branchlets

have irregularly scattered cyclo systems (Pl. V fig. 2, Pl. VI); in some of the colonies with more or less spreading form of growth and very slender branchlets, however, some of the topmost points of these branchlets may show cyclo systems in alternate arrangement on the sides of the branchlets only (Pl. V fig. 1). On the other hand *Stylaster sanguineus*, in which the younger parts of the colonies generally have a regular alternate arrangement of the cyclo systems on the sides of the branchlets only, sometimes may show a distribution of the cyclo systems without apparent order, even in very young branchlets (cf. Broch, 1936, fig. 8 d). In the older parts of colonies of *S. sanguineus* there are often numerous cyclo systems on the anterior and the posterior surfaces of the larger branches, though in much smaller numbers than in *A. stellulata*.

There is but one other species of the genus *Allopora* that has a cup-shaped upper part of the gastropore comparable to that in *A. stellulata*, viz., *A. venusta* Verrill, as distinctly appears from Fisher's figure of a longitudinal section (1938, Pl. 61 fig. 2a). In his description of the coral, Fisher remarks that the central cup (of the gastropore) is shallower than and of a different form from that of *A. californica* Verrill, the figure of a longitudinal section of this coral (l. c., Pl. 61 fig. 3 b) showing that the walls of the cup are flat, not concave as in *A. venusta*, the gastropore of *A. californica* thereby becoming rather funnel-shaped than cup-shaped. Though the upper part of the gastropore of *A. venusta* is entirely similar to that of *A. stellulata*, the two species show a different lower part of the gastropore, especially because the gastrostyle of *A. stellulata* is long and slender, in contradistinction to that of *A. venusta*, which is broadly conical with rounded top. Moreover, in *A. venusta* the gastropore has a ring-shaped ridge of spines encircling the top of the gastrostyle, while in *A. stellulata* the more or less cylindrical lower part of the gastropore is rather regularly covered with small spines. For the rest the two species have little in common, being of an entirely different form of growth, the colonies of *A. venusta* sparingly branching in various directions with terminal branches of a thickness of 3 or 4 mm, the colonies of *A. stellulata* regularly branching in the flabellar plane, with pronounced division in side branches, the terminal parts of which are from 0.5 to 1.5 mm in thickness.

In its geographical distribution *Allopora stellulata* seems to be restricted to the southeastern region of the Pacific. As the type specimen came from a small island in the vicinity of Tahiti (Stewart, 1878), the Society Islands are the type locality of the species (Boschma, 1957). Moseley (1880) obtained a specimen of *A. stellulata* at Tahiti said to have come from the Tuamotu Islands. The specimens dealt with in the present paper of which the localities are known are from Tahiti and from the Tuamotu Islands, data corresponding with those previously noted for the species.

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## EXPLANATION OF THE PLATES

## Plate III

*Allopora stellulata* (Stewart), anterior surface of eight colonies from unknown locality in the collections of the Paris Museum. Natural size.

## Plate IV

*Allopora stellulata* (Stewart), specimens in the collections of the Copenhagen Museum.

Fig. 1. The largest colony from Tahiti, anterior surface.

Fig. 2. Another colony from Tahiti, anterior surface.

Fig. 3. One of the colonies from the Tuamotu Islands, posterior surface.

All figures natural size.

## Plate V

*Allopora stellulaia* (Stewart), specimens in the collections of the Paris Museum.

Fig. 1. A branch of the colony of Pl. III fig. 3, showing female ampullae with a smooth surface.  $\times 5$ .

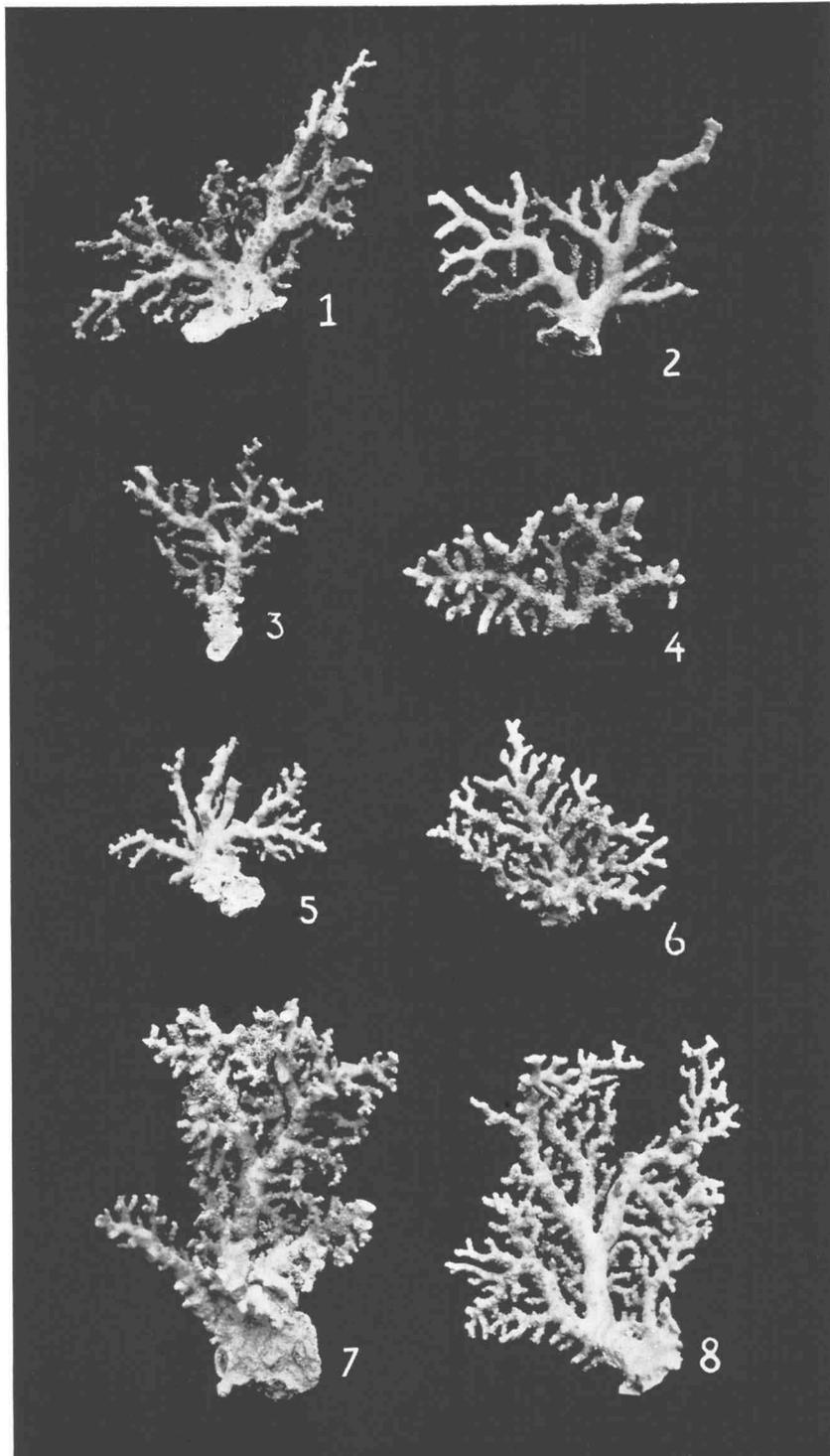
Fig. 3. A branch of a colony showing female ampullae with small spines or radiating ridges.  $\times 5$ .

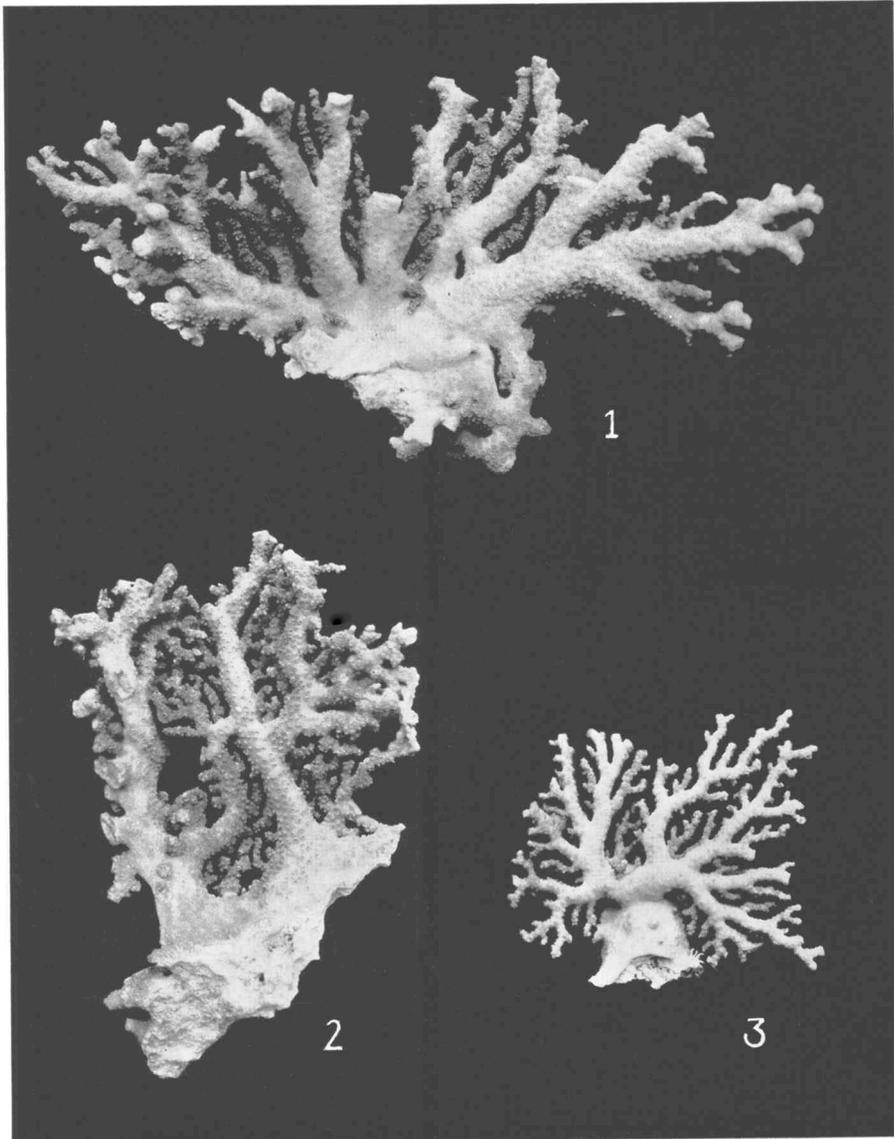
## Plate VI

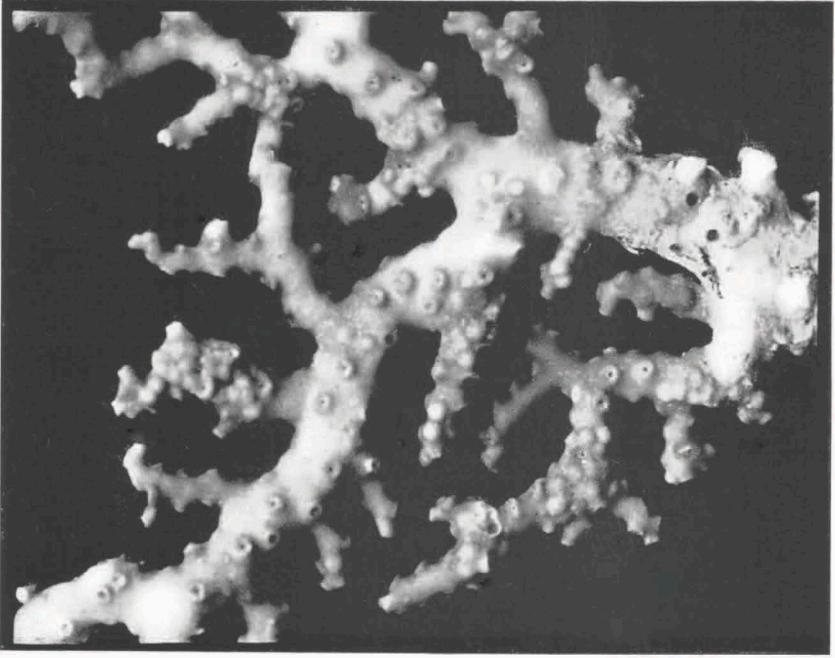
*Allopora stellulata* (Stewart), specimens from Tahiti in the collections of the Copenhagen Museum, showing male ampullae.

Fig. 1. A branch of the colony of Pl. IV fig. 1, posterior surface  $\times 5$ .

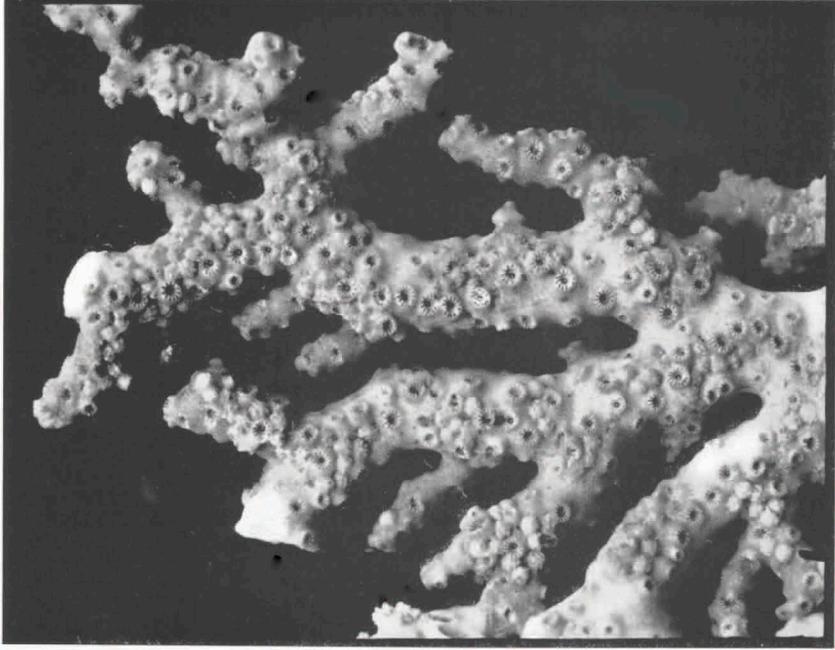
Fig. 2. A branch of the colony of Pl. IV fig. 2, anterior surface.  $\times 5$ .



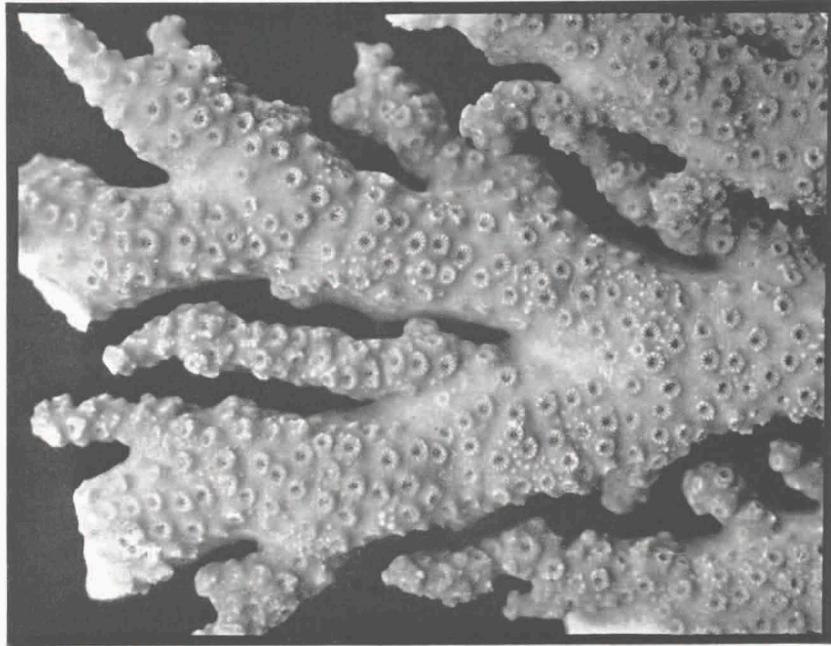




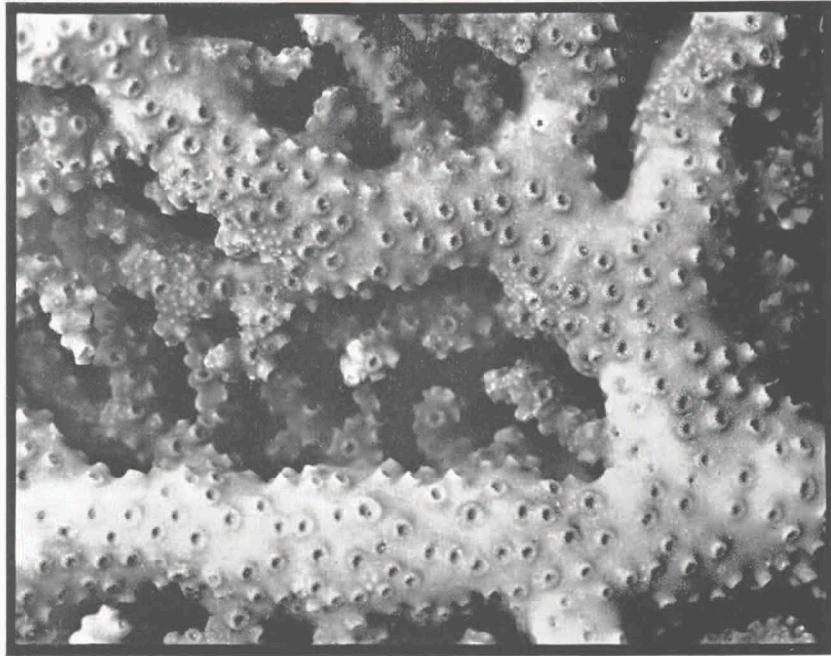
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