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SOME CORALS FROM AMERICAN SAMOA AND THE FIJI ISLANDS

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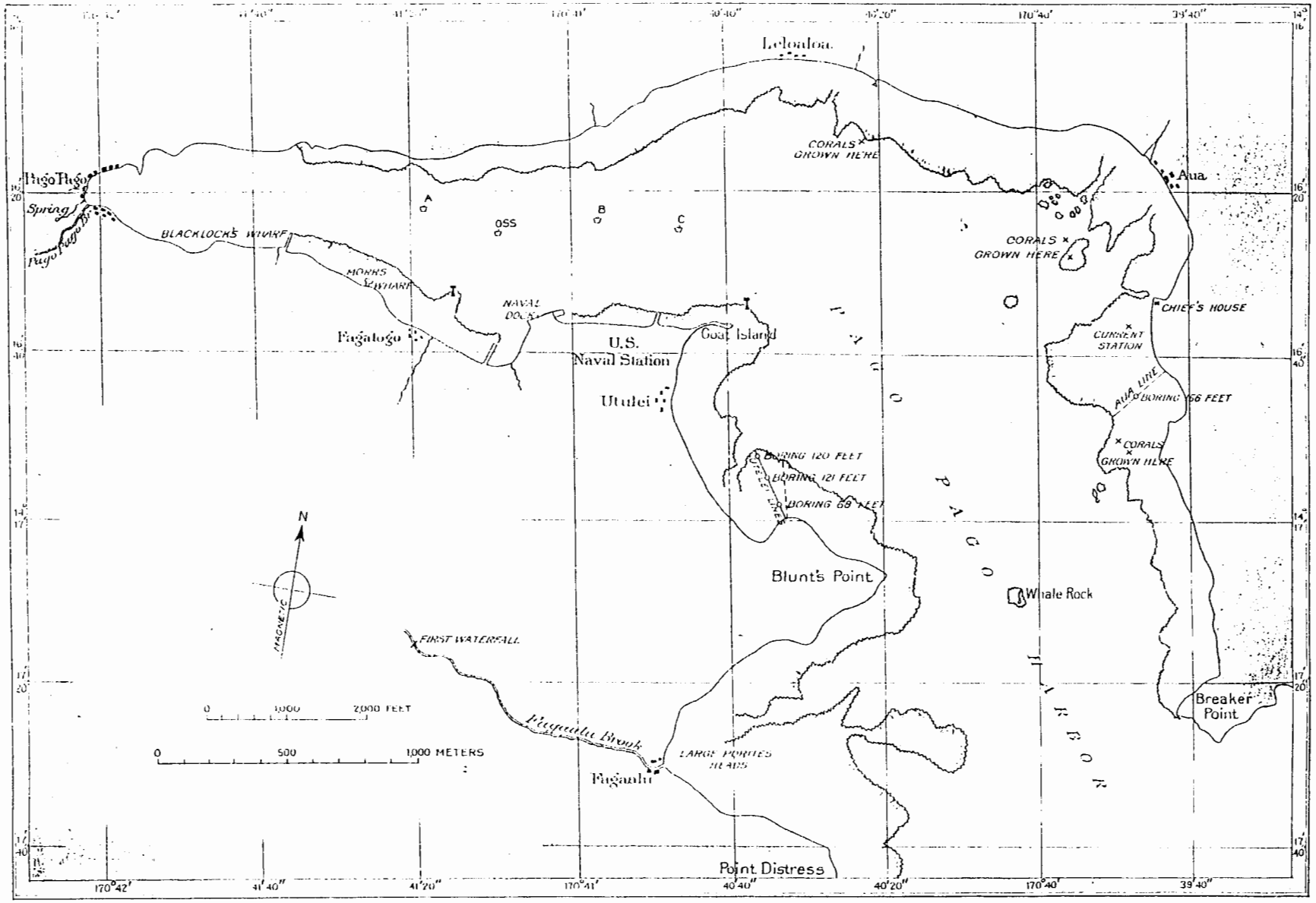

Pago Pago Harbor showing the Aua Line stations at which corals were grown, and depths of borings through the reefs at Utelei and Aua.

PLATE A

SOME CORALS FROM AMERICAN SAMOA AND THE FIJI ISLANDS.

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V

INTRODUCTION.

HISTORICAL REVIEW OF RECENT INVESTIGATIONS OF THE DEPARTMENT ON CORALS AND CORAL-REEF PROBLEMS.

For a number of years the Department of Marine Biology of the Carnegie Institution of Washington, under the direction of the late Dr. Alfred G. Mayor, has done considerable work on the study of coral reefs and problems relating to them. The investigations were first undertaken at the Department's laboratory at Tortugas, Florida, on the corals along the Florida reef-tract. In 1908, Dr. T. Wayland Vaughan began a study of the corals of this area, the results of which important work have been published in Year Books Nos. 7 to 14 of the Carnegie Institution of Washington and elsewhere.

The large number of problems and unsettled questions originated by these inquiries naturally led the investigators into other fields in search for solutions and verifications. In 1913 an expedition set out for Thursday Island in Torres Straits, off the northern end of Cape York, in order to study the celebrated coral reefs there. Much to the disappointment of the members, however, the reefs were found to be covered by a layer of mud which killed all but the largest corals. The expedition then headed for the Murray Islands, 120 miles from Thursday Island, within 5 miles of the outer edge of the Great Barrier Reef and 75 miles south of the coast of New Guinea. Here rich coral reefs were found, with abundant opportunity for study. Due to the illness of Dr. Vaughan, which prevented him from accompanying the expedition, Dr. Mayor undertook a study of the ecology of the Murray Island reefs. The former, however, critically worked over a large collection of corals from there, together with collections from Cocos-Keeling Islands and Fanning Island. The results of these investigations are to be found in Publication No. 213, Carnegie Institution of Washington.

The Samoan Expedition.

Following this, the next region to be studied was the island of Tutuila, American Samoa. The investigation here lasted over a number of years. The exact time extended over the following periods: March 4 to April 18, 1917; July 1 to August 5, 1918; July 21 to September 17, 1919; April 2 to July 28, 1920, excepting the time from April 6 to May 14, which was devoted to a visit to Fiji, where a collection of corals was made, which are considered in this paper.

The corals collected at Samoa, together with the few specimens from the Fiji Islands, were sent to Dr. Vaughan at the U. S. National Museum. On

the kind recommendation of Professor Edward W. Berry, of the Johns Hopkins University, I was invited by Dr. Vaughan to study them and prepare the report which forms the subject-matter of this paper. The task has proved to be a very interesting and profitable one to me, and it is my hope that in some small measure the results obtained may add to the general knowledge of the coral fauna.

Advantages Enjoyed in the Performance of the Work.

The conditions under which the work has been accomplished have been ideal. Through the kindness of Dr. R. S. Bassler, of the U. S. National Museum, I have had the use of an excellent room at that institution, where the facilities for such a study as this are unparalleled. Here I have had the privilege of communicating at all times with Dr. Vaughan, who has always graciously and freely given of his time and advice. Dr. Vaughan placed at my disposal all the coral collections in the museum, and also permitted me the use of his books.

The collection of living species of corals in the U. S. National Museum is probably exceeded in size only by that of the British Museum (Natural History). The important collections which it contains include the following:

(1) That of the U. S. Exploring Expedition, which Dana studied and reported on in his volume on Zoophytes. The Museum contains most of the type species described by him.

(2) That of the North Pacific Exploring Expedition, described by Dr. E. A. Verrill, of Yale University.

(3) The important collections made by the U. S. Bureau of Fisheries steamer *Albatross*, especially that made in the Hawaiian Islands in 1902, which furnished the basis for Dr. Vaughan's work on "Madreporaria of the Hawaiian Islands and Laysan," Bulletin 59, U. S. National Museum.

(4) The Philippine collections, which include about 3,000 specimens purchased from Mr. J. B. Steere, those made by the *Albatross* in 1907–1908, and other minor ones.

(5) The important collections from Murray Island by Dr. A. G. Mayor, Cocos-Keeling Island by Dr. Wood Jones, and Fanning Island by Mr. Carl Elschner, all of which have been mentioned above.

Besides the main collections there are numerous smaller ones, so that taken *en masse* a large store of material for comparative purposes has been available.

The Island of Tutuila, with an Account of Its History.

The island of Tutuila is the largest of the group known as American Samoa. The others consists of Aunuu and Cockscomb, which are satellites of Tutuila, and the Manua group, consisting of Tau, Olosega, and Ofu, and Rose Atoll. All of these islands, with the exception of Rose Atoll, are of volcanic origin.

Most of the investigations centered about Tutuila, and by far the greater part of the corals were collected from its fringing reef. The harbor

of Pago Pago, with its rich coral reefs, offered an ideal location for experiments of this nature.

The geology of Tutuila was investigated by Professors Reginald A. Daly and Rollin T. Chamberlin. The results of these investigations may be found in the annual report of the Director of the Department for the years 1919 and 1920 respectively, and also in Publication 340 of the Carnegie Institution of Washington. The latter work gives a thorough discussion of the problem. Since one of the main objects of the expedition was to obtain more knowledge on the old question of the formation of coral reefs, particular attention was given to this phase of the subject.

Dr. Mayor (Annual Report, 1920) sums up the history of Tutuila as conceived by Dr. Chamberlin as follows:

"A platform about 2 miles in width was cut by marine erosion around the island. Then this platform became submerged, while at the same time the island tilted so that the platform sank to a slightly greater depth on the southeast than along the north shore. Then reefs grew around the island, and on the north shore, where the platform was shallow, the fringing reefs largely fused with the off-shore barrier reef; but on the south shore, where the platform was submerged more deeply, the fringing reef in most places did not fuse with the barrier reef, but the lagoon remained intact between them. Later a submergence of about 190 feet occurred and the sea cliffed the shores, and finally the sea-level sank about 10 feet and then the modern fringing reefs began to grow outward from the shores over the seaward slopes of the island."

On the outer margin of the old 2-mile-wide platform surrounding the island corals began to form a barrier reef. At present this reef is submerged about 180 feet and the platform on which it grew is at least 400 feet below the present sea-level. Thus, according to Chamberlin (Annual Report, 1920):

"Tutuila, therefore, is consistent with the Darwin-Dana coral-reef hypothesis to the extent that a submergence of 400 feet has occurred since the corals began to form the old barrier reef; but in other respects it does not fit the requirements of that hypothesis, inasmuch as the barrier reef, instead of being built up several thousand feet from the slopes of a sinking island, is found to be rooted on a broad, wave-cut platform which, slightly submerged, afforded favorable conditions for coral-reef growth."

Chamberlin's explanation of "planation plus subsidence" is thoroughly treated in Publication 340.

Some of the Methods Used in the Investigation and a Few of the Results Obtained.

In order to facilitate the work of systematically studying the relations and abundance of the different species of corals on the reef-flat of Pago Pago Harbor, a line was surveyed across the reef.[1] This line, known as the Aua line because of its nearness to the village of Aua, was 855 feet long. It was surveyed and marked at 100-foot intervals by iron stakes across the reef-flat off the southern end of Aua village, on the east side of Pago Pago Harbor.

[1] See map of Pago Pago Harbor, plate A.

The line starts from a large "Pua tree" on the beach and runs S. 39° W. (magnetic) to the largest coral rock on the outer edge of the reef, marked "coral block, 3 feet," on Hydrographic Chart No. 2563, of Pago Pago Harbor. Dr. Mayor carried out many experiments over the reef-flat to determine the growth-rate, the influence of changed habitat, silt, fresh water, etc., on various species of corals. The detailed results of these investigations appear in his two papers, "The Structure and Ecology of the Samoan Coral Reefs" and "The Growth-rate of Samoan Corals" (Publication 340, Carnegie Institution of Washington). Often the experiment of dividing a colony from the reef-flat in half and placing one part in shallow, agitated water and the other half in deep, quiet water, was carried out. In this paper I have endeavored to point out the differences which these opposite conditions have caused on the morphology of the corals.

At Tutuila, just as at Murray Island, Australia, the largest number of corals was found to be growing in comparatively quiet water, about 200 feet shoreward from the region where the surges die out. The largest number of species, however, was found where the surges die out in ordinary weather.

Table 1 illustrates the percentage of coral-heads of the four genera which comprise over 90 per cent of the colonies of the reef-flats, as reported by Dr. Mayor.

TABLE 1.

Name of coral.	Percentage of coral heads.	
	Murray Island.	Tutuila, Samoa.
	p. ct.	*p. ct.*
Porites	38	47.4
Acropora	18	33.6
Pocillopora	10	4.01
Psammocora	rare	10.0
Seriatopora	25	0.0
	91	95.01

From this it is seen that *Porites* is the most abundant genus at the two places, and yet, according to Dr. Mayor, it is not so conspicuous as *Acropora*. At Samoa, *Psammocora* takes the place of *Seriatopora*, which is entirely absent.

CLASSIFICATION OF THE LARGER CORAL GROUPS.

Concerning the present system of classification, I can only repeat after others that it is in a highly unsatisfactory condition. As Dr. Vaughan has pointed out in his Murray Island paper, there are certain groups which are apparently natural, such as the Fungiidæ, the Acroporidæ, and the Poritidæ. Such a group, however, as the so-called Astræidæ present such problems that it is very difficult to classify them. Mr. Matthai's[1] attempt to

[1] Matthai, G., 1914. Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, pt. 1, pp. 1–140, 38 pls.

classify them on the basis of the character of the directive mesenteries has turned out to be very unsatisfactory, it seems to me, when it is compelled to include within the genus *Favia* many species which, in my opinion, are very different generically. Dr. Vaughan's treatment of the group (Car. Inst. Wash., Pub. 213, p. 100) appears to me to be much more satisfactory, and I am following his method in this paper. He divides Matthai's genus *Favia* into three families, Orbicellidæ, Faviidæ, and Mussidæ, and distributes the species among the four genera *Orbicella*, *Favia*, *Favites*, and *Acanthastrea*. The main criteria on which this classification is based is the method of asexual reproduction and the character of the septal margins. Dr. Vaughan emphasizes the tentativeness of this classification and realizes its weakness.

Problem of the Species.

The species problem, difficult as it is in all biologic groups, is still more perplexing in such variable forms of life as the corals, where environment stamps its influence so effectively. With our insufficient knowledge concerning the evolution of species, we can only use the term "species" in a more or less artificial manner for purposes of classification. Our main object, it seems to me, with our present information, should be, therefore, to give as clear a picture as possible of the material on which we are working, realizing the imperfection of our classification. With this thought uppermost, we can use to advantage the term "species" as defined by Dr. Vaughan in his report of the Hawaiian Island corals. He says:

> "A species is a group of individuals connected among themselves by intergrading characters and separated by distinct lacunæ from all other individuals or groups of individuals."

If our knowledge of corals were greater, and if we knew the limits of each coral species in its evolutionary march, either continuous or discontinuous, then we could use the Linnæan system as it stands without trouble. It is at times, however, very difficult to know the limits of these species, since the variation is so great. Ordinarily, if we think a specimen is far enough removed from a recognized and described type to suit our own personal views, we give it another specific name. Another person may not think it far enough removed to justify its separation. Who is right?

Bernard (The Unit of Classification for Systematic Biology, Proc. Camb. Phil. Soc., vol. 11, 1901, pp. 268–280) clearly recognized the limits of the Linnæan system as applied to our present knowledge of corals and experienced such difficulty that he proposed a temporary abandonment of it, with the substitution of a locality-number system. He proposed keeping the generic name and putting in place of the specific name a numerical fraction which told the number of distinct forms of the genus at that locality and to which one of these forms the specimen happened to belong. Thus, "*Porites*, Singapore, $\frac{4}{20}$" would mean that there were 20 distinct forms of

Porites known from Singapore, and that the one referred to was described and figured as No. 4. Bernard used this system in cataloguing the perforate corals of the British Museum.

Mr. J. Stanley Gardiner (On the Unit of Classification for Systematic Biology; A Reply to Mr. Bernard. Proc. Camb. Phil. Soc., vol. 11, 1902, pp. 423–427) criticized Mr. Bernard's proposal severely, mainly because of the unit of his classification, and also for the fact that it takes into account locality alone. I can thoroughly appreciate Bernard's attitude toward the binomial system, and yet do not believe that he gave us a better plan. Even the fact that it is a numerical classification is against it. It gives no picture of the species, an essential part of any classification. Ideas can much more readily be remembered when associated with a name than with a number. The average person does not react to a number as he does to a name, about which there is something distinctive. Gardiner, himself, believes that he can recognize the limits of species so that he can use the binomial system to advantage. He admits, however, that the separation of species from varieties requires "the examination of thousands of specimens, and that it is a task of Herculean proportions."

When a large number of specimens are available the variation may be seen to be enormous in some species. This is well illustrated in such species of *Pavona* as are described below. When there is a slight gradation taking place through many forms, so that the specimen which represents one end of the series and the one which represents the other end appear to be specifically unlike, we are still obliged, in accordance with our definition, to place them all in the same species. Often we find that two apparently distinct species are in reality members of a series connected by intergrading characters. Frequently we find specimens that lie between two previously described species and thus indicate the possibility that all may belong to an intergrading series. The question is, how are we going to designate these midway specimens? Shall they be given a new specific name? This problem has arisen several times in connection with this work, and I have often been tempted to solve it in the manner outlined below.

Suppose we find some specimens which combine some of the characters of two previously described species and appear to lie midway between them. Ordinarily we treat them in one of the following ways: We either give them a new specific name; call them a variety under one or the other outlying species; or else say that they are still within the limits of that species. Instead of following any one of the methods, it seems to me that the simplest manner of treatment would be to use some symbol which would tell our opinion in the matter and at the same time serve to locate as accurately as possible the position of the specimens in the nomenclatural table. If, for instance, we are undecided concerning some specimens, since they combine some of the characters of *Leptoria gracilis* (Dana) and some of *Leptoria*

phrygia (Ellis and Solander), and if they appear closer to the latter, we might easily designate them

Leptoria phrygia (Ellis and Solander)→*gracilis* (Dana).

This reads

Leptoria phrygia (Ellis and Solander) grade *gracilis* (Dana).

Following this it would be necessary to make a clear statement as to the reason for the designation, making plain which characters are variable. This not only gives a picture of the specimens, but I believe, if the method were followed to any extent, it would aid materially toward the collection of information showing in what direction the march of evolutionary variation tends. I have been somewhat hesitant about using this system to any great extent here until I have had more expressions of opinion from others concerning its value.

In his publications, Dr. Vaughan has endeavored to make clear the forms which he has described by an extensive use of the term "variety." He says in his Hawaiian paper: "A variety would be a secondary mode on a species curve." Wherever possible I have made use of this system, which often meets the requirements to the best advantage.

SAMOAN CORALS ACCORDING TO STATION.

The stations from which Dr. Mayor collected the Samoan corals come under four distinct divisions. First, those which were taken at measured distances from shore along the Aua line; second, those from various localities on the Aua reef-patch without regard to the Aua line; third, those dredged at various places in and near Pago Pago Harbor; fourth, those from tide-pools near the seaward edge of the Aua reef and the Utelei reef. Tables 2 to 6 inclusive give the lists of species and other information of these divisions in the order indicated above.

TABLE 2.—*List of corals from Aua line and distances from shore, in feet.*

	50 to 75.	100 to 125.	200 to 225.	400 to 424.	424 to 448.	460 to 484.	526 to 550.	600 to 624.	700 to 724.	766 to 790.	812 to 836.	850 to 874.
Pocillopora damicornis Linnæus, typical				×				×				
Pocillopora damicornis var. cespitosa Dana				×		×		×	×	×		×
brevicornis Lamarck												×
Leptastrea purpurea (Dana)	×	×	×	×				×	×			
Galaxea fascicularis Linnæus												×
Favites abdita (E. and S.)								×				×
Goniastrea retiformis (Lamarck)												×
Leptoria phrygia (E. and S.)→gracilis (Dana)									×			
Hydnophora microconos (Lamarck)							×		×			
Fungia fungites (Linnæus)									×			
Pavona divaricata Lamarck						×	×	×	×	×		
frondifera Lamarck				×				×	×	×		
decussata Dana						×	×					
Psammocora contigua Esper, typ				×		×					×	
var. tutuilensis, n. var								×				
Montipora venosa (Ehrenberg)									×	×		
elschneri Vaughan										×		
ehrenbergii Verrill										×		
trabeculata Bernard										×		
verrilli Vaughan									×			
Acropora formosa var. gracilis (Dana)				×			×	×	×	×		
var. brachiata (Dana)						×	×	×	×	×		
hebes (Dana)									×	×	×	
samoensis (Brook)								×	×			
valida (Dana)									×	×		
fructicosa (Brook)												×
corymbosa (Lamarck)										×		
hyacinthus (Dana)	×								×	×		×
quelchi (Brook)										×		
leptocyathus (Brook)												×
massawensis von Marenzeller												×
crateriformis (Gardiner)												×
tutuilensis, n. sp.												×
Porites lobata Dana forma nodulosa, new forma									×	×		
lutea M. E. and H. typ					×		×	×				
var. haddoni Vaughan	×	×					×	×				
murrayensis Vaughan	×	×					×					
andrewsi Vaughan	×		×	×		×	×	×				
undulata Klunzinger							×	×		×		
Alveopora verrilliana Dana							×					
Millepora truncata Dana							×	×	×			

TABLE 3.—*Summary table of Aua-line corals.*

Distance from shore (feet).	Depth at low tide (inches).	Character of bottom.	No. of species at each station.	No. of species according to growth-form.		
				Fragile branches and free disks.	Stout branches.	Massive or incrusting.
50 to 100	18 to 24	Coarse, sandy.	5	2	....	3
100 225	24	Limestone, sand, coral.	4	2	....	2
400 484	6 to 8	Rocky limestone.	9	6	....	3
500 550	....	.....	15	7	2	6
600 624	9 to 12	Rocky, hard.	16	7	1	8
700 790	12	Hard, rocky, broken limestone.	24	9	3	12
800 874	18	Hard, rocky limestone with tide-pools.	13	2	7	4

A certain amount of interpolation was resorted to in computing these figures. For instance, if a species was found at the 700-foot station and also at the 500-foot station, it has been taken for granted that it also was present 600 feet from shore.

It is interesting to compare table 3 with the similar one in Vaughan's Murray Island report (Carnegie Inst. Wash. Pub. 213, p. 69). The two tables bring out practically the same information and agree remarkably well. The line I across the southeast reef of Murray Island, which is equivalent to the Aua line, begins at 300 feet from shore and reaches to the seaward edge of the reef at 1,775 feet from shore. Table 3 shows that there are a few corals of massive growth-form growing within 50 to 100 feet of the shore, but, as in the case of the Australian corals, they reach their greatest development near the outer edge of the reef, between 700 and 800 feet. Those with stout branches begin near the center of the reef and increase in the number of species toward the outer edge. Those with fragile branches grow best in the central portion of the reef and are reduced in number near the outer and inner edges.

TABLE 4.—*List of corals collected at various places on Aua reef-patch, without relation to Aua line.*

	400 ft.	500 ft.	600 ft.	700 ft.	Depth at low tide (inches).	Character of bottom.	Character of water.
Pocillopora damicornis var. cespitosa Dana	×	....	....	×	12	.....	Rough.
brevicornis Lamarck	....	....	×	....	....	.....	.....
eydouxi M. E. and H.	....	....	....	×	12	Rocky and broken.	Agitated.
Leptastrea purpurea Dana	....	....	×	....	12	Rocky	Somewhat agitated.
Galaxea fascicularis Linnæus	....	....	....	×	....	.....	.....
Favia pallida (Dana)	....	....	×	....	15	Do	Fairly quiet.
Favites abdita (E. and S.)	....	....	....	×	12	Hard limestone.	Agitated.
halicora (Ehrenberg)	....	....	×	....	....	.....	.....

TABLE 4.—*Continued.*

	400 ft.	500 ft.	600 ft.	700 ft.	Depth at low tide (inches).	Character of bottom.	Character of water.
Hydnophora microconos (Lamarck)	....	....	....	×	12	Rocky	Rough.
Mussa sinuosa (Lamarck)	....	....	....	×	12	Do	Fairly agitated.
Pavona frondifera Lamarck	×	....	....	....	8	Rocky limestone	Quiet.
decussata Dana	×	....	....	....	8	Do	Do.
Psammocora contigua var. maldivensis Gardiner	×	....	....	....	8	Do	Do.
samoensis n. sp	....	....	....	×	Very shallow	Rocky	Agitated.
Montipora venosa (Ehrenberg)	×						
verrilli Vaughan	....	....	×	×	12	Do	Rough.
Acropora hebes (Dana)	....	....	×	....	.....	.....	Quiet, shallow.
teres (Verrill)	....	....	....	×	24	Hard, rocky	
samoensis (Brook)	....	....	....	×	.....	.....	Agitated.
fructicosa (Brook)	....	....	×				
corymbosa (Lamarck)	×	....	....	....	8	Limestone reef-flat.	Quiet.
cymbicyathus (Brook)	....	....	....	×			
hyacinthus (Dana)	....	....	....	×	12	Rocky	Agitated.
leptocyathus (Brook)	....	....	×	×	12	Broken limestone	Do.
massawensis von Marenzeller	....	....	×				
palifera (Lamarck)	....	....	....	×	12	Rocky	Rough.
vanderhorsti, n. s	....	....	....	×	.....	Rocky, with broken limestone.	Do.
Porites lutea var. haddoni Vaughan	×	....	....	....	.....		
andrewsi Vaughan	×	....	....	....	8	Rocky limestone.	

Table 5 gives the names of the species which were dredged, their locations, and the depth in fathoms.

TABLE 5.

	Off Utelei reef.	Off Aua reef.	Off buoy A.	Off Loa Loa.	Off Trading Point.	Off Taema Bank.
Pocillopora brevicornis Lamarck	.....	.....	.....	.....	.....	7.5 to 13
eydouxi M. E. and H	.....	.....	.....	2		
Cyphastrea microphthalma Lamarck	18					
Fungia fungites (Linnæus)	.....	5				
patelliformis Boschma	.....	.....	12 to 18			
Pachyseris speciosa (Dana)	7.5 to 19	.....	12 to 14			
levicollis (Dana)	18	.....	17			
Leptoseris gardineri van der Horst	18 to 27	17 to 18	12 to 16	18		
scabra Vaughan	.....	8 to 16	12 to 14			
Coscinaræa columna Dana	.....	2				
Acropora cymbicyathus (Brook)	.....	.....	.....	.....	×	
prolixa Verrill	1	5.5				
palifera (Lamarck)	.....	2				
tutuilensis, n. sp	.....	.....	.....	.....	.....	7.5 to 13
pagoensis, n. sp	.....	.....	.....	.....	.....	7.5 to 13
Porites faustinoi, n. sp	.....	3.5 to 5.5				
horizontalata, n. sp	18	8 to 16	12 to 14			
Alveopora allingi, n. sp	.....	16.66	.....	16.66		
Millepora truncata Dana	1	.....	.....	2		

Aua reef and Utelei reef are on opposite sides of Pago Pago Harbor. The distance between the seaward edge of one from that of the other is about 3,000 feet. The list in table 6 gives the names of those species found growing in the tide-pools on the seaward edges of these reefs. There are 40 species in all, and 16 of these are common to both reefs.

TABLE 6.

	Tide-pools, Aua reef.	Tide-pools, Utelei reef.		Tide-pools, Aua reef.	Tide-pools, Utelei reef.
Pocillopora brevicornis Lamarck	×	×	Fungia fungites (Linnæus)	×	×
eydouxi M. E. and H.	×	×	Pachyseris carinata Brüggemann	.....	×
Euphyllia glabrescens C. and E.	.....	×	Pavona divaricata Lamarck	×	×
Orbicella curta Dana	×	×	Coscinaræa columna Dana	.....	×
Galaxea fascicularis Linnæus	×	×	Psammocora superficialis Gardiner	×	.....
Favia favus Forskål	×	×	Diploastrea heliopora (Lamarck)	×	×
stelligera (Dana)	×	.....	Dendrophyllia diaphana Dana	.....	×
rotumana (Gardiner)	.....	×	Astreopora profunda Verrill	×	×
Favites abdita (E. and S.)	×	×	Montipora vaughani, n. sp	.....	×
halicora (Ehrenberg)	×	×	tuberculosa (Lamarck)	.....	×
Goniastrea retiformis (Lamarck)	×	×	M. verrilli var. auaensis, n. var	.....	×
pectinata (Ehrenberg)	×	.....	berryi, n. sp	×	.....
Leptoria phrygia (E. and S.)→gracilis Dana	.....	×	Acropora prolixa (Verrill)	.....	×
tenuis (Dana)	.....	×	leptocyathus (Brook)	×	.....
Meandra lamellina Ehrenberg	.....	×	rotumana (Gardiner)	×	.....
Hydnophora microconos (Lamarck)	×	×	palifera (Lamarck)	×	×
Hydnophora microconos (Lamarck)→ rigida (Dana)	.....	×	Porites undulata Klunzinger	×	×
Merulina vaughani van der Horst	.....	×	Alveopora verilliana Dana	.....	×
sinuosa (Lamarck)	×	.....	Millepora alcicornis Linnæus	.....	×
			truncata Dana	×	×

CORALS FROM THE FIJI ISLANDS.

The following species were collected from the barrier reef off the mouth of Suva Harbor:

Pocillopora damicornis var. cespitosa Dana.
Galaxea fascicularis Linnaeus.
Favia speciosa (Dana).
Meandra dædalea (E. and S.).
Hydnophora mayori, n. sp.
Fungia paumotensis (Stutchbury).
Pavona decussata Dana.
Acropora exigua (Dana).
samoensis (Brook).
canaliculata (Klunz.).
latistella (Brook).

LIST OF SPECIES FROM SAMOA AND FIJI CONSIDERED IN THIS PAPER.

(91 species and 7 varieties.)

Pocillopora damicornis Linnaeus.
var. cespitosa Dana.
brevicornis Lamarck.
eydouxi M. E. and H.
Euphyllia glabrescens (Chamisso and Eysenhardt).
Orbicella curta Dana.
Cyphastrea microphthalma (Lamarck).
Leptastrea purpurea (Dana).
Galaxea fascicularis (Linnaeus).
Favia favus Forskål.
pallida (Dana).
stelligera (Dana).
speciosa (Dana).
rotumana (Gardiner).
Favites abdita (Ellis and Solander).
halicora (Ehrenberg).
Goniastrea retiformis (Lamarck).
pectinata (Ehrenberg).
Leptoria phrygia (E. and S.)→gracilis Dana.
tenuis (Dana).
Meandra dædalea (E. and S.).
lamellina Ehrenberg.
esperi (M. E. and H.).
Hydnophora microconos (Lamarck).
(L.)→rigida (Dana).
mayori, n. sp.
Merulina vaughani van der Horst.
Mussa sinuosa (Lamarck).
Symphyllia nobilis (Dana).
Fungia fungites (Linnæus).
paumotensis Stutchbury.
patelliformis Boschma.
Pachyseris speciosa (Dana).
levicollis (Dana).
carinata Brüggemann.
Pavona divaricata Lamarck.
frondifera Lamarck.
decussata Dana.
Leptoseris gardineri van der Horst.
scabra Vaughan.
Coscinaræa columna (Dana)
Psammocora contigua Esper.
var. maldivensis Gardiner.
var. tutuilensis, n. var.
superficialis Gardiner.
samoensis, n. sp.
Diploastrea heliopora (Lamarck).
Dendrophyllia diaphana Dana.
Astreopora profunda Verrill.
Montipora vaughani, n. sp.
venosa (Ehrenberg).
tuberculosa (Lamarck).
elschneri Vaughan.
ehrenbergii Verrill.
trabeculata Bernard.
verrilli Vaughan.
auaensis, n. var.
berryi, n. s.
Acropora formosa var. gracilis (Dana).
var. brachiata (Dana).
exigua (Dana).
hebes (Dana).
teres (Verrill).
nobilis (Dana).
samoensis (Brook).
valida (Dana).
canaliculata (Klunzinger).
fructicosa (Brook).
corymbosa (Lamarck).
cymbicyathus (Brook).
hyacinthus (Dana).
latistella (Brook).
syringodes (Brook).
prolixa (Verrill).
quelchi (Brook).
africana (Brook).
leptocyathus (Brook).
massawensis von Marenzeller.
rotumana (Gardiner).
palifera (Lamarck).
crateriformis (Gardiner).
vanderhorsti, n. sp.
tutuilensis, n. sp.
pagoensis, n. sp.
Porites lobata Dana.
forma nodulosa, n. forma.
lutea M. E. and H.
var. haddoni Vaughan.
murrayensis Vaughan.
pukoensis Vaughan.
andrewsi Vaughan.
(Synaræa) undulata (Klunzinger).
faustinoi, n. sp.
horizontalata, n. sp.
Alveopora verriliana Dana.
allingi, n. sp.
Millepora alcicornis Linnæus.
truncata Dana.

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SYSTEMATIC DISCUSSION OF THE SPECIES.

Class ANTHOZOA.

Subclass ZOANTHARIA Milne Edwards and Haime.

Order HEXACORALLA Haeckel.

MADREPORARIA IMPERFORATA.

Family SERIATOPORIDÆ Milne Edwards and Haime.

1849. *Seriatoporidæ* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 29, p. 262.
1869. *Pocilloporidæ* Verrill, Proc. Essex Inst., vol. 6, p. 90.

Genus POCILLOPORA Lamarck.

1816. *Pocillopora* Lamarck, Hist. nat. Anim. sans Vert., vol. 2, p. 273.
1849. *Pocillopora* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 29, p. 261.

Type species: *Pocillopora acuta* Lamarck.

Pocillopora damicornis (Linnæus).

Plate 1, fig. 1; also illustrated in Mayor's "Growth-Rate of Samoan Corals."

1791. *Madrepora damicornis* (in part) Esper, Die Pflanzenth., Madrep., plates 46 and 46A.
1834. *Pocillopora bulbosa* Ehrenberg, Der Corallenthiere des Rothen Meeres, p. 127, genus 75.
1846. *Pocillopora cespitosa* Dana, U. S. Expl. Exped., Zooph., p. 525, plate 49, figs. 5, 5*a*. (Variety).
1846. *Pocillopora bulbosa* Dana, U. S. Expl. Exped., Zooph., p. 49, figs. 6, 6*a*. (Variety).
1860. *Pocillopora damicornis* Milne Edwards and Haime, Coralliaries, tome 3, p. 303.
1918. *Pocillopora bulbosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 75, plate 21, figs. 1, 1*a*; plate 12, figs. 1, 2, 3.

This is a much confused case of nomenclature. To begin with, Linnæus described a species under the name of *Millepora damicornis* (S. N., ed. 10, sp. 9). Pallas (1766) placed it under *Madrepora damicornis* and recognized three varieties which he called α, β, and γ. Following this, Ellis and Solander (1786, Hist. Zooph., p. 170, No. 73) redescribed the γ variety of Pallas.

In his "Die Pflanzenthiere" Esper described four so-called varieties of *M. damicornis* and published four plates (Nos. 46, 46A, 47, and 48) illustrating these varieties. He considered the variety illustrated by plate 46 as representing the β variety of Pallas, plate 46A the γ variety, and plate 48 equivalent to the α variety.

In 1816, Lamarck revised the classification and separated the genus *Pocillopora* from *Madrepora*. He believed that Esper's plates 46 and 46A illustrate *P. damicornis*, but referred to them as describing the α and β varieties of Pallas and gave the name *P. acuta* to the γ variety.

Ehrenberg (1834, Genus LXXV, sp. 3) follows Lamarck and describes a new species, *Pocillopora bulbosa*. Dana (1846) considers *P. damicornis* as belonging to the alpha variety of Pallas and to Esper's plate 47. He believes *P. bulbosa* Ehrenberg is represented by Esper's plate 46, and believes plate 46A represents a variety of the same species. Milne Edwards and Haime (1860) agree with Dana in referring *P. bulbosa* to Esper's plate 46, but believe that *P. damicornis* is represented by plate 46A.

In all this confusion one fact seems to stand out. It is noticeable that the majority of writers have in mind primarily the same idea as to the typical *P. damicornis*. Ellis and Solander believe that their *P. damicornis* is equivalent to the gamma variety of Pallas, which according to Esper is illustrated by his plate

46A. Lamarck refers to 46 and 46A as describing *P. damicornis*. Milne Edwards and Haime agree that the typical *P. damicornis* is represented by Esper's plate 46A. Dana alone disagrees when he refers to *damicornis* as represented by Esper's plate 47.

Concerning *P. bulbosa* Ehrenberg, Milne Edwards and Haime and Dana are agreed that it is illustrated by Esper's plate 46. Milne Edwards and Haime say that *P. damicornis* and *P. bulbosa* do not appear to be specifically distinct from each other. Considering *P. damicornis* to be represented by Esper's plate 46A, it seems, therefore, as Vaughan (1918) observed, that the *damicornis* of Dana should be given a different name. One of Dana's specimens is No. 660 in the U. S. National Museum, and it appears to be specifically distinct from the common conception of *damicornis*.

From the above it would seem that *P. bulbosa* is a synonym of *P. damicornis*. In the U. S. National Museum there are two specimens which Dana identified as *P. bulbosa*. One of them (No. 718 U. S. Nat. Mus.), which he figured (plate 49, figs. 6, 6*a*), is very similar to Esper's poor illustration 46, and is, according to Dana, typical *P. bulbosa*. The other one (No. 885 U. S. Nat. Mus.), which Dr. Vaughan illustrated (Carnegie Inst. Wash. Pub. 213, plate 21, figs. 1, 1*a*) and which is similar to Esper's plate 46A, is, according to Dana, simply a variety of *P. bulbosa*. It is quite evident that they are very similar. Since it is necessary to come to some understanding concerning these two and other closely related forms, I believe I have sufficient ground to offer the following classification:

Pocillopora damicornis (Linnæus), typical.

This is illustrated by Esper's plate 46A. Vaughan's *P. bulbosa* Ehrenberg (Carnegie Inst. Wash. Pub. 213, plate 21, figs. 1, 1*a*) is also referred here.

Pocillopora damicornis var. bulbosa Ehrenberg=P. bulbosa Ehrenberg, typical.

This variety is represented by Esper's plate 46. Plate 1, figure 1, of this paper shows Dana's figured specimen of *P. bulbosa*, which comes here.

Pocillopora damicornis var. cespitosa Dana=P. cespitosa Dana.

This is the *P. cespitosa* of Dana. I have examined many specimens of *cespitosa*, including Dana's type, and have no hesitancy in referring it to a variety to *P. damicornis*. The only difference between the two is that the former is a neater and a more finely branching type. The typical *damicornis* has a more straggly appearance and generally thicker branches, which are not so finely divided at the summit into little short branchlets. One variety grades gently into the other. *P. damicornis* var. *cespitosa* is thoroughly described by Vaughan (1907) in his report of the Recent Madreporaria of the Hawaiian Islands and Laysan (U. S. Nat. Mus. Bull. 59).

Stations, Pago Pago Harbor, Tutuila, Samoa:

Pocillopora damicornis (Linnæus), typical

No. 1. Aua line, 600 to 624 feet from shore, depth about 9 inches.
Nos. 2, 3, and 4. Aua line, 400 to 424 feet from shore.

Pocillopora damicornis var. cespitosa Dana.

No. 1. Aua line, 400 feet from shore, water 6 inches deep; quiet.
Nos. 2 to 5. Aua line, 600 to 624 feet from shore.
No. 6. Aua line, 460 to 484 feet from shore.
Nos. 7 to 9. Aua line, 700 to 724 feet from shore.
Nos. 10 to 12. Aua line, 766 to 790 feet from shore.
No. 13=No. 3 (Mayor). Aua Reef flat, 700 feet from shore. Rough water about 1 foot deep at low tide.

Nos. 14*a* and 14*b*=Nos. 10S and 10D (Mayor). Two halves of same colony. 14*a*=10S. Half of colony taken from about 400 feet from shore in shallow water on Aua Reef flat and grown in shallow, very rough water on the breaker-washed edge of a reef-flat off Aua. 14*b*=10D. Half of colony grown for year in water 42 feet deep in absence of any currents, off a reef-patch off Aua. The branches of the half grown in deep water grew taller and were more separated than those of the shallow-water half. Part of the deep-water half died, and altogether it was not in as healthy condition as the other half.

No. 15=No. 2D (Mayor). Same history as No. 14*b*.

No. 16=No. 28 (Mayor). From 400 feet from shore on Aua Reef flat, in quiet water 8 inches deep at lowest tide. Bottom rocky. Only a small part of colony living.

No. 17=No. 45D (Mayor). Grown in agitated water, 2 fathoms. Has *brevicornis* facies.

No. 18=No. 17 (Mayor). From Double Point. Growth station No. 1.

No. 19=No. 7 (Mayor). Aua Reef-flat 400 feet from shore. Rocky limestone bottom. Water quiet, about 8 inches deep at lowest tide.

No. 20=No. 6 (Mayor). Same as No. 19.

No. 21=No. 5 (Mayor). Same as No. 19.

No. 22=No. 6 (Mayor). Hard, rocky bottom off Double Point. Water agitated, about 1 foot deep at lowest tide.

Nos. 23 and 24. 150 feet off mouth of big brook. Killed by fresh water and silt.

No. 25=No. 10 (Mayor). Fiji Islands.

Distribution of Pocillopora damicornis (Linnæus).—Sandwich Islands; Tahiti; Laysan; Hawaiian Islands; Indian Ocean; Amboina; Fiji Islands; Cocos-Keeling Islands; Singapore; Fanning Island; Samoa.

Pocillopora brevicornis Lamarck.

Plate 1, fig. 2. Also Mayor's "Growth-Rate of Samoan Corals."

1816. *Pocillopora brevicornis* Lamarck, Anim. sans Vert., vol. 2, p. 275, sp. 4.
1846. *Pocillopora brevicornis* (pars) Dana, U. S. Expl. Exped., Zooph., p. 526, plate 49, fig. 8.
1871. *Pocillopora brevicornis* Verrill, Proc. Essex Inst., vol. 6, p. 92.

The Samoan collection contains 12 specimens of this species. The majority of these agree perfectly with Dana's specimen of *P. brevicornis* from the Fiji Islands, which is No. 721 U. S. Nat. Mus. They are low, cespitose, even-topped, with branches very short, thick, and crowded. A few specimens have slightly longer and less crowded branches, and appear to grade toward *P. meandrina* Dana. This strengthens Vaughan's (U. S. Nat. Mus. Bull. 59, p. 100, 1907) belief that *P. brevicornis* is a part of the same series to which *P. danæ* Verrill, *P. verrucosa* (Ellis and Solander) Lamarck, *P. meandrina* Dana, and *P. elegans* Dana belong. This series is characterized by inconspicuous or obsolete septa and columellæ.

Stations: Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 6. Aua line, 850 to 874 feet from shore.

No. 7. Shallow tide-pool on seaward edge of Utelei Reef.

Nos. 8 and 9. Agitated pure water near seaward edge of Aua Reef. Shallow tide-pools at low tide.

No. 10. Dredged in 7.5 to 13 fathoms over Taema Bank, south of Pago Pago Harbor.

No. 11=No. 49D (Mayor). Grown in agitated water 2 fathoms deep.

Nos. 12*a* and 12*b*=Nos. 20S and 20D (Mayor). Halves of same colony taken from about 600 feet from shore on Aua Reef flat. No. 12*a*=20S was grown in rough water on breaker-washed outer edge of Aua Reef patch. No. 12*b*=20D was placed at depth of 51 feet in quiet water. The deep-water half died without growing, while only part of the other half survived.

Distribution.—East Indies; Fiji and Sandwich Islands; Ceylon; Samoa.

Pocillopora eydouxi Milne Edwards and Haime.

Illustrated in Mayor's "Growth-Rate of Samoan Corals."

1860. *Pocillopora eydouxi* Milne Edwards and Haime, Hist. nat. Corall., p. 306, plate F 4, figs. 1, 1*a*.
1897. *Pocillopora grandis* Gardiner, Proc. Zool. Soc. London, p. 950, plate 57, fig. 3.
1918. *Pocillopora eydouxi* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 79, plate 24, figs. 1, 2, 2*a*.

This species has been adequately described and figured in the above-mentioned publications. It belongs to the group containing well-developed septa and columellæ and is closely related to *P. plicata* Dana, *P. elongata* Dana, *P. coronata* Gardiner, and *P. modumanensis* Vaughan. Vaughan (Bull. 59, U. S. Nat. Mus., p. 93) states that *P. eydouxi* and *P. coronata* are probably synonyms of *P. elongata* Dana. *P. modumenensis* Vaughan is also so similar to these that I doubt its validity. Dr. Mayor collected 6 specimens of this species. Those grown in deep water show very irregularly placed verrucæ. The shallow-water specimens are more regular and have a neater appearance.

Stations. Pago Pago Harbor, Tutuila, Samoa:

No. 1 = No. 42D (Mayor). Grown in agitated water at depth of 2 fathoms.
No. 2 = No. 33D (Mayor). Grown in agitated water at depth of 2 fathoms off Loa Loa village.
Nos. 3 and 4. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
No. 5. Shallow tide-pools on seaward edge of Utelei Reef.
No. 6. = No. 30 (Mayor). From about 700 feet out from shore near seaward edge of reef-flat off Aua village. Water agitated, 1 foot deep at low tide. Bottom rocky and broken.

Distribution.—Cocos-Keeling; Funafuti; Rotuma; Lifu, Loyalty Islands; Samoa.

Family EUSMILIIDÆ Verrill.

Genus EUPHYLLIA Dana.

1846. *Euphyllia* (pars) Dana, U. S. Expl. Exped., Zooph., p. 157.
1918. *Euphyllia* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 81.

Type species: *Caryophyllia glabrescens* Chamisso and Eysenhardt.

Euphyllia glabrescens (Chamisso and Eysenhardt).

1821. *Caryophyllia glabrescens* Chamisso and Eysenhardt, Nov. act. curios nat., vol. 10, pt. 2, p. 369, plate 33, figs. 1, *a* and *b*.
1846. *Euphyllia rugosa* Dana, U. S. Expl. Exped., Zooph,. p. 166, plate 6, figs. 3, 3*a* to 3*c*.
1918. *Euphyllia glabrescens* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 82, plate 26, figs. 2, 3, 3*a*; plate 19, fig. 48.

Vaughan (op. cit., pp. 81, 82, and 83) discusses the nomenclatural history of this species in detail. There is a large suite of specimens belonging to it in the U. S. National Museum collected by J. B. Steere in the Philippine Islands. Dana's type of *E. rugosa* (No. 88, U. S. Nat. Mus.) belongs undoubtedly to the synonymy of *Euphyllia glabrescens* (C. and E.). Dr. Mayor collected 2 small, stunted specimens. The costæ are more prominent on them than is generally found in those from the Philippines. In this respect it resembles Dana's type of *E. rugosa* closely.

Station, Pago Pago Harbor, Tutuila, Samoa.—Shallow water on the seaward edge of Utelei Reef, in breakers.

Distribution.—East coast of Africa to the Samoa Islands.

Family ORBICELLIDÆ Vaughan.

Genus ORBICELLA Dana.

1846. *Orbicella* Dana, U. S. Expl. Exped., Zooph., p. 205.
1918. *Orbicella* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 85.

Type species: *Orbicella annularis* (Ellis and Solander).

Orbicella curta Dana.

1846. *Orbicella curta* Dana, U. S. Expl. Exped., Zooph., p. 209, plate 10, figs. 3, 3*a* to 3*c*.
1914. *Favia wakayana* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., p. 104, plate 25, fig. 4.
1918. *Orbicella curta* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 86, plate 28, figs. 2, 3, 4, 4*a*, 5; plate 17, fig. 32. (with synonymy).

In the U. S. National Museum there is a good suite of specimens belonging to this species, including Dana's type and his type of *P. coronata*, which is a synonym. I am referring 3 Samoan specimens to it. All are explanate fragments with slightly convex, even-topped surfaces. Calices circular or subcircular, occasionally deformed in crowded areas.

The one from Utelei Reef differs from the others by its larger corallites, which stand higher above the peritheca. In this specimen the average-sized calice is 6 mm. in diameter and 5 mm. deep. The septa have arched upper margins and drop nearly vertically to the columella. Costæ prominent with edges serrate. Corallites project at times as much as 3 mm. above the peritheca. Septa in average-sized calice number 18 well-developed ones with 11 reaching columella. There is a cycle of very small septa alternating with the 18 large. Secondaries frequently fuse with primaries. Septal edges roughly serrate, with serrations increasing in size towards columella. Palar lobes not so prominent as in the type specimen. Edges and faces of septa covered with coarse granulations. Columella obscure and made of septal trabeculæ.

In the other two specimens the size of the average corallite is 4.5 mm. in diameter and 3 mm. deep. The corallites are exsert 2 mm. above the peritheca. There are 15 well-developed septa with a cycle of very small alternating ones. Six septa reach the columella. In all other respects they are like the Utelei Reef specimen.

Reproduction takes place by intercalicular budding.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Shallow tide-pools on seaward edge of Utelei Reef.
No. 2. Aua Reef. From agitated water within wash of breakers near seaward edge of upper surface of the reef. Water 2 feet 6 inches deep at lowest tide. Usually about 200 feet inward from seaward edge of the reef.
No. 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

Distribution.—Torres Strait; Kermadec Islands; Fiji Islands; Wake Island; Paumotus; Tahiti; Murray Island; Samoa.

Genus CYPHASTREA Milne Edwards and Haime.

1848. *Cyphastrea* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 27, p. 494.

Type species: *Astrea microphthalma* Lamarck.

Cyphastrea microphthalma (Lamarck).

1816. *Astrea microphthalma* Lamarck, Hist. nat. Anim. sans Vert., vol. 2, p. 261.
1914. *Cyphastrea microphthalma* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 43, plate 7, fig. 6; plate 12, figs. 4 to 9; plate 13, figs. 1, 2, 7; plate 34, fig. 4.
1918. *Cyphastrea microphthalma* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 88, plate 29, figs. 1, 1*a*.

This species is represented in the collection by one small specimen. Matthai's description and plates clearly illustrate the species and mark the differences between it and some closely related ones.

Station.—Dredged in about 18 fathoms off Utelei Reef, Pago Pago Harbor, Samoa. Found living associated with *Leptoseris*.

Distribution.—Red Sea; Indian Ocean; Philippine Islands; Samoá.

Genus LEPTASTREA Milne Edwards and Haime.

Mayor's "Growth-Rate of Samoan Corals," plate 12, figs. 36 *a*, *b*.

1848. *Leptastrea* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 27, p. 494.

Type species: *Leptastrea roissyana* Milne Edwards and Haime.

Leptastrea purpurea (Dana).

1846. *Astræa purpurea* Dana, U. S. Expl. Exped., Zooph., p. 239, plate 12, figs. 10, 10*a* to 10*c*.
1849. *Leptastrea ehrenbergiana* Milne Edwards and Haime, Ann. Sci. nat., 3d ser., Zool., vol. 12, p. 120.
1914. *Leptastrea ehrenbergana* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 68, plate 17, figs. 5 to 7; plate 18, figs. 2 and 7; plate 19, figs. 3 and 4; plate 34, fig. 8.
1918. *Leptastrea purpurea* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 91, plate 30, figs. 1, 1*a*, 2, 3, 3*a*; plate 17, fig. 33 (with synonymy).

There are a large number of specimens belonging to this species in the collection. They are all small, incrusting forms, growing either on lithothamnion or dead coral.

The largest corallum is nodular in shape, with a diameter of about 40 mm. The calices vary from 2 to 5 mm. in diameter. They are polygonal and usually have a narrow groove on the summits of the walls. The small calices have 24 septa alternately larger and smaller, all of the larger ones reaching the columella. The largest calice has 52 septa. In medium-sized calices the members of the first and second cycles are practically the same size. As a rule the inner edges of the septa slope downward to the columella. However, in many cases the inner edges are nearly subvertical. The septal faces are possessed with coarse, conical granulations. The septal edges become more dentate as they approach the columella. The latter is largely papillate and composed of fused edges of the dentate septa. Reproduction takes place predominantly by interstitial budding.

Concerning the differences between *L. purpurea* and *L. transversa*, Vaughan (op. cit., p. 90) says,

"Two of the species, *L. purpurea* and *L. transversa*, have conspicuously polygonal corallites and calices (which are often deformed) and no free corallite limbs. In the former the grouping of the higher cycles of septa around the lower is usually obvious. The septal edges are conspicuously dentate, the septal faces show distinct granulations, and the columella is papillate. In the latter the septal grouping is rare, the septal edges are entire or only with microscopically fine dentations, the septal faces are nearly smooth, and the columella is either without distinct papillae or they are only slightly developed. Usually there is a lamella extending lengthwise of the calice between the directive septa, while the principal septa outside the directive plane fuse to its sides."

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 and 2. Aua line, 400 to 424 feet from shore.
Nos. 3, 4, 5. Aua line, 600 to 624 feet from shore.
No. 6=No. 5 (Mayor). From 600 feet out from shore on the Aua Reef flat off Aua village. Water somewhat agitated, bottom rocky; depth at lowest tides about 1 foot.
No. 7. 150 feet off mouth of big brook. Killed by fresh water and silt.
No. 8. From square No. 4, Aua line, 100 to 125 feet from shore; water 2 feet deep at low tide; bottom coral sand and limestone.
No. 9. From square No. 5, Aua line, 200 to 225 feet from shore; water 2 feet deep at low tide; limestone, sand, and coral bottom.
No. 10=No. 36B (Mayor). Aua line, 700 feet from shore. Did not grow during 15 months.
No. 11. From square No. 3. Aua line 50 to 75 feet from shore. Coarse, sandy bottom.

Distribution.—Red Sea; Indian Ocean; Great Barrier Reef; Philippines; Rotuma and Funafuti; Makemo, Paumotus; Fanning Island; Hawaiian Islands; Samoa.

Genus GALAXEA Oken.

1815. *Galaxea* Oken, Lehrb. Naturg., Th. 3, Abth. 1, p. 72.
1857. *Galaxea* Milne Edwards and Haime, Hist. nat. Corall., vol. 2, p. 223.

Type species: *Madrepora fascicularis* Linnæus.

Galaxea fascicularis (Linnæus).

Mayor's "Growth-Rate of Samoan Corals," plate 13, figs. 48 *a*, *b*.

1904. *Galaxea fascicularis* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 59, plate 8, fig. 4; plate 16, fig. 4; plate 34, fig. 3; plate 38, fig. 6.
1918. *Galaxea fascicularis* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 98, plate 33, figs. 2, 3, 3*a*; plate 34, fig. 1.

There are 5 specimens of *G. fascicularis* in the collection.

Corallum forms a convex cluster. The corallites are subcircular to elliptical and are frequently distorted. Amount of projection of corallites from peritheca is very variable (2 to 12 mm.). Diameter of average-sized, subcircular corallite 5.5 mm.; elliptical ones may measure 8 mm. by 5 mm. The upper ends of the septa are exsert often as much as 3 mm. Distance between corallites 2 to 3 mm.

In the more mature specimens there are four complete cycles of septa. In two of the specimens, however, the majority of corallites show only three cycles. It is evident that these latter are immature specimens. The costæ are distinct at calicular edges and become obscure lower down. The columella is a deeply set tangle composed of the ends of the septa where they fuse.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua line, 812 to 836 feet from shore.
No. 2=No. 48 (Mayor). From about 700 feet off shore of Aua village. Bottom broken and rocky; water about 1 foot deep at low tide.
No. 3. Shallow tide-pools, pure agitated water near seaward edge of Aua Reef.
No. 4. Shallow tide-pools on seaward edge of Utelei Reef. Suva Harbor, Fiji.
No. 5=No. 77F (Mayor). Barrier reef off mouth of Suva Harbor.

Distribution.—Red Sea; Indian Ocean; Great Barrier Reef; Philippine Islands; Fiji Islands; Samoa.

Family FAVIIDÆ Gregory.

Genus FAVIA Oken.

1815. *Favia* Oken, Lehr. Naturg., Th. 3, Abth. 1, p. 67.
1857. *Favia* Milne Edwards and Haime, Hist. nat. Corall., vol. 2, p. 426.
1902. *Favia* Verrill, Trans. Conn. Acad. Arts and Sci., vol. 11, p. 88.
1918. *Favia* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 100.

Type species: *Madrepora fragum* Esper.

Vaughan (op. cit., p. 100) regroups Matthai's[1] 25 species of *Favia* under the old generic names of *Orbicella*, *Favia*, *Goniastrea*, *Acanthastrea*, and *Favites*. As this seems to be the much more satisfactory method, I am following his usage. Below is Vaughan's key to the genera and the revised grouping of the species. Matthai's names are given in the left-hand column and the revised names in the right-hand column. The numbers are those used by Matthai; an asterisk means that the species is represented in the U. S. National Museum.

[1] Trans. Linn. Soc. London, 2d ser., Zool., vol. 17.

Calices subcircular; asexual reproduction normally by intercalicular gemmation. Genus *Orbicella*.

12. *Favia versipora* (Lamarck) ..... **Orbicella versipora* (Lamarck).
13. *Favia wakayana* (Gardiner) ..... **Orbicella curta* Dana.
14. *Favia solidior* (M. Edw. and H.) Perhaps only a variant of *O. curta* (Dana) ..... **Orbicella solidior* (M. E. and H.)

Calices elliptical, subequal fission (except in *F. pallida*). Genus *Favia*.

1. *Favia favus* (Forskål) ..... **Favia favus* (Forskål).
4. *Favia clouei* (Valenciennes) ..... **Favia speciosa* (Dana).
9. *Favia laxa* (Klunzinger) ..... **Favia laxa* (Klz.).
25. *Favia rotulosa* (Ell. and Sol.) ..... *Favia rotulosa* (Ell. and Sol.).
23. *Favia* sp.? = *rotumana* (Gardiner) ..... **Favia rotumana* (Gardiner).
21. *Favia fragum* (Esper) ..... **Favia fragum* (Esper).
8. *Favia ananas* (Ell. and Sol.) ..... *Favia peronii* (M. E. and H.).
11. *Favia acropora* (Linn.) ..... **Favia stelligera* (Dana).
2. *Favia doreyensis* M. Edw. and H. ..... } **Favia pallida* (Dana).
3. *Favia hululensis* Gardiner ..... }
6. *Favia bertholleti* (Val.) ..... **Favia valenciennesii* (M. Edw. and H.).

Calices polygonal, solid separating walls, subequal fission, without spines on upper part of septal edges. Genus *Goniastrea*.

16. *Favia hombroni* (Rousseau)* } ..... { Probably should be referred to *Goniastrea*.
24. *Favia* sp. ? = *tenella* (Gardiner) }

Calices polygonal, intercorallite walls fused, subequal fission, with spines on upper parts of septal edges. Genus *Acanthastrea*.

19. *Favia hemprichii* (Ehrenberg)* } ..... { Probably the same species and probably referable to *Acanthastrea*.
2. *Favia parvimurata* Gardiner. }
10. *Favia hirsuta* (M. Edw. and H.) ..... **Acanthastrea echinata* (Dana).

Calices polygonal, often pentagonal, asexual reproduction by marginal fission. Genus *Favites*.

5. *Favia abdita* (Ell. and Sol.) ..... **Favites abdita* (Ell. and Sol.).
18. *Favia complanata* (Ehrenberg) ..... **Favites complanata* (Ehr.).
17. *Favia vasta* (Klunzinger) ..... **Favites virens* (Dana).
15. *Favia halicora* (Ehrenberg) ..... **Favites halicora* (Ehr.).
7. *Favia pentagona* (Esper) ..... **Favites melicerum* (Ehr.).

Favia favus (Forskål).

1914. *Favia favus* Matthai, Trans. Linn. Soc. London., 2d ser., Zool., vol. 17, p. 79, plate 9, fig. 2; plate 20, figs. 1 to 6; plate 21, figs. 1 to 8; plate 22, figs. 1 to 5; plate 32, fig. 1.

I am referring 6 specimens to this species.

Corallum forming rather light, convex clumps. Corallites elliptical to polygonal, often deformed. The calices are somewhat smaller than those of Matthai's specimens and the number of septa correspondingly less. Average size 10 by 7 mm. across and 6.5 mm. deep. Distance between corallites averages 1 to 1.5 mm.

Number of septa in average-sized calice is 30, of which 9 or 10 reach columella. They are rather thick and are exsert about 1 mm. Each septum may be divided into two parts: (1) an upper portion which extends from the corallite rim to about half the way to the columella; (2) at this point it widens and forms a bench of 1 mm., and then drops nearly vertically to the columella. The serrations of the septal margins are large on the upper portion and much finer and more numerous on the lower. In 2 specimens the septa of the first cycle are very prominent in some of the calices. Septal faces covered with rough spinules, which, with the exsert, serrated margins, give the corallum a rough appearance throughout.

The columella is deep seated and rather poorly developed.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
Nos. 4 to 6. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Red Sea; Chagos, Solomon; Seychelles; Maldives; Minikoi; Singapore; Ceylon; Weligama; Funafuti; Tongatabou; Dar-es-Salaam; Samoa. In the U. S. National Museum there are some specimens from French Somaliland and the southern Philippines, identified by Dr. Vaughan as belonging to this species.

Favia stelligera (Dana).

1846. *A. Orbicella stelligera* Dana, U. S. Expl. Exped., Zooph., p. 216, plate 10. figs. 9*a* to 9*e*.
1914. *Favia acropora* Matthai (*non* Esper), Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 102, plate 25, figs. 1, 3; plate 33, fig. 1.
1918. *Favia stelligera* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 101, plate 34, figs. 2, 2*a*, 2*b*, 3; plate 35, figs. 1, 1*a*, 2, 2*a*, 3, 4. (With synonymy).

Corallum heavy; texture dense. Often formed like slightly flattened cylinder with all edges rounded off. Surface smooth to gently undulating. The individual corallites are much smaller than those of the other species of the genus. They average from 2 to 2.5 mm. in diameter; usually subcircular except when elongated for reproduction; rims distinct. Distance between corallites ranges from 0.75 to 2 mm.; average distance 1 mm. Calices shallow. Number of septa ranges from 15 to 24; 6 to 13 meet columella. Matthai speaks of them thickening towards walls. This thickening is so slight that it is scarcely noticeable in the Samoan specimens. The septa are roughly serrated and covered with fine spinules. They are slightly exsert and are separated by a groove from those of adjoining corallites. A cycle of very small septa usually alternate with the well-developed ones. The columella is distinct, but very loosely constructed. Reproduction takes place usually by subequal fission, but there are many cases of distinctly unequal fission. A partition never crosses the septa.

Stations, Pago Pago Harbor, Tutuila, Samoa.—Nos. 1 to 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

Distribution.—Red Sea; Indian Ocean; Pacific Ocean; Rotuma; Fiji Islands; Paumotus; Fanning Island; Cocos-Keeling Islands; Samoa.

Favia speciosa (Dana).

1846. *Astræa speciosa* Dana, U. S. Expl. Exped., Zooph., p. 220, plate 11, figs. 1, 1*a* to 1*d*.
1846. *Astræa puteolina* Dana, U. S. Expl. Exped., Zooph., p. 223, plate 11, figs. 3, 3*a*, 3*b*.
1918. *Favia speciosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 103, plate 36, figs. 1, 2, 2*a*, 3, 4, 4*a*; plate 37, figs. 1, 2, 3, 4, 4*a*. (With synonymy.)

Two small, hemispherical specimens in the collection from Suva Harbor, Fiji, agree perfectly with Dana's type of *Astræa puteolina*. Vaughan (op. cit., p. 103) has described this form of *Favia speciosa* and has figured Dana's type of *puteolina* (plate 36, fig. 3). Many irregularly shaped, deformed corallites, which are rather crowded, are characteristic of the form.

Station.—Nos. 1 and 2 = Nos. 76F and 60F (Mayor). From tide-pool on barrier reef off Suva Harbor, Fiji.

Distribution.—Red Sea; Djibouti; Maldives; Chagos; Ceylon; Cocos-Keeling Islands; Great Barrier Reef; Amboina; Philippines; Fiji Islands; Fanning Island.

Favia pallida (Dana).

1846. *Astræa pallida* Dana, U. S. Expl. Exped., Zooph., p. 224, plate 10, figs. 13, 13*a* to 13*e*.
1918. *Favia pallida* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 105, plate 38, figs. 1 to 7; plate 16, figs. 26, 27, 29, 30. (With synonymy.)

There are 2 specimens in the Samoan collection which belong to facies 3 of Vaughan (op. cit., p. 107). Plate 38, figure 4, and plate 16, figure 26, of Publication 213 illustrate this facies.

Stations:

No. 1. Aua Reef flat, 580 feet from shore, on rocky bottom, about 15 inches deep at low tide; water fairly quiet. Pago Pago Harbor, Tutuila, Samoa.
No. 2. Rose Island, Samoa. Shallow water, about 5 inches deep at low tide, on the lithothamnion ridge.

Distribution.—From Maldives eastward to the Samoa Islands.

Favia rotumana (Gardiner).

Plate 1, figs. 3*a*, 3*b*, 3*c*.

1899. *Astræa rotumana* Gardiner, Proc. Zool. Soc. London, Astraeid Corals from the South Pacific, p. 750, plate 47, fig. 3.
1914. *Favia* sp.? Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 113, sp. 23.

The two fragments from Rose Island have a rather dense, solid structure, and the one from the Utelei Reef is incrusting lithothamnion. The following is a brief description of specimen No. 2, from the former locality.

This is a piece of what was evidently a large, heavy, subhemispherical corallum. The corallites are subelliptical, except where compressed to distinctly polygonal shape. Average size 10 by 7 mm., and 7 mm. deep. As a rule, they are close together.

Septa thickened in wall; exsert as much as 2.5 mm.; drop nearly vertically into calice, but near bottom they form bench containing palar protuberance, from which the principal ones extend downward to columella. Septal edges may be nearly entire, except for very fine dentations. In the average-sized calice 10 or 11 septa join the columella. Septal faces contain very fine granulations. The columella is made of septal trabeculæ and is very spongy. Reproduction by subequal fission.

Besides these specimens, the U. S. National Museum has some splendid examples of the species from Hereheretue Island.

Stations:

No. 1. Rose Island. Shallow water on the lithothamnion reef-flat.
No. 2. Rose Island. Shallow water in pools 6 inches deep at low tide, surrounded by lithothamnion.
No. 3. Shallow tide-pools along seaward edge of Utelei Reef, Pago Pago Harbor, Tutuila, Samoa.

Distribution.—Funafuti; Rotuma; Wakaya; Hereheretue Island; Samoa.

Genus FAVITES Link.

1807. *Favites* Link, Besch. Samml., Rostock, 3d pt., p. 162.
1901. *Favites* Vaughan, Samml. Geol. Reichs. Mus. Leiden, 2d ser., vol. 2, p. 21.
1902. *Favites* Verrill, Trans. Conn. Acad. Arts and Sci., vol. 11, p. 92.
1918. *Favites* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 109.

Type species: *Madrepora abdita* Ellis and Solander = *Madrepora favosa* Esper, plate 45A, fig. 2.

Favites abdita (Ellis and Solander).

Mayor's "Growth-Rate of Samoan Corals," plate 7, figs. 20, *a*, *b*.

1914. *Favia abdita* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 91, plate 9, fig. 5; plate 29, figs. 1 to 4; plate 35, fig. 2.
1918. *Favites abdita* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 109, plate 40, figs. 1 to 5; plate 16, fig. 31. (With synonymy.)

In general, the corallum has a hillocky mode of structure. On the hillocks the corallites slope against one another. Usually the walls are appreciably thicker at the base than at the top and thus resemble waves. The calices are polygonal and very variable in diameter and depth. Averages in these dimensions are about 8 mm. and 4 mm. respectively.

The average-sized calices contain 33 septa, not including the cycle of very fine, insignificant ones with nearly entire edges. Septal margins very roughly serrated, the serrations increasing in size towards the columella, although rather prominent at the summit also. At the base they often constitute a palar crown around the columella. The septa are exsert about 1 mm. The columella is composed of

twisted trabeculæ and often has a papillate appearance. Reproduction takes place by marginal fission.

I have referred 5 specimens to this species. No. 2 is practically exactly like Dana's type of *Astræa robusta*, which is nearly typical *Favites abdita*. The other specimens differ from the typical form by their smaller calices, and also by having rather prominent septal dentations just within the calicular rims, which, however, become larger towards the columella. Generally the typical *F. abdita* has septal margins which are fairly smooth near the summit of the wall and become rougher farther down.

Distinguishing characteristics.—The hillocky appearance is in general characteristic of *F. abdita*, but can not be relied upon too much. This peculiar growth-form is a result of the method of reproduction, and is therefore liable to be found in all species of *Favites*. Some specimens of *F. abdita* resemble those of *F. halicora* (Ehrenberg) so closely that it is very hard to tell them apart. In general, they can be separated by the shallower calices, hillocky structure, and more gently sloping septa of *F. abdita*. Usually *F. halicora* has walls with flatter, often centrally grooved summits, and septa which plunge down sharply into the calicular opening. As a rule, also, the septal dentations just within the calices of *F. halicora* are more pronounced than is the case in the other species.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1 = No. 20 (Mayor). From about 700 feet out on Aua Reef. Water agitated; bottom hard limestone; 1 foot deep at lowest tides.
No. 2 Aua line, 600 to 624 feet from shore.
No. 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
No. 4. Aua line, 850 to 874 feet from shore.
No. 5. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Red Sea; Indian Ocean; widely distributed in Pacific Ocean as far east as Samoa.

Favites halicora (Ehrenberg).

1914. *Favia halicora* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 106, plate 26, figs. 3, 5 to 7.
1918. *Favites halicora* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 110, plate 41, figs. 1, 2, 3.

I am referring 6 specimens to this species. They show only in slight degree the hillocky structure so characteristic of *F. abdita*. Calices polygonal with rounded corners. Average calice 13 by 9 mm. across. In the usual-sized calice there are 37 well-developed septa, 18 of which reach the columella. Alternating with these there is a cycle of thin, small septa. Average depth of calices is 6 mm. The septal dentations are pronounced throughout entire length of septa, becoming slightly larger as the columella is approached. Septal faces covered with spinules. Intercorallite walls average 2 to 3 mm. wide at the top. Rather frequently there is a groove between the corallites. Columella made of twisted trabeculæ with rough ends projecting vertically upward. Reproduction by marginal fission.

Distinguishing characteristics. (See under *F. abdita* (Ellis and Solander.)

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua Reef flat, 600-foot station.
No. 2. Not known.
Nos. 3 and 4. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
Nos. 5 and 6. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Red Sea; Maldives; Murray Island; Fanning Island; Samoa.

Genus GONIASTREA Milne Edwards and Haime.

1848. *Goniastrea* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 27, p. 495.

Type species: *Astrea retiformis* Lamarck.

Goniastrea retiformis (Lamarck).

1816. *Astrea retiformis* Lamarck, Hist. Anim. sans vert., II, p. 265, 2d édit., p. 415.
1914. *Goniastrea solida* Matthai, Trans. Linn. Soc. London, 2d ser., Zool., vol. 17, p. 117, plate 10, fig. 1; plate 28, figs. 3, 4; plate 31, fig. 6; plate 33, fig. 4; plate 38, fig. 3.
1914. *Goniastrea retiformis* Matthai, op. cit., p. 119, plate 10, fig. 3, plate 31, figs. 1 to 5, plate 33, fig. 3, plate 38, figs. 2, 4.
1918. *Goniastrea parvistella* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 114, plate 44, figs. 2, 2*a*.
1918. *Goniastrea retiformis* Vaughan, op. cit., p. 114, plate 15, fig. 24; plate 16, fig. 25.

Vaughan (op. cit., p. 114) corrects Matthai's use of *G. solida* and applies Dana's name of *G. parvistella* to this species. The main difference that I am able to make out in all these specimens is in the thickness of the walls. The Samoan specimens show walls, however, which are as thin as those in typical *G. retiformis* in some parts of the corallum, and in other parts are as thick as those of Dana's type of *G. parvistella*. I am inclined, therefore, to put all of them under *Goniastrea retiformis* and make the thick-walled specimens a variety, var. *parvistella*. The *parvistella* variety has slightly smaller calices than those of the type.

I have examined very carefully all of the specimens of *G. retiformis* in the U. S. National Museum, including those in the Samoan collection, and have compared them with Dana's type of *G. parvistella* (No. 67 U. S. Nat. Mus.) and with Matthai's descriptions and figures of *G. solida* and *G. retiformis*.

The following is a brief description of one of the typical specimens:

Corallum massive with even-topped, undulating surface. Calices polygonal; diameter 2 to 4 mm., depth 1 to 2.5 mm. Inter-calicular walls are 0.50 to 1 mm. thick. In an average-sized calice there are 20 septa, alternating with which is a cycle of rudimentary ones. The well-developed septa unite with the rudimentary ones of the adjoining corallites. All the septa are roughly serrate. From 7 to 11 reach the columella, and these have large paliform lobes surrounding it which at times extend two-thirds of the way up to the surface of the corallite.

I am placing all the Samoan specimens with the typical *G. retiformis*.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Just back of the breakers, in shallow water on Aua Reef flat.
No. 2. Aua line, 850 to 874 feet from shore.
No. 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
No. 4. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Red Sea; Indian Ocean; Great Barrier Reef; Amboina; Philippine Islands; eastward in Pacific to Samoa Islands.

Goniastrea pectinata (Ehrenberg).

1834. *Astræa pectinata* Ehrenberg, Corallenth. Roth. Meer., p. 96.
1918. *Goniastrea pectinata* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 114, plate 43, figs. 1, 2, 3, 3*a*, 4, 5, 5*a*. (With synonymy.)

The lone specimen from the Samoa Islands has a small, rounded, knob-like corallum. Many calices meander somewhat, especially at the summit of the colony. The average-sized calice is 7 by 5 mm. across and 3 mm. deep. A few meandering ones are drawn out to 12 mm. and retain a width of 4 mm. Walls thin, between 0.75 and 1 mm. thick. Septa wide near surface and give walls appearance of appreciable thickness. Upper septal margins are nearly horizontal, and then they drop practically vertically to bench possessing palar lobes. Septa exsert at times as much as 0.75 mm. Septal edges roughly serrated, with serrations of nearly same

size; faces covered with spinules. In an average-sized calice there are 28 well-developed septa with 14 reaching columella. Alternating with the well-developed ones there is a cycle of rudimentary ones which usually join the large septa of the adjoining corallites. Columella very poorly developed. Reproduction by sub-equal fission.

Station, Pago Pago Harbor, Tutuila, Samoa—Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

Distribution.—Red Sea; Great Barrier Reef; southern Philippine Islands; Fiji Islands; Samoa Islands.

Genus LEPTORIA Milne Edwards and Haime.

1848. *Leptoria* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 27, p. 493.

Type species: *Madrepora phrygia* Ellis and Solander.

Leptoria phrygia (Ell. and Sol.)→gracilis Dana.

Plate 2, figs. 1*a*, 1*b*.

I have been considerably puzzled concerning these specimens and have been compelled to place them in this category until a larger suite can be available for study. Vaughan has discussed *Leptoria phrygia* and *L. gracilis* in his Murray Island work, pages 117 and 118. His plate 46, figure 1, shows Ellis and Solander's type of *Madrepora phrygia*, which is in the Hunterian Museum, Glasgow. Figures 4 and 4*a* of the same plate show Dana's type of *Meandrina gracilis*. The main differences in these types consist in the more crowded septa and the perhaps slightly sharper collines of the latter. Ellis and Solander's type contains "from 11 to 12 large septa to 1 cm. without or rarely with intermediate small septa, septal margins flat across the collines." Dana's type contains as many as 26 septa to the centimeter and "has broadly triangular collines, or the upper septal margins may be flatly arched."

Plate 45, figure 5, and plate 46, figure 3, of Vaughan's paper show a specimen of *L. phrygia* from Cocos-Keeling Island which differs from the type by having more crowded septa and at times low, triangular septal margins over the collines. This shows a tendency towards *L. gracilis*. Plate 46, figures 4 and 4*a*, shows Dana's specimen of *L. gracilis* from the Fiji Islands.

The Samoan specimens illustrate an apparent intergradation between the species to a great extent. One specimen, especially, shows rather crowded septa whose upper margins are exceedingly flat. The number of septa per centimeter is intermediate between the two types. As no other criteria are known, it is very possible that the two species are variants of one. Until more specimens are available I am keeping them separate.

The following is a brief description of specimen No. 2.

Corralum explanate, even-topped, undulating. Calices indistinct and meandering; system of meandering collines and valleys. Distance between colline summits is 3 to 4 mm.; depth of valleys 2.5 mm. Septa slightly exsert, cross walls, and generally fuse with corresponding septa of neighboring row; 18 or 19 in every centimeter. Septal margins nearly horizontal on top of collines, but at times form flat triangle. Septa drop nearly vertically into valleys; margins finely and regularly serrate. Septal faces spinulose with spinules occurring in rows so as to give septa a leaf-like appearance with venations. The columella is lamellar, with the spinulose, lamellate plates compressed parallel to the valleys. There are about 8, stretched out, one behind the other, in the valleys for every centimeter.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua line, 700 to 724 feet from shore.
No. 2 Shallow tide-pools on seaward edge of Utelei Reef.
No. 3. Agitated shallow water just back of the lithothamnion ridge, Aua Reef.

Distribution of Leptoria phrygia (Ellis and Solander).—Cocos-Keeling Islands; southern Philippines; Ceylon.

Distribution of Leptoria gracilis (Dana).—Fiji Islands; Murray Island; Indian Ocean; Red Sea.

Leptoria tenuis (Dana).

1846. *Meandrina tenuis* Dana, U. S. Expl. Exped., Zooph., p. 262, plate 14, figs. 7, 7*a* to 7*d*.
1918. *Leptoria tenuis* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 119, plate 47, figs. 1, 1*a*.

I am referring one specimen to this species. Identification is based on Dana's type No. 62 U. S. National Museum and on a specimen also in the U. S. National Museum from the Southern Philippines, collected by J. B. Steere. The following is a description of this species:

Fragment of very light, massive corallum. Rows of meandering valleys and collines. Walls very thin. Septa thin and slightly exsert. Septal margins nearly flat across the collines or form broad triangles with apices immediately above wall; side margins with nearly equally sized, fine serrations drop vertically into valleys. The septa cross collines and fuse with corresponding septa of adjoining row. Septal faces possess regular rows of spinules which give septa a frond-like appearance with venations. Distance from summit to summit 3 to 4 mm., width across valleys from one septal margin to another 1 mm., depth of valleys 2.5 mm. About 16 large septa per centimeter of calicular row; rarely any small septa. Columella same as in preceding description, except thinner.

This specimen differs from the type by its narrower valleys, but agrees with the specimen from the southern Philippines in this respect. There may be a distance of 5 mm. from summit to summit in Dana's type. It differs from the other specimens of *Leptoria* by its thinner walls, septa, and columellæ.

Station, Pago Pago Harbor, Tutuila, Samoa.—No. 1. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Fiji Islands; southern Philippines; Samoa.

Genus MEANDRA Oken.

1815. *Meandra* Oken, Lehrb. Naturgesch., Th. 3, Abth. 1, p. 70.
1918. *Meandra* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 119. (With synonymy.)

Type species: *Madrepora labyrinthiformis* Linnæus.

There are 14 specimens of *Meandra* in this collection, all of which belong to the part of the genus designated as *Cœloria* by Milne Edwards and Haime. Five of the specimens are from the Fiji Islands and the others from American Samoa.

Meandra dædalea (Ellis and Solander).

1786. *Madrepora dædalea* Ellis and Solander, Nat. Hist. Zooph., p. 163, plate 46, figs. 1, 2.
1918. *Meandra dædalea* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 119, plate 44, figs. 3, 3*a*; plate 45, fig. 1; plate 14, fig. 20. (With synonymy.)

All 5 of the specimens from the Fiji Islands belong to this species. The average length of the series is 14 to 15 mm. The following is a description of No. 3, from Fiji:

Corallum subhemispherical, 8 to 10 cm. in diameter and 4.5 cm. high. The valleys are winding and average 15 mm. in length; distance between walls 5 mm.; average distance from columella to top of highest septa 5 mm. Walls 1 mm. thick at level of columella, becoming thinner towards summits, where they are often perforated. Septa exsert 1 to 2 mm.; edges roughly serrate; faces spinulose; margins plunge nearly vertically into valleys. Septa average 11 per centimeter; first two cycles nearly same size, and at times small septa of third cycle appear. Septa slightly thickened in walls. Columella trabecular.

Stations, Suva Harbor, Viti Levu Island, Fiji.—Nos. 1, 2, 3, 4, 5 = Nos. 71F, 56F, 54F, 63F, 61F (Mayor), from a tide-pool on the barrier reef off Suva Harbor.

Distribution.—Indian Ocean; eastward in Pacific to Fiji.

Meandra lamellina Ehrenberg.

1834. *Meandra (Platygyra) lamellina* Ehrenberg, Corallenth. Roth. Meer., p. 99.
1879. *Cœloria arabica* Klunzinger, Die Korallthiere des Roth. Meer., pt. 3, p. 17, plate 2, figs. 1 to 3; plate 9, figs. 10*a* to 10*c*.
1918. *Meandra lamellina* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 119, plate 45, figs. 2, 2*a*.

I have had some hesitancy in placing the 8 specimens collected by Dr. Mayor in this species. This was mostly due to their thin walls. Klunzinger, however, evidently considers this character of minor importance, and Vaughan (op. cit., p. 120) agrees with him. The specimens in the U. S. National Museum apparently show quite a variation in this respect. Besides the specimens collected by Dr. Mayor, there are 2 in the U. S. National Museum, presented by Lieut. T. D. Bolles, U. S. Navy, from Samoa.

The corallum may form rounded heads, or low, spreading masses. The calices form long valleys which are generally winding at the center of the corallum but straighten near the peripheries. The walls are very thin and often perforated. Valleys 4 to 6 mm. wide and 4 to 6 mm. deep. Septa exsert 1 to 1.5 mm.; margins roughly serrated and fall steeply to bottom of valleys; faces with fine granulations; the upper edges of the septa are quite broad, 1 to 2 mm. There are 14 to 15 septa to a centimeter; generally 3 cycles can be made out. Columella trabecular.

The specimens resemble *Meandra edwardsi* (Gardiner) somewhat, but the septa are more crowded and not so regular, and the valleys are shallower.

Stations, Pago Pago Harbor, Tutuila, Samoa.—Nos. 1 to 8. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Red Sea; Indian Ocean; Murray Island; southern Philippine Islands; Samoa; Wake Island; Fanning Island.

Meandra esperi (Milne Edwards and Haime.)

1857. *Cœloria esperi* Milne Edwards and Haime, Hist. Nat. des Corall., vol. 2, p. 317.
1879. *Cœloria esperi* Klunzinger, Die Korallthiere des Roth. Meer., part 3, p. 19, plate 2, fig. 6.

The specimen from Rose Island, Samoa, agrees with Klunzinger's description and illustration very well. Vaughan (Carnegie Inst. Wash. Pub. 213, p. 120) states that it seems to him that *C. esperi* is the same as *C. astreiformis* Milne Edwards and Haime, as the only definite difference is the thickness of the walls. If this were the only difference I believe his specimen of *Meandra astreiformis* should be placed with *M. esperi*, as it has in general rather thick walls. Another difference, however, is that *M. esperi* has longer series, and in this respect the Murray Island specimen corresponds to *M. astreiformis*. It is probable that the two species really should be combined, but until more specimens are available I am keeping them separate.

Station, Rose Island, Samoa.—Shallow channels about 6 inches deep at low tide on the lithothamnion reef-flat of Rose Atoll.

Distribution.—Red Sea; Rose Island, Samoa.

Genus HYDNOPHORA Fischer de Waldheim.

1807. *Hydnophora* Fischer de Waldheim, Mus. Demidoff, vol. 3, p. 295, 1 plate.
1918. *Hydnophora* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 121. (With synonymy.)

Type species: *Hydnophora demidovii* Fischer de Waldheim = *Madrepora exesa* Pallas.

Milne Edwards and Haime (Hist. nat. Corall., vol. 2, pp. 420–425) divide *Hydnophora* into two divisions: § A (foliaceous *Hydnophora*) and § AA (massive *Hydnophora*). They say, however, "nevertheless one ought only to attach a very minor importance to this character." Vaughan (op. cit., p. 121, 122) states that

he believes that the species of the two divisions, plus *H. contignatio* (Forskål), and *H. tenella* Quelch, are all stages or growth-forms of the one species, *H. exesa* (Pallas). He did not, however, intend to include in this § BB of § AA.

Hydnophora microconos (Lamarck).

1857. *Hydnophora microcona* Milne Edwards and Haime, Hist. nat. Corall., vol. 2, p. 423.
1918. *Hydnophora microconos* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 122, plate 47, figs. 3, 3*a*; plate 18, fig. 42.

There are 5 specimens in the Samoan collection. There is a tendency for the corallum to have a massive, knob-like structure. In 4 of the specimens the monticules are generally conical, although at several places they become elongated. In one specimen they are cylindrical with slightly convex tops. Diameter of monticule at base averages 2 mm.; average height 3 to 4 mm.; distance between summits 3 to 4 mm. Septa thin; fine serrations on margins; faces possessed with minute granules. On the normal monticule the well-developed septa alternate with a cycle of very small ones.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua Reef, about 700 feet from shore. Water rough, about 1 foot deep at low tide, rocky bottom. Growing with specimen of *Montipora verrilli* Vaughan.
No. 2. Pure agitated water near seaward edge of Aua Reef.
No. 3. Aua line, 700 to 724 feet from shore. Branched *Acropora* zone.
No. 4. Aua line, 526 to 550 feet from shore.
No. 5. Shallow tide-pools on seaward edge of the Utelei Reef.

Distribution.—Red Sea; Indian Ocean; Murray Island; Amboina; southern Philippines; Rotuma; Wakaya (Fiji Islands); Fanning Island; Samoa.

Hydnophora microconos (Lamarck)→rigida (Dana.)

1918. *Hydnophora microconos* Vaughan (op. cit., p. 122, plate 47, figs. 3, 3*a*).
1918. *Hydnophora rigida* Vaughan (op. cit., p. 122, plate 48, figs. 2, 3).

There is one specimen from the Utelei Reef which I am forced to place in this category, as it lies halfway between *H. microconos* and the specimen of *H. rigida* from Fanning Island which is pictured by plate 48, figure 2, in the above-mentioned work of Vaughan. The latter appears to be a rough-water specimen, whereas Dana's type of *H. rigida* is obviously a quiet-water one. The Samoan specimen was grown in shallow tide-pools on the seaward edge of the reef, and has the tendency to form short, thick branchlets. It has the growth-form of a rough-water variety of *H. rigida*, and yet the monticules and other features of the corallum are similar to *H. microconos*. It is possible that the Fanning Island specimen should not be referred to *H. rigida*.

Station, Pago Pago Harbor, Tutuila, Samoa.—Shallow tide-pools on seaward edge of Utelei reef.

Hydnophora mayori, new species.

Plate 2, figs. 2*a*, 2*b*.

The lone specimen which Dr. Mayor collected in the Fiji Islands is a delicately branched example growing on lithothamnion. On the lower portions of the branches the monticules are distinct and placed in even longitudinal rows. Toward the ends they lose their individuality and become fused into ridges.

The species is very similar to Dana's type of *Hydnophora rigida* (No. 148, U. S. Nat. Mus.), which was illustrated by Vaughan (Carnegie Inst. Wash. Pub. 213, plate 48, fig. 3). It is, however, much more delicate, with smaller corallum and thinner and shorter branches. If one of the small branchlets of Dana's type were

replaced by a branch of this species it would be difficult to note the change with the naked eye. Close observation, however, shows the septal edges of *H. mayori* to have distinct serrations of a sharp, toothlike character, increasing noticeably in size toward the valleys. This is lacking in *H. rigida*, which has nearly entire septal margins. The valleys of *H. mayori* are made rough by the serrations of the septal edges, which at times fuse to form a loose, irregular reticulum. Another difference between the two is that in this species the monticules are inclined toward the ends of the branches, while in *H. rigida* they generally stand out perpendicularly. The septal faces are finely granulose.

There are a number of specimens in the U. S. National Museum, collected by J. B. Steere from the southern Philippines, which are very similar to *H. mayori*. I hesitate, however, to place them here because there is so little tendency to form individual monticules and because the serrations of the septal edges are very unpronounced.

Station, Suva Harbor, Fiji Islands.—No. 74F (Mayor). Tide-pool on the barrier reef.

Distribution.—Fiji Islands; ? Philippine Islands.

GENUS NOT REFERRED TO ANY FAMILY.

Genus MERULINA Ehrenberg.

1834. *Merulina* Ehrenberg, Corallenth. Roth. Meeres, p. 104.

Type species: *Madrepora ampliata* Ellis and Solander.

Merulina vaughani van der Horst.

1846. *Merulina ampliata* Dana, U. S. Expl. Exped., Zooph., p. 272.
1904. *Merulina ampliata* Gardiner, Fauna and Geogr. Mald. and Laccadive Arch., vol. 2, p. 789, plate 64, figs. 47, 48.
1921. *Merulina vaughani* van der Horst, Siboga Exped., part 2, p. 39, plate 5, fig. 1; plate 6, fig. 1.

I agree with van der Horst in believing that Dana's *M. ampliata* should be separated from *M. ampliata* (Ellis and Solander). Dana emphasizes the roundness of the collines, which is totally unlike the sharp, narrow, irregular character of the collines of *M. ampliata* (Ellis and Solander) as illustrated by the specimen from Torres Strait in Vaughan's paper (Carnegie Inst. Wash. Pub. 213, plate 52, figs. 1, 1*a*, 1*b*). There are some specimens in the U. S. National Museum from the central Philippines with thick, rounded walls, which undoubtedly belong to this species. Gardiner's specimens of *M. ampliata* from the Maldives also no doubt belong here.

The Samoan representative is a fragment of a large plate-like specimen with the edges turned down. It agrees well with van der Horst's description and plate and with Dana's type of *M. ampliata*. The edges of the septa and septo-costæ are exceedingly rough, possessing coarse, frosted granulations. The usual distance from summit to summit of adjoining ridges is 3 mm., but may be as much as 5 mm. Septo-costæ exsert as much as 0.5 mm.

Gardiner's plate 64, figs. 47, 48, illustrate the species very well.

Station, Pago Pago Harbor, Tutuila, Samoa.—Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—East Indies (Dana); Maldives; Philippines; Saleyer-anchorage (van der Horst); Samoa.

Family MUSSIDÆ Verrill.

Genus MUSSA Oken.

1815. *Mussa* Oken, Lehrb. Naturgesch., Th. 3, Abth. 1, p. 73.
1918. *Mussa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 122.

Type species: *Madrepora angulosa* Pallas.

Mussa sinuosa (Lamarck).

1816. *Caryophyllia sinuosa* Lamarck, Hist. nat. Anim. sans Vert., vol. 2, p. 229.
1918. *Mussa sinuosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 123, plate 49, figs. 1, 2, 3; plate 50, figs. 1, 1*a*, 1*b*. (With synonymy.)

Vaughan (op. cit., p. 123) includes in the synonymy of this species, *Madrepora angulosa* γ Ellis and Solander, *Mussa costata* Dana, *Mussa sinuosa* Dana, *Mussa cytherea* Dana, *Mussa sinuosa* Milne Edwards and Haime, *Mussa brueggemanni* Quelch, and *Mussa brueggemanni* Bedot. It is quite evident that there is a gradation between these forms. The variation within the species, however, is rather large, and it is advisable to keep in mind the direction in which it occurs. The three distinctive forms of the species are represented by the three names: (1) *Mussa cytherea* Dana, (2) *Mussa sinuosa* (Lamarck) = *Mussa costata* Dana, (3) *Mussa brueggemanni* Quelch. *M. sinuosa* (Lamarck) = *M. costata* Dana occupies the central position. All have the same septal dentation and differ mainly only in growth-form.

In *M. cytherea* the series are elongated, the branches compressed, the valleys narrow in proportion to their lengths, and the space between the series narrow. The septa drop at a steep angle into the valleys.

In typical *M. sinuosa* (Lamarck) the series are not so elongated, the valleys wider in proportion to their lengths, the space between the series wider, and the septal margins grade at a gentler angle into the valleys.

M. brueggemanni Quelch represents a still more advanced stage in this line of variation. The whole series may be likened to the gradual opening or closing of the petals of a flower. In *M. brueggemanni* the walls in places lie almost horizontal, with the lateral septal margins facing upward. The space between the calicular series is also increased.

The Samoan collection contains 5 small branches from what apparently were 5 good-sized specimens. No. 1 is near the *cytherea* end of the series, No. 2 is typical *sinuosa*, and Nos. 3, 4, and 5, are near the *brueggemanni* end.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1, 3, 4, 5. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

No. 2. Aua Reef flat, 680 feet from shore, fairly agitated water, rocky bottom, 1 foot deep at low tide.

Distribution.—Red Sea; Murray Island; Amboina; southern Philippines; Fiji Islands; Tahiti; Samoa.

Genus SYMPHYLLIA Milne Edwards and Haime.

1848. *Symphyllia* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 27, p. 491.

Type species; *Meandrina sinuosa* Quoy and Gaimard = *Mussa nobilis* Dana.

Aside from the fusion of the walls of neighboring series, *Symphyllia* appears to have all the main characteristics of *Mussa*. Verrill (Trans. Conn. Acad. Sci., vol. 11, p. 115, 1902) combined these two genera under the name of *Mussa*. I believe that he was probably right in doing this, but since *Symphyllia* is so poorly represented in the U. S. National Museum, I am following Vaughan's (Carnegie Inst.

Wash. Pub. 213, p. 124) example of keeping them separate until more specimens are available.

Symphyllia nobilis (Dana).

1833. *Meandrina sinuosa* Quoy and Gaimard, Zooph. Voy. de l'Astrolabe, Zool., vol. 4, p. 227, plate 18, figs. 4, 5 (*non* Le Sueur, 1820).
1846. *Mussa nobilis* Dana, U. S. Expl. Exped., Zooph., p. 187.
1918. *Symphyllia nobilis* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 124, plate 17, fig. 35. (With synonymy.)

Dr. Mayor collected but one small specimen of *Symphyllia*, which I refer to this species.

Description.—Small fragment of what was evidently a good-sized corallum. Upper surface slightly convex. Average distance between summits of collines 15 mm.; length of only complete series 45 mm.; from surface of columella to top of large septa 10 to 15 mm. Deep furrow in dividing-wall of series.

The septa generally alternate in size and number about 9 to 1 centimeter. The large ones may be over 1 mm. in thickness in the wall, upper edges possessed with 2 or 3 very prominent teeth (2 to 3 mm. long); inner septal margins have 2 or 3 large teeth at the distal end and several smaller, more regular ones below. The inner edges of the smaller teeth possess numerous sharp, regularly spaced dentations throughout their length. Large septa exsert 2 to 4 mm.; small septa 1 to 1.5 mm.

Columella tangle of twisted trabeculæ; 1 to 3 axial septa connect adjoining columellæ. Costæ prominent, with small, irregularly placed spines. Endothecal dissepiments 1.5 to 2 mm. apart.

There are in the U. S. National Museum 3 specimens of this species from the southern Philippines, collected by J. B. Steere, and 2 specimens which Dr. Mayor collected at Murray Island, besides Dana's type. The Samoan specimen is more similar to those from the Philippines than to those from Murray Island. It has deeper valleys, however, than any of the others, the septal dentations, although of the same pattern, are larger, and the furrow in the dividing-wall is deeper.

Station, Pago Pago Harbor, Tutuila, Samoa.—Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Maldives; Singapore; Rotuma; Murray Island; Amboina; southern Philippines; New Mecklenburg; Samoa.

MADREPORARIA FUNGIDA.

Family FUNGIIDÆ Dana.

Genus FUNGIA Lamarck.

1801. *Fungia* Lamarck, Syst., Anim. sans Vert., p. 369.
1902. *Fungia* Döderlein, Korallengat. Fungia, Abhandl. Senckenb. naturf. Gesellsch., vol. 27, pt. 1, pp. i–iii, 1–162, 25 plates.
1905. *Fungia* Vaughan, Proc. U. S. Nat. Mus., vol. 28, p. 380.
1907. *Fungia* Vaughan, U. S. Nat. Mus. Bull. 59, pp. 110–134.
1918. *Fungia* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 127.
1921. *Fungia* van der Horst, Mad. of Siboga Exped., pt. 2, Mad. Fungida, p. 5.

Type species: *Madrepora fungites* Linnæus.

Fungia fungites (Linnæus).

1902. *Fungia fungites* Döderlein, Korallengat. Fungia, p. 136, plates 20 to 25.
1918. *Fungia fungites* Vaughan, Carnegie Inst. Wash. Pub. 213, p.127.

I am referring 9 specimens to this species. The range in size is so large that I am giving a dimensional table.

	No. of specimen.								
	1	2	3	4	5	6	7	8	9
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Greatest diameter	183	168	145	142	98	84	72	44	15
Smallest diameter	155	165	120	122	91	80	68	42	14
Height	48	65	45	42	24	15	34	9	5

Description of No. 4.—Corallum arched on top, concave beneath. Wall excessively perforated. At periphery there are about 12 septa to 1 cm.; irregular in size. Septal margins serrated with fairly regular teeth which are somewhat thickened at summits; 6 to 8 in 1 cm.; nearly free of granulations. Septal faces of large septa have less number of granulations than those of small ones. Septa imperforate. Oral slit 30 by 4 mm. and 13 mm. deep.

On the underside the costæ are crowded and covered with large styliform spines. Maximum height of spines 3 mm., rough at their tips, due to projecting trabeculæ.

Döderlein's monograph (Taf. 23, figs. 1 and 1*a*) shows a specimen of *F. fungites* var. *confertifolia* from the Samoa Islands, which is identical with the one just described. Nos. 1, 2, and 3 also belong to this variety. Specimen No. 6 can be recognized as belonging to his variety *haimei*. The septa are very thin and frequently perforated. Döderlein's work (Taf. 20, fig. 8) shows a specimen from Koseir, Red Sea, which has identical septa and dentations.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
Nos. 2 and 9. 150 feet off mouth of big brook, killed by fresh water and silt.
No. 3. Aua line 700 to 724 feet from shore. Branched *Acropora* zone.
Nos. 4, 5, and 8. Shallow tide-pools on seaward edge of the Utelei Reef.
No. 6. Quiet water at depth of 30 feet off Aua Reef patch.
No. 7. Tide-pool on Utelei Reef, 2 feet deep at low tide.

Distribution.—From Red Sea and the east coast of Africa to Samoa.

Fungia paumotensis Stutchbury.

See Dr. Mayor's "Growth-Rate of Samoan Corals," plate 25, fig. 64F for illustration.

1833. *Fungia paumotensis* Stutchbury, Trans. Linn. Soc. London, XVI, p. 485; plate 32, fig. 6.
1902. *Fungia paumotensis* Döderlein, Korallengat. Fungia, p. 88, plate 7, figs. 1 to 5.
1907. *Fungia paumotensis* Vaughan, U. S. Nat. Mus. Bull. 59, p. 134, plate 35.

I am referring to this species one specimen which was collected by Dr. Mayor in the Fiji Islands. It was broken in half and new parts had begun growing over the fractured sides.

Description.—Corallum oval. Combining both halves, its dimensions are as follows: length 123 mm., width 71 mm., thickness 21 mm., weight 8 ounces. One half inclined to arch above, the other half rather flat.

Wall perforate near the margin, but solid in the large central area.

Costæ crowded and fairly distinct to the central area. Ribs covered with small, bunchy, rough, close-fitting spines; 16 to 20 of latter in 1 cm. The roughness of the spines, their crowded and sometimes fused-together condition give the ribs a straggly appearance as they spoke out from the central area.

Oral slit 40 by 4 mm.

Septa unequal in height; those of the higher cycles much thinner than those of the lower, which are from 0.5 to 1 mm. thick. Large septa without perforations; small ones generally perforate. Margins with close-setting, fine teeth; faces covered with sharp, conical granulations. Septa crowded, 14 in 1 cm. at edge of corallum. Columella only fairly well developed and papillate in character.

Distinctive characteristics.—This species is quite similar to *F. scutaria* Lamarck, but can be told from it by the fact that the septa are of equal height at the margins in the latter species and unequal in this species. Again, *F. scutaria* nearly always has well-developed tentacular lobes, whereas those of *F. paumotensis* are very insignificant, if present at all. The one exception to this is the typical *Fungia scutaria* Lamarck, which, according to Döderlein (op. cit., p. 95), possesses an indistinct or weak tentacular lobe.

One small specimen of *Fungia* which has evidently recently been released from the attached anthocyathus stage was collected from the Utelei Reef, Pago Pago Harbor, Samoa. It is not sufficiently developed to make identification reliable, although it undoubtedly belongs either to *F. paumotensis* or *F. scutaria.*

The corallum is oval, size 56 by 40 by 11 mm. Oral slit 15 by 3 mm. Septal margins finely dentate in places and elsewhere smooth. Costæ distinct, possessed with rough, crowded spines which are often fused into short, straggly ridges. Mural perforations uncommon. All septa project same distance at margin. Tentacular lobes very indistinct, but indications are present for development in this respect if specimen had continued growth. Papillate columella fairly well developed.

The specimen probably belongs to *F. scutaria* Lamarck.

Station.—Fiji Islands, mouth of Suva Harbor, on the barrier reef. No. 64F (Mayor).

The small, undeveloped specimen came from a tide-pool on seaward edge of Utelei Reef, Pago Pago Harbor, Tutuila, Samoa.

Distribution.—Paumotus; Tahiti; Philippine Islands (Quelch); Hawaiian Islands (Quelch); Amboina; Moluccas; Fiji Islands; ? Samoa.

Fungia patelliformis Boschma.

1923. *Fungia patelliformis* Boschma. Madreporaria of the Siboga Exped., part 4, *Fungia patella*, p. 8, pl. 9, figs. 9, 11, 13 to 16*a*.

The collection contains an excellent suite of 12 specimens of this species. They range in size from the smallest, which measures 25 mm. in diameter, to the largest, whose greatest diameter is 126 mm. and least 90 mm. The very small specimens are subcircular and the larger ones elongate. The suite shows that there is a decided tendency for the corallum to become oblong as it grows larger. All of the specimens are characterized by an exceedingly thin corallum. Usually they possess a large attachment scar.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 6. Dredged from depth of 108 feet north of buoy A.

Nos. 7 to 10. Dredged from depth of 16 to 18 fathoms between Oceanic S. S. Co. mooring-buoy and naval mooring-buoy A. Bottom muddy.

No. 11. Dredged from depth of 12 to 14 fathoms near buoy A. Color dull purple-brown.

No. 12. Unknown.

Distribution.—Dutch East Indies; Samoa.

Family AGARICIIDÆ Verrill.

Genus PACHYSERIS Milne Edwards and Haime.

1849. *Pachyseris* Milne Edwards and Haime, Acad. Sci., Comptes rend., vol. 29, p. 72.

Type species: *Agaricia rugosa* Lamarck.

I consider the following species of *Pachyseris* to be valid: *P. rugosa* (Lamarck), *P. speciosa* (Dana), *P. levicollis* (Dana), *P. valenciennesi* Milne Edwards and Haime (=*P. monticulosa* Verrill), *P. involuta* Studer, and *P. carinata* Brueggemann. All are represented in the U. S. National Museum with the exception of *P. involuta.*

Pachyseris speciosa (Dana).

1846. *Agaricia speciosa* Dana, U. S. Expl. Exped., Zooph., p. 337, plate 21, fig. 7.
1918. *Pachyseris speciosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 131, plate 54, figs. 3, 3*a*, 4, 4*a*.
1921. *Pachyseris speciosa* van der Horst, Mad. Siboga Exped., part 2, p. 35.

Identification is based on Dana's type No. 199 and on a specimen from Murray Island described in the above-mentioned paper of Vaughan, both of which are in the U. S. National Museum.

I refer 8 specimens to this species. They all show some slight variations, but in major characteristics are identical. All are fragments, with the exception of No. 1, which is a good-sized saucer-shaped specimen with the largest diameter measuring 24 cm. and the smallest 18 cm. On the underside there is an ample attachment-stalk roughly 5 cm. in diameter.

The ridges are distinct in all parts of the colony, but increase in height and sharpness towards the margins of the corallum. The septa are identical with those of Dana's type No. 199. As in the latter, they are practically equal in size. On close observation, however, one can occasionally observe a row of darker colored, slightly thicker septa alternating with thinner, more projecting ones, which have their edges more crinkled. This feature is so insignificant that it can be recognized only on very close examination. All the septa have crinkled edges. The columellæ are composed of septa fused across the valleys and thus form an interrupted floor along the valley axes.

I agree with van der Horst in placing *P. haimei* Quelch with this species. The differences as outlined by Quelch are so variable that they can not be of specific value.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged in about 19 fathoms off Utelei Reef.
No. 2. Dredged in from 12 to 14 fathoms from north of buoy A.
Nos. 3 and 6. Dredged from depth of about 108 feet. North shore of harbor.
No. 4. Dredged from depth of 18 fathoms off north end of Aua Reef.
No. 5. Dredged in 8 to 16 fathoms north of Aua Reef.
No. 7. Dredged in 7.5 fathoms at start to 9 fathoms at end, inshore from experiment reef-patch. Hard bottom, northern edge of Aua Reef.

Distribution.—East Indies; Murray Island; Tahiti; Ambon anchorage, Saleyer anchorage (van der Horst); Samoa.

Pachyseris levicollis (Dana).

1846. *Agaricia levicollis* Dana, U. S. Expl. Exped., Zooph., p. 338, plate 22, fig. 2.
1921. *Pachyseris levicollis* van der Horst, Mad. Siboga Exped., part 2, p. 36.
1922. *Pachyseris levicollis* van der Horst, Trans. Linn. Soc. London, 2d ser., Zool., vol. 18, p. 427.

I have examined very closely, with the aid of the microscope, Dana's types of *Agaricia levicollis* and *Agaricia speciosa*, Nos. 190 and 199 respectively of the U. S. National Museum. I find the following features of comparison:

(1) The ridges of *P. speciosa* are much higher than those of *P. levicollis*, which at times are nearly perfectly flat. Around the border of the corallum of the latter they may be slightly elevated.

(2) The septa in *P. levicollis* are so nearly equal in size that it is impossible to see any alternation. Occasionally in the other species one can distinguish alternating septa on very close observation.

(3) The septal edges of *P. speciosa* are more crinkled than those of the other species, which at times may be nearly straight.

(4) The columella of both species is essentially alike, although that of *P. levicollis* is perhaps a little better developed.

Dr. Mayor collected one large specimen of this species and a small fragment. The large one was dredged dead and a good deal of it was lost. It is a big, explanate, undulating disk with the margins broken off. It measures 25 cm. by 22 cm., and towards the central area is 8 mm. thick. It offers a difference to the type in that the septal margins are decidedly crinkled. The ridges vary in width from 2 mm. to 5 mm. Dana speaks of the ridges being narrow, and yet some in his type are 4 mm. broad. In general, those of the Samoan specimens are broader than those of the type. Due to the dead condition of the corallum, the columella does not show up well, although it seems to have been of the same degree of development as that of Dana's specimen.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged from depth of 108 feet, north shore, Aua Reef.

No. 2. Dredged from depth of 17 fathoms, on a soft and muddy bottom between Oceanic S. S. Co. buoy and mooring buoy A.

Distribution.—East Indies (Dana); Murray Island; Tahiti; Red Sea; East Indian Archipelago; Samoa.

Pachyseris carinata Brueggemann.

1879. *Pachyseris carinata* Brueggemann, Jour. Mus. Godeffroy, H. 14, p. 208.
1918. *Pachyseris torresiana* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 132, plate 55, figs. 1, 1*a*.
1921. ? *Pachyseris rugosa* van der Horst, Mad. Siboga Exped., part 2, p. 37, plate 4, fig. 3; plate 6, fig. 2.
1921. *Pachyseris carinata* van der Horst, Mad. Siboga Exped., part 2, p. 37, plate 5, fig. 3.

In van der Horst's paper mentioned above he believes that he recognizes among other species of *Pachyseris*, *P. rugosa* Lamarck, *P. carinata* Brueggemann, and *P. torresiana* Vaughan, all of which have, according to him, large bifacial fronds. The specimens which he has referred to these species resemble each other so closely that he thinks it very likely they all belong to the same species. From the remarks he makes concerning them and from his illustrations it certainly does appear that his surmise is correct. I am inclined to believe, however, that the specimens which he referred to *P. rugosa* do not belong there, but should be placed with *P. carinata*.

As van der Horst himself has emphasized (op. cit., p. 37), according to Milne Edwards and Haime the septa of *P. rugosa* are distinctly alternating. This is not at all obvious in van der Horst's illustration (plate 4, fig. 3, 1921) of *P. rugosa*, neither is it characteristic of *P. carinata* and *P. torresiana*, to which he likens his *rugosa*. Also, I believe that *P. rugosa* Lamarck is not inclined to have large bifacial fronds, as is characteristic of the other two species, but rather a thin, irregular, undulating, explanate corallum. According to Milne Edwards and Haime, *P. rugosa* has very thin septa whereas in *P. carinata* and *P. torresiana* they are rather thick.

I have before me Vaughan's types of *P. torresiana* and have no hesitancy in placing it with *P. carinata*. I do not believe that the shape of the fronds should constitute a specific difference.

From the points I have mentioned above I have come to the conclusion that *P. rugosa* (Lamarck) should probably be kept apart from *P. carinata*, and that in all likelihood van der Horst's *rugosa* belongs to *carinata*.

The Samoan collection contains two splendid examples of this species. No. 1 is a colony of upright fronds from an irregular base. The manner of arrangement of the fronds resembles that of *Pavona decussata* somewhat. No. 2 is made up

of the fusion of two large fronds at their periphery and thus has the appearance of one. The sides possess small bud-like fronds. The specimen is 116 mm. wide, 98 mm. tall, and 5 mm. thick. In both specimens the columella is a well-developed, longitudinal lamella. Viewed with the naked eye, it has the appearance of stitches made by a sewing machine.

Vaughan's type of *P. torresiana* (op. cit. p. 132, plate 35, figs. 1, 1*a*) illustrates the species very well.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Shallow, quiet, often silted water near Governor's wharf.
No. 2. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Isle of Ponapé; Torres Strait, Australia; Timor; Samoa.

Genus PAVONA Lamarck.

1801. *Pavona* Lamarck, Syst. Anim. sans Vert., p. 372.
1918. *Pavona* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 132.

Type species: *Pavona cristata* Lamarck = *Madrepora cristata* Ellis and Solander = *Lophoseris knorri* Milne Edwards and Haime = *Pavona formosa* Dana = *Pavona cactus* (Forskål).

Pavona divaricata Lamarck.

Plate 2, figs. 3*a*, 3*b*. Also illustrated in Dr. Mayor's "Growth-Rate of Samoan Corals," plate 18, figs. 15*d*, 15*f*.

1816. *Pavonia divaricata* Lamarck, Anim. sans Vert., vol. 2, p. 240, No. 5.
1846. *Pavonia divaricata* Dana, U. S. Expl. Exped., Zooph., p. 327, plate 22, fig. 6.
1921. *Pavona divaricata* van der Horst, Mad. Siboga Exped., pt. 2, p. 24.
1922. *Pavona divaricata* van der Horst, Trans. Linn. Soc. London, 2d ser., Zool., vol. 18, No. 6, p. 419.

One of the most remarkable examples of the wide variation in the genus *Pavona* is afforded by the species *P. divaricata* Lamarck and *P. frondifera* Lamarck. Dana's original specimens of these two species are Nos. 151 and 191, respectively, in the U. S. National Museum.

The former has narrow, thick branches, very angular, keeled, and coalescent. The latter is made of broad plates with many carinæ and perpendicular platelets, so as to produce the subrectangular growth so characteristic of typical *P. decussata*. Two such apparently different specimens would certainly be widely separated specifically if intermediate forms were not available to prove their relationship.

Verrill (Proc. Essex Inst., vol. 5, p. 44, 1867) described a new species, *P. foliosa*, the type of which is No. 413 U. S. National Museum. This is without question a young specimen of *P. frondifera* with thin crispate plates. There is an excellent suite of specimens in the museum collected by J. B. Steere in the southern Philippines, which prove this beyond a doubt. The relationship between the two is very similar to that existing between Dana's *P. boletiformis* and older specimens.

Dr. Mayor collected a large number of specimens which bring out some very interesting facts. It is quite evident from a study of them and all other similar ones in the U. S. National Museum that the two species *P. divaricata* and *P. frondifera* grade towards each other to such an extent that it is nearly impossible to draw a dividing-line between them.

Using as a starting-point the young specimen of Verrill's type of *P. foliosa*, gradation seems to proceed along two lines: (1) normal, (2) irregular.[1]

By normal gradation or growth is meant that sort in which the plates retain their general shape, become thicker and broader, and finally reach the mature stage as exemplified by Dana's specimen of *P. frondifera*.

[1] For an explanation concerning the illustrations showing these lines of variation see under *P. frondifera* Lamarck.

By irregular gradation is meant that in which the plates become much curled at their growing tips, become keeled, and thus divide into delicate, narrow, angular branchlets.

It is this latter direction of gradation which runs so near to *P. divaricata*. The two species may belong together, but I am keeping them separate on the following grounds:

The fronds of *P. frondifera* are more delicate and thinner than *P. divaricata*. Those of the latter are thick, sturdy, and narrow. Although the tips may be sharp, the keels become thick within 1 or 2 mm. from the top. The fronds of the former taper slowly and delicately to the summits.

Although both species have convex ambulacra, there is a tendency for this characteristic to be more pronounced in *P. frondifera*. In many places on the specimens belonging to the other species the ambulacra are flat.

The growth experiment described below under specimens 9*a* and 9*b* give further reason for keeping the species separate.

I am referring the following 15 specimens to *P. divaricata:*

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1, 2, 3. Aua line, 766 to 790 feet from shore. These 3 specimens are nearly typical. The ambulacra are convex on basal portions and often flattened near tops of fronds. Septo-costæ alternating. Columella absent or poorly developed; compressed style.

Nos. 4 and 5. Aua line, 700 to 724 feet from shore. Similar to preceding. No. 5 shows synapticulæ well; calices relatively thin.

No. 6. Aua line, 600 to 624 feet from shore. Fronds rather thin, approaching *P. frondifera.*

No. 7. Aua line, 526 to 550 feet from shore. Irregular specimen; columella fairly well developed. Ambulacra rounded.

No. 8. 150 feet off mouth of big brook. Killed by fresh water and silt.

Nos. 9*a* and 9*b* = Nos. 15D and 15S (Mayor). These represent a growth experiment and are two halves of the same colony placed in different environments. No. 9*a*, which is exactly similar to Dana's specimen, was taken from relatively quiet, shallow water on the Aua Reef flat and placed in quiet water at a depth of 51 feet. No. 9*b* was placed on the breaker-washed edge of the Aua Reef patch. The latter half would hardly be recognized as belonging to the same species. The fronds have fused together completely and the corallum has taken on a dense, massive, convoluted shape until it resembles *P. varians* Verrill. This experiment has helped to strengthen my belief that the two species *P. frondifera* and *P. divaricata* should be kept separate, even on the apparently rather superficial criterion of the thickness of the keeled fronds. It shows that *P. divaricata* is not a rough-water facies of *P. frondifera* with correspondingly thicker fronds. No. 9*a* was taken from quiet water and placed in quiet water and still has the characteristic thick branches of typical *P. divaricata.*

No. 10. Shallow tide-pools on seaward edge of Utelei Reef. Rough-water specimen similar to 9*b*.

Nos. 11, 12, 13, and 14. Shallow tide-pools at low tide in agitated pure water near seaward edge of Aua Reef. No. 11 is a large, beautiful specimen. One side of it is identical with No. 9*b*, i. e., the branches have fused tightly to form a massive convoluted growth. As you pass from this edge towards the center the fronds gradually unfold themselves and separate from each other. When the other side is reached they have assumed the typical, keeled, divaricate structure, although somewhat dwarfed.

No. 15, Aua line, 460 to 484 feet from shore. Heavy corallum, thick coalescent fronds, arched ambulacra, alternating septo-costæ, poorly developed styliform columella.

Distribution.—Indian Ocean; Fiji Islands; Tongatabu; island of Ponapé; Indo-Australian Archipelago; Singapore; Wakaya; Rotuma; Samoa.

Pavona frondifera Lamarck.

Plate 3, figs. 1*a* to 1*e*. Also Mayor's "Growth-Rate of Samoan Corals."

1846. *Pavonia frondifera* Dana, U. S. Expl. Exped., Zooph., p. 328.
1867. *Pavonia foliosa* Verrill, Proc. Essex Inst., vol. 5, p. 44.
1901. *Pavonia frondifera* Studer, Zool. Jahrb., Heft 5, p. 391.
1921. *Pavona frondifera* van der Horst, Siboga Exped., part 2, p. 23. (With synonymy.)

For a discussion of this species see under *P. divaricata* Lamarck. I have endeavored to show the two lines of variation mentioned above by plate 3, figures 1*a* to 1*e*. Figures 1*a*, 1*b*, and 1*c* show the normal gradation and figures 1*a*, 1*d*, and 1*e* show the irregular. Figure 1*a* is Verrill's type of *P. foliosa*, figure 1*b* a specimen from the Philippines collected by J. B. Steere, and figure 1*c* shows Dana's specimen of *P. frondifera*. Figure 1*d* shows a fragment of No. 7 and figure 1*e* illustrates No. 8 of the Samoan collection.

The species is characterized by numerous carinæ, relatively thin walls, and pronouncedly rounded ambulacra.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 and 8. Aua line, 600 to 624 feet from shore.
No. 2. Aua line, 700 to 724 feet from shore.
No. 3. Aua Line, 766 to 790 feet from shore.
No. 4. Aua line, 400 to 424 feet from shore.
Nos. 5 and 6. 150 feet from mouth of big brook. Killed by fresh water and silt.
No. 7=No. 49 (Mayor). From 400 feet from shore, off Aua village, on the reef-flat, in quiet water; 8 inches deep at lowest tides; bottom of rocky limestone.

Distribution.—"Austral Seas"; Singapore; Fiji Islands; Philippines; Samoa; Loo Choo Islands; Caroline Islands; Billiton; Java; Java Sea; Indian Ocean.

Pavona decussata Dana.

Plate 4, fig. 1. Also Mayor's "Growth-Rate of Samoan Corals," plate 8, figs. 23, *a*, *b*.

1846. *Pavonia decussata* Dana, U. S. Expl. Exped., Zooph., p. 329, plate 22, fig. 4.
1846. *Pavonia boletiformis* Dana, U. S. Expl. Exped., Zooph., p. 327, plate 22, fig. 7 (*non* Lamarck).
1918. *Pavona decussata* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 134.
1918. *Pavona danai* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 136, plate 55, fig. 2; plate 56, figs. 2, 2*a*. (With synonymy.)
1921. *Pavona decussata* van der Horst, Siboga Exped., part 2, p. 22. (With synonymy.)
1921. *Pavona danai* van der Horst, Siboga Exped., part 2, p. 23.
1922. *Pavona decussata* van der Horst, Trans. Linn. Soc. London, 2d ser., Zool., vol. 18, p. 418.

Dana's original specimen of *P. boletiformis* (*non* Lamarck) type of Milne Edwards's *Lophoseris danai* is No. 136, U. S. National Museum. Vaughan has described and figured it (op. cit., p. 137, plate 56, figs. 2, 2*a*). It is obviously a very young specimen, and because of this fact some difficulty has arisen regarding it and other closely related species.

Dana's original specimens of *P. decussata* are also in the U. S. National Museum. The one which he described and figured has rather large fronds, which measure as much as 4 inches in breadth. The various specimens which have since been collected and described by later writers have served to bring closer together the type of *P. danai* and that of *P. decussata*, which by themselves appear quite different.

Vaughan and van der Horst (op. cit., p. 22, 1921) agree that probably the principal difference between the two is the breadth of the fronds. However, both Vaughan's and van der Horst's specimens of *Pavona danai* have far broader fronds than Dana characterized as specific. Besides this, the two other original specimens of Dana's *P. decussata* (Nos. 167 and 200, U. S. National Museum) have much narrower fronds than those of his described specimen, and indeed often come within the limit of his *P. boletiformis* in this respect. It is quite evident, therefore, that

we can not depend on the lobation of the plates as the dividing-line between the two species.

Both species have generally poorly developed carinæ, although those of *P. decussata* are usually thought of as being rather more pronounced. This character, however, can not be relied upon.

The only differences that seem to be of distinguishing value are the following:

(1) The rows of calices are closer together in typical *P. decussata* and are more regular. The average distance between the row is 2.5 to 3 mm., whereas in *P. danai* it is 3.5 to 4 mm. In the latter they do not keep the same distance apart, but may be 2 mm. apart at one point and suddenly jump to 5 mm. within the distance of 3 septo-costæ.

(2) In *P. decussata* the rows of calices generally border closely the growing edge of the frond, whereas in *P. danai* there may be no calices within 10 mm. of the edge.

(3) In *P. danai* the septo-costæ are lax and the larger ones stand out distinctly from the insignificant intermediates. In the other species they are relatively more crowded and neater in appearance.

The U. S. National Museum contains a large number of specimens which have been referred to one or the other of these species and which, together with those from Samoa, demonstrate a gradation between them. The specimen of *P. danai* from the Cocos-Keeling Islands which Vaughan described and figured (op. cit., p. 136, plate 55, fig. 2) appears to represent the connecting-link between the two so-called species. The specimen from the Caroline Islands mentioned by Vaughan (op. cit., p. 137) and collected by Professor W. A. Bryan certainly bridges the gap between typical *P. danai* and the Cocos-Keeling specimen. The one from the Caroline Islands, however, has all the characteristics of typical *P. danai*, whereas the Cocos-Keeling one tends more towards *P. decussata*. The specimen from Zamboanga and the one from Mariveles, Luzon, which Vaughan mentions (op. cit., p. 137) also lie on the *P. decussata* side of the line.

It is quite evident that there is a gradation from Dana's type of *P. danai*, through the Caroline Island specimen and similar ones from the Philippines in the U. S. National Museum, to those from Cocos-Keeling. Further gradation from these latter specimens through 4 collected by Dr. Mayor from the Samoa Islands and 2 from the Fiji Islands leads to typical *P. decussata*. The Cocos-Keeling specimen appears to represent the midway point with characteristics common to both but inclining more towards *P. decussata* than *P. danai*.

Since the gradation is so complete, I am combining the two under *P. decussata*. Those specimens which have the characteristics of *P. danai* as outlined above and which are on that side of the Cocos-Keeling specimen I consider belong to *P. decussata* var. *danai*. Those on the other side belong to typical *Pavona decussata* Dana. It is possible that the variety *danai* simply represents the early stage in the growth of the corallum, as indeed many specimens seem to indicate. In this case it would of course not be a true variety. Since, however, there are some very well-developed specimens in the suite which have the characteristics of this variety, I feel justified in following the plan presented.

I refer to typical *P. decussata* the four Samoan specimens and the two from the Fiji Islands. The latter (Nos. 4 and 5) are nearly identical with Dana's specimen No. 200, U. S. National Museum. The other four lie in between them and the one from Cocos-Keeling described by Vaughan.

Stations:

Pago Pago Harbor, Tutuila, Samoa—

No. 1 = No. 23 (Mayor). From Aua Reef flat, 400 feet from shore, in quiet water about 8 inches deep at lowest tides. Bottom rocky, limestone.

No. 2. Aua line, 526 to 550 feet from shore.

No. 3. Aua line, 460 to 484 feet from shore.

No. 6. 150 feet from mouth of big brook, killed by fresh water and silt.

Fiji Islands—

Nos. 4 and 5 = Nos. 68F and 42F (Mayor). Mouth of Suva Harbor.

Distribution.—Red Sea; Indian Ocean; Amboina; Sulu Sea; southern Philippines; Luzon, Philippines; Caroline Islands; Java; Sumatra; Billiton; Moluccas; Indo-Australian Archipelago; Fiji Islands; Samoa.

Genus LEPTOSERIS Milne Edwards and Haime.

1849. *Leptoseris* Milne Edwards and Haime, Comptes rendus, Acad. Sci. Paris, vol. 29, p. 72.
1886. *Domoseris* Quelch, Report on the Coral-Reefs, Challenger Exped., p. 125.
1907. *Leptoseris* Vaughan, Bull. 59, U. S. Nat. Mus., p. 137.
1922. *Leptoseris* van der Horst, Trans. Linn. Soc. London, 2d ser., Zool., vol. 18., pp. 421–423.

Gardiner, Vaughan, and van der Horst all agree that *Domoseris* is probably not generically distinct from *Leptoseris*. Quelch (op. cit., p. 125) says:

"The presence of the elevated projections, and the nature of the septo-costæ separate the genus [*Domoseris*] from *Leptoseris* which it somewhat resembles at the extreme marginal parts, where the projections are less marked and the septo-costæ more uniform."

From a study of the specimens in the U. S. National Museum I have come to the conclusion that these features can not separate the genera.

Leptoseris gardineri van der Horst.

Plate 4, fig. 2.

1905. *Leptoseris papyracea* Gardiner, Fauna and Geog. of the Maldive and Laccadive Arch., vol. 2, sup. 1, part 3, p. 947, plate 92, fig. 23.
1921. *Leptoseris gardineri* van der Horst, Mad. Siboga Exped., part 2, p. 30.

Van der Horst is undoubtedly right in removing Gardiner's specimens from *L. papyracea* (Dana). Dana's type of *Pavona papyracea* is No. 137 in the U. S. National Museum. This is a small, delicate specimen with much-crisped fronds. The calices are shallow and inclined to open perpendicularly to the face of the frond rather than towards the end, as described by Gardiner. Van der Horst's (op. cit., p. 30, plate 5, fig. 7) illustration fits the species very well.

Gardiner's plate 92, figure 23, shows typical *L. gardineri*. I am referring 10 specimens to this species. They vary a good deal in respect to the thickness of the fronds. Specimen No. 1 is 3.5 mm. thick at the base of the frond, while No. 6 is 8 mm. thick. The undersides are finely granulated and possess low convex costæ which vary in thickness in the different specimens. The costæ of No. 4 resemble those of Gardiner's specimen in that every fourth one is more conspicuous. The costæ of No. 1 are wider and more pronounced than those of the others, and are nearly equal in size. Gardiner's description is adequate.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged from 12 to 14 fathoms northwest of buoy A.

Nos. 2 and 5. Dredged from depth of 108 feet north of buoy A.

No. 3. Dredged in 17 to 18 fathoms off north end of Aua Reef. Bottom hard, with very little mud.

No. 4. Dredged in about 19 fathoms off Utelei Reef.

No. 6. Dredged in about 18 fathoms off Utelei Reef.

Nos. 7 and 8. Dredged at 110 feet depth off reef near Loa Loa.

No. 9. Dredged near Aua Reef patch at 18 fathoms.

No. 10. Caught in snapper at 27 fathoms off Utelei Reef.

Distribution.—Suvadiva (Gardiner); west coast of Lombok, Amboina (van der Horst); Samoa.

Leptoseris scabra Vaughan.

1907. *Leptoseris scabra* Vaughan, Bull. 59, U. S. Nat. Mus., p. 139, plate 41, figs. 1, 1*a*, 2.
1922. *Leptoseris scabra* van der Horst, Trans. Linn. Soc. London, 2d ser., Zool., vol. 18. p. 421.

I refer 2 specimens to this species. No. 1 is a delicate, bowl-shaped example, 74 mm. in diameter and attached to lithothamnion. It is a fairly young colony and the central calice is distinct. It is exactly like the specimens from Hawaii, described by Vaughan in the above publication, with the exception that the columella is rather well developed and compressed to fit the elliptical calices. Septo-costæ usually distinctly alternating.

Specimen No. 2 is much older and larger and resembles the dead colony mentioned by Vaughan from station 4053. It is explanate, with the edges broken off and lost, but its dimensions at present are 150 by 100 mm. and from 2 to 6 mm. in thickness. The swollen, proximal sides of the calices produce a more or less continuous ridge across the corallum when the corallites are placed close together, as is frequently the case The septo-costæ alternate in size, and the larger ones are elevated slightly above the smaller. The larger septo-costæ are not perforated as much as is usually the case. The under side is striped with costal striæ which alternate in prominence. Vaughan's description is excellent.

This species is evidently rather closely related to *L. regularis* (Quelch).

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged alive from a depth of 12 to 14 fathoms on fairly hard bottom with some mud, near buoy A.
No. 2. Dredged in 8 to 16 fathoms, north of Aua Reef.

Distribution.—Hawaiian Islands; Amirante, Cargados, Providence (Indian Ocean); Samoa.

Genus COSCINARÆA Milne Edwards and Haime.

1848. *Coscinaræa* Milne Edwards and Haime, Acad. Sci., Comptes rend., t. 27, p. 496.

Type species: *Coscinaræa monile* (Forskål) = *Coscinaræa meandrina* Milne Edwards and Haime = *Psammocora fossata* (Dana.)

Coscinaræa columna (Dana).

Plate 4, figs. 3*a*, 3*b*, 3*c*.

1846. *Psammocora columna* Dana, U. S. Expl. Exped., Zooph., p. 347, plate 25, figs. 1, 1*a*, 1*b*.
1898. *Psammocora savigniensis* Gardiner, Pro. Zool. Soc. Lon., p. 538, plate 45, fig. 4.

Dana's type specimen is No. 188, U. S. National Museum. It is a large colony of thick, erect, columnar fronds with rounded summits. The four Samoan specimens are insignificant compared to it in size. They are small, convex-topped, and possess no fronds. The calicular characters, however, are identical. Dana's figures of the type are very poor. Because of its bulk it can not be pictured here, but Nos. 1 and 2 from Samoa illustrate the species very well.

The following is a description of No. 1:

Small fragment from basal portion of corallum. Under surface free, completely covered by epitheca. At the rim it is only 2 mm. thick and gradually thickens up to 2 cm. at the place it is broken off. The calices are either completely surrounded by rounded collines or they may run in series of from 2 to 6 centers. The width of the collines is from 2.5 to 4 mm.; the average distance between the calices which lie in the same valley is 2 mm. The calicular fossæ are 0.5 mm. or less in diameter. The septa vary in number. In the individual calices, however, about 32 to 36 septa may be counted high up near the summit. Of these, 12 to 15 generally reach the calicular fossa; the rest fuse with them before the

center is reached. The septa are rather thick, usually thicker than the space between them. The septal edges are neatly covered with low, rough, blunt, subequal granules. The septal faces possess minute spines. In places the septo-costæ are continuous over the collines to those of the neighboring calice. In general, however, the summits of the collines become trabecular and take on a somewhat reticular appearance. The columella is fairly deep, distinct, and is made up of trabeculæ from the septal edges.

Nos. 3 and 4 differ from the other two by having slightly longer series and fewer individual calices. No. 4 is particularly distinguished in this respect and is also peculiar by having the collumellæ sunken lower than is usual.

From the study of the specimens in regard to their environment it would appear that those grown in quiet water have more sloping collines and consequently more open calices than those of rough-water habitat.

As can be readily seen by the description and figures, this species is very similar to *C. savigniensis* (Gardiner). I doubt the validity of the latter. In describing the breadth of the collines, Gardiner must have measured only their summits, whereas I have recorded their entire width from fossa to fossa. The species is very similar to *C. monile* Forskål and appears to be, as Gardiner has remarked (Fauna and Geog. of Mal. and Lac. Arch., vol. 2, sup. 1, p. 950) concerning *C. savigniensis*, a denser edition of it. Dana's type of *Psammocora fossata* is No. 198, U. S. National Museum. This specimen certainly belongs to *C. monile*.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Found 2 fathoms deep in quiet water off Aua Reef patch.
Nos. 2 and 3. Shallow tide-pools on seaward edge of Utelei Reef.
No. 4.=No. 41D (Mayor). Grown at depth of 2 fathoms in agitated water off Loa Loa village.

Distribution.—Funafuti; Rotuma (Gardiner); Fiji (Dana); Samoa.

Genus PSAMMOCORA Dana.

1846. *Psammocora* Dana, U. S. Expl. Exped., Zooph., p. 34.

Type species: *Pavonia obtusangula* Lamarck.

As van der Horst (1921 Siboga Exped., part 2, p. 32) pointed out, *Stephanaria* Verrill should be absorbed in *Psammocora*. Gardiner (Fauna and Geog. of the Mald. and Lac. Archipelagoes, vol. 2, supl. 1, part 3, p. 950) believes he can distinguish 4 separate species of the branching type of *Psammocora: P. obtusangula* (Lamarck), *P. contigua* (Esper), *P. digitata* Edw. and H., and *P. divaricata* Gardiner. It is quite a problem to know just what *P. obtusangula* is like. There is very little difference between it and *P. contigua* (Esper) in the descriptions of Milne Edwards and Haime. Gardiner sums up the differences by saying "*P. contigua* is distinguished by its less delimited and smaller calices and lesser number of septa." I have found that some specimens of *P. contigua* have rather large calices in places and the number of septa often is as much as that given by Edwards and Haime as characteristic of *P. obtusangula* (6 to 10). What is needed very badly is a good photograph of *P. obtusangula*. Gardiner believes *P. contigua* is the same as Dana's *P. plicata* (*non* Lamarck). Although Dana's original specimen of *P. plicata* is No. 217, U. S. National Museum, it is so badly corroded that it is impossible to express an opinion. Vaughan (1918, Carnegie Inst. Wash. Pub. 213, p. 141) believes it perhaps belongs to *P. gonagra* Klunzinger, which, according to Von Marenzeller (1906), is the same as *P. planipora* Ed. and H.

Psammocora contigua Esper.

Plate 5, figs. 1*a*, 1*b*. See also Mayor's "Growth-Rate of Samoan Corals."

1797. *Madrepora contigua* Esper, Die Pflanzentiere, p. 81, t. 66.
1886. *Psammocora ramosa* Quelch, Challenger Exp., Report on Reef-Corals, p. 128, plate 6, figs. 6-6*b*.
1905. *Psammocora contigua* Gardiner, Fauna and Geog. of Mald. and Laccad. Arch., vol. 2, sup. 1, p. 951.
1921. *Psammocora contigua* van der Horst, Siboga Exped, part 2, p. 33. (With synonymy.)

All of the branched specimens of *Psammocora* in the collection belong to this species. Gardiner recognizes two varieties, the typical and his variety *maldivensis*. I believe that both of these varieties are represented in the collection, but the only criterion on which I can divide them is the arrangement of the calices. In the type the calices are arranged in rows in the valleys on the branches with a good deal of coenenchyma between them. Variety *maldivensis* has the calices crowded together, with a corresponding lessening of coenenchyma and inconspicuous lines.

Gardiner gives ample room for variation in growth-form. In this he was correct, as is demonstrated by the growth experiments outlined below. Some of the specimens have branches which are flattened out at their ends and at times are coalescent and twisted; others have crooked, rod-like branchlets, with irregular sides, generally about 15 mm. long and 4 mm. in diameter. Both types of branching occur on the same specimen, and it is merely a matter of which type predominates.

I refer 6 specimens to the type form. The branches have on their sides longitudinal ridges which are devoid of calices. Between the ridges each valley is occupied by a line of calices. There are usually 4 thick, petal-like septa with distinct limits, between which are other septa which extend as a network beyond the calice and become lost in the coenenchyma. The coenenchyma occupies a good deal of space between the calice rows. The columella is rather inconspicuously situated below the inner edges of the septa.

Five specimens belong to the variety *maldivensis*. They differ from the type only in the manner mentioned above. I fail to recognize any distinct differences either in the number of septa or in the height of the columella.

Variety tutuilensis, new variety.

Plate 5, figs. 2*a*, 2*b*.

One good-sized specimen shows such marked differences from the others that I am placing it in a new variety.

The growth is of the usual arborescent manner, with branches flattened. Average thickness of the latter, 4 mm. Near the top of the corallum they further branch, the branchlets being either delicately rod-shaped with rounded ends, or flattened, coalescent, and twisted, 5 to 20 mm. wide. Thin cylindrical rods often protrude from the sides of the branches. Except for these the sides are smooth, being practically free of ridges or humps. The calices are numerous, crowded together, and at times show indications of forming in rows. They are larger than those of the other varieties, the axial fossæ themselves being usually over 0.25 mm. in diameter. The septa (6 to 10 in number) are of two kinds—one kind short, petal-like, of well-defined extent, 3 or 4 in number; the other, appearing between the former, of indefinite length, extending into the coenenchyma. The columella is usually distinct and consists in some cases of a single rounded rod pointed at the top, and in others has the shape of a cross.

That the habitat has a great influence on the growth-form of *P. contigua* was adequately demonstrated by the growth experiments performed by Dr. Mayor. The usual experiment of dividing a colony in half and placing one part in deep,

quiet water and the other in shallow, agitated water was carried out on three examples. In all the cases the effect was similar. The parts grown in deep, quiet water have long, delicate, rod-like branches, twisted and with irregular sides. Those grown in rough water have shriveled up into well-nigh massive form, with branches fused and stunted. Besides the differences in growth-form, the quiet-water halves are rougher in appearance, due to the fact that the septa and many of the protuberances of the coenenchyma stand out distinctly above the common level.

Those specimens located in the ordinary habitat of the reef assumed the natural form of growth of *P. contigua.*

Stations, Pago Pago Harbor, Tutuila, Samoa:

Psammocora contigua Esper, typical:

Nos. 1 and 3. Aua line, 400 to 424 feet from shore.

No. 2=Nos. 1D and 1S (Mayor). These represent the two halves of the same coral colony. No. 1D was grown in 42 feet of quiet water, and No. 1S was grown on the breaker-washed outer edge of Aua Reef flat.

No. 4. Aua line, 812 to 836 feet from shore.

Nos. 5 and 6. Aua line, 526 to 555 feet from shore.

P. contigua var. *maldivensis* Gardiner:

Nos. 1 and 5=No. 40 (Mayor). Aua line, 400 feet off-shore of Aua village. Water quiet, bottom rocky, depth 8 inches at lowest tide.

No. 2=Nos. 17D and 17S (Mayor). Deep and shallow water halves of same colony. No. 17D was grown at depth of 51 feet; No. 17S was raised in agitated shallow water on edge of Aua Reef flat.

No. 3=No. 41 (Mayor). Unknown.

No. 4=Nos. 5D and 5S (Mayor). Deep and shallow water halves of same colony. No. 5D was grown in 42 feet of water; No. 5S on breaker-washed edge of Aua Reef.

P. contigua var. *tutuilensis*, new var.:

No. 1. Aua line, 600 to 624 feet from shore, depth about 9 inches.

Distribution of Psammocora contigua Esper.—Indian Ocean; Fiji Islands; Maldives; Minikoi; Funafuti; Singapore; Dutch East Indies; Samoa.

Psammocora superficialis Gardiner.

1898. *Psammocora superficialis* Gardiner, Proc. Zool. Soc. London, No. 35, p. 537, plate 45, fig. 2.

One small specimen in the collection agrees with Gardiner's description and plate very well.

Station.—Pago Pago Harbor, Tutuila, Samoa. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

Distribution—Funafuti; Samoa.

Psammocora samoensis, new species.

Plate 5, figs. 3*a*, 3*b*, 3*c*.

This belongs to the group of massive *Psammocoras*. In growth-form it resembles very closely *Psammocora nierstraszi* van der Horst (Siboga Exped., part 2, p. 34, plate 2, figs. 3, 4). Dr. Mayor collected two examples which show a few differences.

No. 1 is shaped roughly like a bent cylinder with rounded ends, and has no attachment scar. It measures about 8 cm. in length and 3 cm. in diameter. Specimen No. 2 is a low, irregularly shaped mass with a large basal attachment scar.

They are covered with irregular, twisted ridges of varying height. Reproduction takes place along the sides of the ridges near the top, and thus is produced in the rapidly growing portions of the corallum the arete-like structure so peculiar to this mode of propagation. In one place on No. 2 there are a few small cones such as van der Horst speaks of as characteristic of his *P. nierstraszi*. These are insignificant, however, and the entire remaining surface is made up of irregular,

twisted ridges of varying lengths and misshapen valleys. The calices are separately sunken in and the fossæ themselves average over 0.5 mm. in diameter. No. 1 varies from No. 2 in having thinner septa, although the number is common to both (12 to 13). The spaces between the septa in No. 1 are nearly as thick as the septa themselves. In No. 2 the latter are thicker and show very well the petal-shaped or elliptical septa and alternating rod-shaped ones, so characteristic of many *Psammocoras*. The elliptical septa are short, while the alternating ones extend farther up the ridge wall, where they fork, one prong becoming petal-shaped and the other straight. This pronging is arranged in such a way that in back of the first series of petal-shaped septa straight or rod-like ones extend; thus once again there is an alternating series of thick elliptical ones and straight ones. In their extension towards the top of the ridge, two more series of this kind may be seen at times. The limits of the series are marked by parallel rows of synapticulæ. This arrangement is best seen in the actively growing portions of the corallum. The elliptical rods are bulged and stand above the others, producing a rough surface. The septa are granulose.

The columella is well developed. It generally consists of an irregular central hump with a variable number of smaller rods surrounding it. These are at times so tangled up and fused with one another that no definite structure can be made out.

Stations.—Pago Pago Harbor, Tutuila, Samoa. Nos. 1 and 2, 225 feet and 200 feet respectively inward from seaward edge of Aua Reef flat. Shallow, relatively agitated water; rocky bottom.

Family OULASTREIDÆ Vaughan.

1919. *Oulastreidæ* Vaughan, Bull. 103, U. S. Nat. Mus., p. 453.

Genus DIPLOASTREA Matthai.

1914. *Diploastrea* Matthai, Trans. Linn. Soc. London, ser. 2, Zool., vol. 17, p. 72.
1918. *Diploastrea* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 142.
1919. *Diploastrea* Vaughan, Bull. 103, U. S. Nat. Mus., p. 469.

Diploastrea heliopora (Lamarck).

1816. *Astrea heliopora* Lamarck, Hist. nat. Anim. sans Vert., vol. 2, p. 265.
1919. *Diploastrea heliopora* Vaughan, Bull. 103, U. S. Nat. Mus., p. 470, plate 134, figs. 1, 1*a*, 1*b*, 1*c*. (With synonymy.)

In the U. S. National Museum there are Dana's types of *Astrea glaucopis* and *Astrea patula*, and also specimens of *Orbicella minikoiensis* Gardiner, all of which belong to the synonymy of *Diploastrea heliopora*. Dr. Mayor collected 2 specimens belonging to this species. They agree very well with those described in previous publications. The columella is broad (as much as 3.5 mm. in diameter at times) and consists of closely set perpendicular rods formed from the trabeculæ of the septal margins.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Shallow tide-pools on seaward edge of Utelei Reef.
No. 2. Pure agitated water in shallow tide-pools at low tide on Aua Reef.

Distribution.—French Somaliland; Minikoi; New Britain; Fiji Islands; Samoa. Widely distributed, from the east coast of Africa eastward to the Samoa Islands.

MADREPORARIA PERFORATA.

Family EUPSAMMIIDÆ Milne Edwards and Haime.

Genus DENDROPHYLLIA De Blainville.

1830. *Dendrophyllia* de Blainville, Dict. Sci. nat., vol. 60, p. 319.
1860. *Dendrophyllia* Milne Edwards and Haime, Hist. Nat. Corall., vol. 3, p. 112.

Type species: *Madrepora ramea* Linnæus.

Dendrophyllia diaphana Dana.

1846. *Dendrophyllia diaphana* Dana, U. S. Expl. Exped., Zooph., p. 389, plate 30 [27], fig. 3.
1918. *Dendrophyllia diaphana* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 144, plate 60, figs. 2, 2*a*, 3, 3*a*.

The two specimens from Samoa agree very well with Dana's type and the specimen from Cocos-Keeling Islands in the U. S. National Museum. This species is very similar to *D. manni* (Verrill). Vaughan (op. cit., p. 145) says regarding this:

"The nearest related form known to me is *C. manni* Verrill, from the Hawaiian Islands, which has much larger calices, and while alive normally has vermilion-red polyps."

No. 1 from Samoa is recorded as being a bright red in color, whereas Dr. Wood-Jones reports the Cocos-Keeling specimen as being brown-black. It agrees closer with *D. diaphana* in other respects, however. Due to the small number of specimens of this genus in the U. S. National Museum, I am not able to add any knowledge concerning the relation between the closely related species of *D. aurea*, *D. danæ*, *D. manni*, *D. willeyi*, and *D. diaphana*.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Crevices in shaded places in shallow tide-pools in pure agitated water in the breakers along seaward edge of Utelei Reef. Incrusting *Acropora*.

No. 2. West side of Pago Pago Harbor, 100 feet from shore. Water about 8 inches to 3 feet at low tide; in rocky crevices, growing always with the oral end downward. *Porites* in the neighborhood.

Distribution—Singapore; Cocos-Keeling Islands; Samoa.

Family ACROPORIDÆ Verrill.

Genus ASTREOPORA de Blainville.

1830. *Astreopora* de Blainville, Dict. Sci. nat., vol. 60, p. 348.
1896. *Astræopora* Bernard, Cat. Gen. Astræopora, Cat. Madreporaria Brit. Mus., vol. 2, pp. 77–99.
1918. *Astreopora* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 145.

Type species: *Astrea myriopthalma* Lamarck.

Astreopora profunda Verrill.

1846. *Astræopora pulvinaria* Dana (*non* Lamarck), Zooph., p. 415, plate 29, figs. 3, 3*a*, 3*b*, 3*c*.
1875. *Astræopora profunda* Verrill, appendix to Dana's Corals and Coral Islands, p. 333.
1896. *Astræopora profunda* Bernard, Cat. Mad. Corals of Brit. Mus., vol. 2, p. 98, plate 30; plate 33, fig. 20.

Identification based on one of the type specimens, No. 208, U. S. National Museum. Two specimens were collected from Samoa.

No. 1 has a somewhat explanate growth-form, while No. 2 is subhemispherical and contains slightly larger calices than the type and No. 1.

No. 1 is a fragment of what was evidently a good-sized corallum. The upper surface is convex. Some of the calices have their margins elevated, while others are even with the surface of the coenenchyma. As a rule they are subcircular, but often they are distorted. The fully developed corallites measure from 1.5 to 2.5 mm. across their calicular openings. Small calices appear frequently in the depressions between the mature ones. Distance between the larger calices is from 1.5 to 3 mm., usually about 2 mm. Depth of calices 3 to 4 mm.

There are usually two distinct cycles of septa, with the rudiments of a third frequently visible. The six primaries are much more prominent than the secondaries. The former are narrow near the margin and become so broad farther down that they fuse and form a fairly distinct columella. Occasionally one or two secondaries may reach the columella, but in general they are not nearly broad enough. In the type the edges of the septa possess moderate serrations. This is not so pronounced in this specimen.

The coenenchyma is rather porous. The surface is possessed with tall, roughly terminated spines. The latter are best developed around the calicular margins. Very perforate and only fairly continuous platforms are formed by the coenenchyma.

This species is very similar to *A. myriopthalma* (Lamarck), but can be distinguished mainly by the presence of a columella. In the latter species the septa do not fuse to make a distinct columella and a rudimentary tertiary is rarely seen.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Shallow tide-pools on seaward edge of Utelei Reef.
No. 2. Pure agitated water in shallow tide-pools near outer edge of Aua Reef.

Distribution.—Fiji Islands; Banda; Great Barrier Reef; Samoa.

Genus MONTIPORA Quoy and Gaimard.

1833. *Montipora* Quoy and Gaimard, Voy. de l'Astrolabe, Zool., vol. 4, p. 247.
1847. *Montipora* Bernard, Brit. Mus. (Nat. Hist.), Cat. Madreporaria, vol. 3, pp. 1–166, 177–184.

Type species: *Montipora verrucosa* Quoy and Gaimard (*non* Lamarck) = *Montipora foveolata* (Dana).

The genus *Montipora* is one of the most interesting of coral genera. Bernard, in his splendid work on the Montiporæ of the British Museum, has contributed a great deal to our knowledge of this genus. He makes the variations in the coenenchyma the basis for his five divisions. Following is his key to the divisions:

I. Glabrous, in which the surface is smooth.
II. Glabro-foveolate, in which the foveolate appearance is not very marked, or perhaps only confined to the younger portions of the stock, where growth is very rapid.
III. Foveolate, in which the interstices swell up into continuous or interrupted ramparts.
IV. Papillate. (*a*) In which the interstices swell up in irregular patches. (*b*) In which the papillæ form hoods or underlips, etc., to the calices. (*c*) In which the papillæ run together to form ridges. (*d*) In which the papillæ form regular rounded or nipple-shaped swellings.
V. Tuberculate. (*a*) In which the tubercles are distinct. (*b*) In which the tubercles run together to form ridges.

Studer (Zool. Jahrb., Heft 5, 1901, p. 396) reported *Montipora fungiformis* Bernard and *M. lobulata* Bernard from Samoa. Neither of these species is represented in this collection. Ortmann (Zool. Jahrb., III, 1888, p. 155) described *Montipora scabriculoides* from Samoa, which he subsequently identified as *Montipora exerta* Quelch.

FOVEOLATE MONTIPORÆ.

Montipora vaughani, new species.

Plate 6, figs. 1*a*, 1*b*.

The specimen is a massive, irregular fragment which measures 12.5 cm. long and 6 cm. wide. It is very thick, 2 cm. at the edge and 4.3 cm. where it is broken off. The main part of the corallum was probably considerably thicker. The surface is smooth and undulating. The border is rounded and the calices appear on the underside as far as 2 cm. from the edge, where they meet the epitheca.

The interstitial elevations of the coenenchyma rise to the same level above the calices, and since they are fused together they form irregularly meandering ridges around the calices. The latter are conspicuous and deeply set (about 2 mm.) between the ridges, which have nearly vertical sides and drop immediately into the calicular fossa. The ridges may inclose but one calice or there may be as many as six strung out side by side in a row and jammed against each other in the short valleys. The calices average about 0.8 mm. in diameter; the distance across the valleys from one ridge to another is 0.8 to 1 mm.; the thickness of the ridges averages 1 mm.

The septa are well developed. Six thick primaries nearly meet in the center of each calice; they can be seen to fuse a short distance below the calicular surface. Two directives can usually be made out by their slightly greater breadth and thickness. The six intermediates are thick, but usually short.

The dense, streaming reticulum rises from just above the epitheca and shoots upward in the form of thin, closely placed rods joined together by transverse processes. The coenenchyma rises 2 mm. above the surface of the calices and ends as continuous, rounded-topped walls of the same height and 1 mm. thick. The entire coenenchyma is a rather dense reticulum, although when enlarged and viewed from the top it appears to be somewhat spongy.

This distinctive and interesting species probably belongs to the foveolate group of Bernard. It could also be regarded as belonging to the papillate group, with regularly fused papillæ.

The specimen described is the only one in the collection, with the exception of a smaller fragment from the same station.

Station.—Pago Pago Harbor, Tutuila, Samoa. Shallow water, washed by breakers on seaward edge of Utelei Reef.

PAPILLATE MONTIPORÆ.

Montipora venosa (Ehrenberg).

Plate 6, figs. 2*a*, 2*b*.

1834. *Porites venosa* Ehrenberg, Korallenthiere, p. 118.
1897. *Montipora venosa* Bernard, Brit. Mus. Cat. Madreporaria, vol. 3, p. 69, plate 32, fig. 15. (With synonymy.)
1918. *Montipora venosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 153, plate 63, fig. 3; plate 19, fig. 46.

There are three specimens belonging to this species in the collection. They correspond with Bernard's description and illustration so well that it is unnecessary for me to describe them in detail. Two are incrusting, rather heavy, and from 1 to 2 cm. thick. The third is a large, heavy, subspherical specimen with a maximum diameter of 12 and a minimum one of 10 cm. The upper surface is made of an irregularly scattered reticulum, occuring as single papillæ or as rings around the calices. Between the papillæ smooth valleys are scattered indiscriminately, so that the surface has a patchy appearance.

The calices are from 0.5 to 0.75 mm. in diameter. Six well-developed primary septa alternate with weakly developed secondaries.

Vaughan's (op. cit., p. 153) specimens in the U. S. National Museum from Murray Island, Australia, differ from these and the description of Bernard considerably. The calices are much larger and less crowded, the septa better developed, and the surface of the corallum much more even in the case of the former. It is evident, however, that they belong to this species, with perhaps one exception. The specimen from the lithothamnion ridge should very probably be separated. The latter is foveolate, has no papillæ, and the two cycles of septa are exceedingly well developed and remarkably regular. The smooth, regular appearance of the surface offers a marked contrast to the rough, irregular surface of typical *M. venosa.*

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Quiet, shallow water of Aua Reef flat, 450 feet from shore.
No. 2. Aua line, 766 to 790 feet from shore.
No. 3. Aua line, 700 to 724 feet from shore.

Distribution.—Red Sea; Amboina; Fiji Islands; Samoa.

Montipora tuberculosa (Lamarck).

Plate 6, figs. 3*a*, 3*b*, 3*c*.

1816. *Porites tuberculosa* Lamarck (*non* Klunzinger), Anim. sans Vert., ii, p. 272.
1897. *Montipora tuberculosa* Bernard, Brit. Mus. Cat. Montipora, p. 112. (Synonymy.)

I have hesitated somewhat between putting this specimen here or with *Montipora sinensis* Bernard. Bernard says concerning the two: "This type [*M. sinensis*] is probably allied with *M. tuberculosa* of Lamarck, from which, however, it differs mainly in the size of the calices, which are much smaller in Lamarck's type." The calices of *M. sinensis* measure 0.75 mm. in diameter, while in Lamarck's type they are only 0.4 mm. The Samoan specimen seems to lie between the two in this respect, with calices of 0.5 to 0.7 mm. and averaging 0.6 mm. I am placing it with *M. tuberculosa* because it corresponds to it better in the following minor differences:

(1) *M. sinensis* has calices which are "sunk somewhat below the surface of the coenenchyma as indentations," which is not the case in this species.

(2) The calices are slightly more crowded in *M. tuberculosa* (1 mm. apart).

(3) There is more of a tendency for the papillæ to unite to form crests in *M. tuberculosa*.

(4) Bernard says concerning *M. sinensis:* "To the naked eye the septa seem to fill up the cavity so that no dark fossa is visible." This impression is not given in the Samoan specimen. Bernard's illustration of *M. sinensis* (plate 19, fig. 3), however, seems to show dark fossæ rather plainly.

Station.—Pago Pago Harbor, Tutuila, Samoa. Shallow tide-pools on seaward edge of Utelei Reef.

Distribution.—Samoa.

Montipora elschneri Vaughan.

1918. *Montipora elschneri* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 154, plate 64, fig. 1, 1*a*.

Both specimens of this species in the collection are incrusting and have nearly completely surrounded the dead coral on which they grew. In this respect they differ from the type (in the U. S. National Museum), the corallum of which is an irregularly shaped, thick plate. The surface, the corallites, and the coenenchyma, however, are so similar that they must belong to this species.

The upper surface is identical with that of the type, except that the low elevations or lumps are more pronounced. The undersurface is smooth and entirely without papillæ. On the under surface the calices are less distinct and slightly smaller (0.4 to 0.5 mm.) than those above (0.5 to 0.7 mm.).

As a rule, the tops of the calices are even with the coenenchymal surface. On specimen No. 2, however, the calicular openings have very frequently been carried upward by surrounding coenenchyma. This, of course, makes the surface much rougher.

The six primary septa are well developed, but scarcely ever extend beyond the half-diameter circle. The intermediate septa are distinct.

This species seems to have some points in common with Von Marenzeller's *Montipora densa*.

Station.—Pago Pago Harbor, Tutuila, Samoa. Nos. 1 and 2, 766 to 790 feet from shore, Aua line.

Distribution.—Fanning Island; Samoa.

TUBERCULATE MONTIPORÆ.

Montipora ehrenbergii Verrill.

Plate 7, fig. 1.

1834. *Porites foliosa* (partim) Ehrenberg (*non* Pallas), Korallenthiere, p. 117.
1875. *Montipora ehrenbergii* Verrill, in Dana's Corals and Coral Islands, p. 333.
1879. *Montipora tuberosa* Klunzinger, Korallenthiere, II, p. 32, plate 6, fig. 6; plate 5, fig. 8; plate 10, fig. 3.
1897. *Montipora tuberosa* Bernard, Brit. Mus. Cat. Montipora, vol. 3, p. 136.

There are 4 specimens of this species in the Samoan collection. All are explanate, with turned-up margins wherever free. The surface rises into irregular knobs and lobes.

Nos. 1 and 2 are possibly pieces of the same colony. No. 1 measures 12 by 8.5 cm.; No. 2 measures 19 by 10 cm. The others are small fragments. Thus the Samoan specimens are much smaller than that described by Klunzinger. The knobs and lobes are not so high as those usually attributed to this species. The highest is 2.5 cm.; the thickest 2 cm.

The tallest tubercles never exceed 1.5 mm., the majority being in the neighborhood of 1 mm. The tubercles are slightly taller and more dense on the knobs and at times fuse to form short, thin, irregular walls between the calices. This latter characteristic can often be observed on Dana's type of *Montipora hispida*, No. 341, U. S. National Museum, which is very similar in many respects.

The explanate basal portions have upturned edges. This and the fact that the tubercles are not so reguarly distributed over the upper surface are the main features which distinguish it from *M. hispida* (Dana).

The free-growing young margins of the corallum are somewhat different from the interior and older portions. The calices are not so crowded and are frequently arranged in rows, slightly elevated, with valleys between. The calices appear as protuberant rings which rise with the rings of tubercles. I think it very probable that Bernard's *Montipora annularis* (op. cit., p. 115, plate 23, fig. 4; plate 33, fig. 15) represents a very young form of *M. ehrenbergii*. Specimen No. 3 resembles it very much.

There is a specimen from the Philippines collected by J. B. Steere, which is typical *M. ehrenbergii*.

Station.—Pago Pago Harbor, Tutuila, Samoa. Aua line, 766 to 790 feet from shore.

Distribution.—Red Sea; Philippines; Samoa.

Montipora trabeculata Bernard.

Plate 7, fig. 2.

1897. *Montipora trabeculata* Bernard, Brit. Mus. Cat. Montipora, p. 148, plate 27, fig. 2; plate 34, fig. 9.

Two medium-sized specimens and a fragment of this species were collected by Dr. Mayor.

The corallum consists of an irregular basal plate, which sends up compact tufts of vertical branches. The branches divide, the branchlets being subcylindrical, upright, and very crowded. They often fuse to form ridges. One outstanding feature is the fact that the branchlets are flat-topped and all end at practically the same level. Diameter of average branchlet is 3 to 4 mm.

Specimen No. 2 does not have the tubercles as crowded as in No. 1. Bernard's description is adequate. Plate 7, figure 2, shows a natural-sized view of No. 2.

It is possible that this species is a branching variety of the preceding.

Station.—Pago Pago Harbor, Tutuila, Samoa. Aua line, 766 to 790 feet from shore.

Distribution.—Great Barrier Reef; Samoa.

Montipora verrilli Vaughan.

1907. *Montipora verrilli* Vaughan, Bull. 59, U. S. Nat. Mus., p. 168, plate 63, figs. 2, 2*a*, 2*b*; plate 64, figs. 1, 1*a*.
1918. *Montipora verrilli* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 158.

I am referring 3 specimens to typical *M. verrilli* and have been able to compare them to all those from Hawaii and the Fanning Islands in the U. S. National Museum. They are all small incrusting forms. Nos. 2 and 3 have slightly smaller calices in general, although in the type the diameter varies from 0.4 to 0.9 mm. The circle of tubercles around the calices which is so characteristic of *M. verrilli* is very prominent in the Samoan specimens. The septa are rather well developed.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua Reef about 700 feet from shore; rough water about 1 foot deep at low tide; rocky bottom. This specimen has completely grown over a circular piece of dead coral and is joined to a beautiful specimen of *Hydnophora microconos* (Lamarck).

No. 2. Aua Reef flat; quiet water about 5 inches deep at lowest tide; 640 feet from shore.

No. 3. Aua line, 700 to 724 feet from shore. Incrusting branched *Acropora*.

Variety auaensis, new variety.

Plate 7, figs. 3*a*, 3*b*.

One specimen shows such differences that I am making it the type of a new variety. Following is a description of it:

Corallum incrusting, explanate. Very irregular surface covered with low, pimple-like mounds and ridges. Measures 10 cm. by 6.5 cm. Very thin where there is no free edge (2 mm.), but 11 mm. thick where it extends beyond lithothamnion which it incrusts. Upper surface has soft, woolly, fleecy appearance.

Calices are very inconspicuous. Dark spots are not plainly visible where fossæ are present. This is due partly to the exceedingly well developed septa. The calices are rather numerous, though irregularly placed. In places they jam up close together and at others are widely separated. They are closer together on the center of the corallum and less numerous at the margins. They are minute, ranging from 0.4 mm. to 0.75 mm. A few, however, which are raised by the tubercles measure 1 mm. in diameter. The calices of the underside average about 0.4 mm. in diameter. They are 1 mm. apart and are surrounded by a distinct reticular ring.

Of the six stout primary septa the two directives generally fuse in the center of the calice and the others frequently extend to the point of fusion. This gives rise to a false columella. The intermediate secondary septa are also well developed and often reach to nearly the half-diameter circle. The calicular margins are distinct. I have seen a few of the larger calices having beginnings of a third cycle of septa.

The coenenchyma is made up of rather dense reticulum with very minute, rough granulations extending above the surface. Cross-section shows a thin, streaming layer with thin trabeculæ running to the upper and lower surfaces. Those bending upward rise above the surface in the form of tubercles. The junctions between the upward-streaming trabeculæ are slightly stouter than those below. The tubercles are very irregular in size and shape. They are generally bushy, and range in height from 0.4 to 1.5 mm. In some parts of the corallum they form rings of individual tubercles around the calices and at other parts fuse to form ridges which run irregularly in all directions between the calices. In places they

are very similar to the ridges of some papillate species, such as *Montipora prolifera* Brueggemann. The calices are found both in the valleys between the ridges and also on the pimple-like mounds and ridges.

This variety is distinguished from typical *Montipora verrilli* mainly by its very inconspicuous calices, well-developed septa and the fact that the tubercles fuse and run as ridges. Some places on the corallum appear as typical *M. verrilli*, except for the inconspicuous calices. At an ordinary distance from the eyes it is nearly impossible to distinguish any fossæ.

Station.—Pago Pago Harbor, Tutuila, Samoa. Shallow tide-pools on seaward edge of Utelei Reef, in breakers.

Distribution of Montipora verrilli.—Hawaiian Islands; Fanning Islands; Samoa.

Montipora berryi, new species.

Plate 7, figs. 4*a*, 4*b*.

Corallum is a small, solid, incrusting plate with an irregularly convex upper surface. It measures 8 by 5 cm. and is from 2 to 9 mm. thick.

The calices are very crowded, less than their diameter apart, and frequently jammed together. They average 0.7 mm. across and are only fairly distinct amid the forest of tall tubercles.

The septa are well developed, the six primaries often crossing beyond the half-diameter circle. The secondaries are unevenly although well developed, and some may be nearly as broad as the primaries. Two large directives usually are conspicuous. The primaries can frequently be seen to fuse lower down in the calice, a styliform columella at times resulting.

The surface of the corallum is very rough, because of numerous low humps and ridges closely crowded together, with corresponding narrow valleys between them. From the rather densely reticular streaming layer trabeculæ flow to the upper and lower surfaces. The trabeculæ are of different thicknesses, but on the whole are rather stout and are held together by transverse partitions. Those going upward rise high above the surface in the form of tall, fairly even, bushy tubercles which extend as much as 2 mm. above the tops of the calices. The entire space between the calices is taken up by these tubercles. Those on the raised portions of the corallum are larger than those in the valleys. They generally form rings around the calices (6 to 8 surrounding each calice). On the raised portions they frequently fuse so as to form a solid wall. These walls are not long, however, and are seldom made up of more than 2 or 3 fused tubercles. These large tubercles give the corallum an exceedingly rough appearance.

This species is somewhat similar to *M. effusa* Dana, the type of which is No. 316, U. S. National Museum. It is separated from the latter by its growth-form, its closely packed calices, broader septa, slightly taller, more crowded tubercles, and heavier corallum.

Station.—Pago Pago Harbor, Tutuila, Samoa. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.

Genus ACROPORA Oken.

1815. *Acropora* Oken, Lehr. Naturg., Th. 3, Abth. 1, p. 66.
1902. *Acropora* Verrill, Trans. Conn. Acad. Arts and Sci., vol. 11, pp. 164–208.
1918. *Acropora* Vaughan, Carnegie Inst. Wash. Pub. 213, pp. 159–186.

Type species: *Millepora muricata* Linnæus = *Madrepora cervicornis* Lamarck.

Brook, in his splendid work on the corals of the genus *Acropora* in the British Museum (1893), reported the species shown in table 7 from Samoa.

Those species marked with an asterisk have been identified in this collection. The species *A. arcuata* (Brook) has been referred to the synonymy of *A. hyacinthus* (Dana) for reasons presented under that species.

TABLE 7.

Name.	Localities according to Brook.
Acropora pacifica (Brook)	Samoa Islands; Tizard Bank.
cymbicyathus (Brook)*	Pacific Ocean; Fiji; Samoa.
arcuata (Brook)*	Pacific Ocean; Samoa Islands.
samoensis (Brook)*	Pacific Ocean; Samoa Islands.
plantaginea (Lamarck)	Tahiti; Samoa; Tongatabu; Singapore; Ceylon.
leptocyathus (Brook)*	Samoa.
syringodes (Brook)*	Great Barrier Reef; Samoa; South Seas.
rosaria var. diffusa (Brook)	Samoa Islands.
echinata (Dana)	Fiji; Samoa; Australia; Sulu Sea; Sandwich Islands; Liu Kiu Islands.

Studer (Zool. Jahrb., Vierzehnter Band, 5, Heft. 1901) lists the species given in table 8 from Samoa.

TABLE 8.

Name.	Localities according to Studer.
Acropora secunda (Dana)	Widely spread in Indo-Pacific Ocean; Singapore; Ceylon; Rotuma; Great Barrier Reef; Samoa.
gracilis (Dana)	Ceylon eastward to Samoa.
austera (Dana)	Indo-Pacific Ocean; Singapore; Rotuma; Samoa.
rosacea (Esper)	East Indian Ocean; Samboangan; Ternate; Solomon Islands; Fiji; Samoa.
armata (Brook)	Indo-Pacific Ocean; Singapore; Diego Garcia; Tahiti; Samoa.
arcuata (Brook)	Samoa.
conferta (Quelch)	Fiji; Tongatabu; Great Barrier Reef; Torres Straits; Admiralty Islands; Samoa.
samoensis (Brook)	Samoa.

I believe him correct in keeping *A. secunda* (Dana) separate from *A. nobilis* (Dana). This is discussed under the latter species. Dr. Mayor did not collect an example of *A. secunda*.

Acropora gracilis (Dana) has been included under *A. formosa* (Dana) in this paper. I believe it very doubtful that any of Dana's *A. spicifera* belongs to *A. armata* (Brook) as Studer has indicated (op. cit., p. 395). As there are no specimens of *A armata* in the U. S. National Museum, however, I can not be more positive.

Acropora formosa (Dana).

Plate 8, fig. 1 (Dana's type No. 888, U. S. Nat. Mus.); figs. 2*a*, 2*b*; figs. 3*a*, 3*b*.

1846. *Madrepora formosa* Dana, U. S. Expl. Exped., Zooph., p. 473, plate 31, fig. 2; plate 38, fig. 4.
1846. *Madrepora brachiata* Dana, U. S. Expl. Exped., Zooph., p. 474, plate 38, fig. 3.
1846. *Madrepora gracilis* Dana, U. S. Expl. Exped., Zooph., p. 482, plate 41, fig. 3.
1893. *Madrepora formosa* Brook, Cat. Genus Mad., p. 43. (With synonymy.)

The Samoan collection contains a large suite of specimens belonging to this species, and although they show considerable variation, they are undoubtedly specifically alike. The two main directions in which variation occurs is in the thickness of the stems and the shape of the calicular openings.

Brook recognized the minor importance of the diameter of the branches and combined *A. brachiata* with *A. formosa*. Dana's original specimens of these two

species are in the U. S. National Museum and show another difference besides the thickness of the branches. This difference lies in the calicular openings of the radial corallites. In the majority of cases the apertures of the radial corallites of *A. brachiata* are oblique, while they are more often cut at right angles to the corallite in *A. formosa*. This is so variable, however, that I am leaving the two combined.

To typical *A. formosa* and the *brachiata* variety I wish to add another variety, var. *gracilis*. Dana's type of *A. gracilis* is No. 333, U. S. National Museum. It is nearly exactly like *A. formosa*, with the exception that many of its radial corallites are truncated obliquely and thus have elliptical openings. Many others, however, have circular apertures, as in typical *A. formosa*. Specimen No. 265, U. S. National Museum, was marked by Dana *Madrepora formosa?*. So many of its corallites have oblique apertures that Dana hesitated in placing it with this species. In the Samoan suite there is also wide variation in this respect on the same colonies. I believe, therefore, that *A. gracilis* is only a variety of *A. formosa* with oblique apertures predominating. The type of *A. brachiata*, No. 295, U. S. National Museum, resembles the type of *A. gracilis* more than *A. formosa* because of its frequent obliquely truncated radial corallites.

As the gradation from variety *gracilis* to variety *brachiata* is so gradual, I have had to choose a purely arbitrary boundary. I have called all specimens *gracilis* whose branches are 12 mm. or less in diameter and the larger specimens *brachiata*. This procedure may be criticized, but I believe it good policy to subdivide a species where the variation is considerable, in order to give a clearer picture of the species.

I am referring all of the Samoa specimens to the varieties *gracilis* and *brachiata*. In all of them corallites with elliptical apertures predominate over those with circular openings, especially on the higher parts of the branches.

In the *gracilis* variety the branches are 6 to 12 mm. in diameter. They are spreading-ramose and attenuate. The axial corallites vary from 1.5 to 2.5 mm. in diameter including the walls, and average 2 mm. long. There is generally a cycle of 6 well-developed septa with a cycle of less-developed intermediate ones. The radial corallites are usually from 2 to 3 mm. long on the upper parts of the branches, and become very short on the basal parts of the stems. In between the well-developed ones are closely crowded smaller corallites all over the corallum. The corallites are tubo-nariform; the outer sides very slightly thicker than the inner; the tips truncated obliquely. Septa best developed when calicular walls are thickest. This is usually the case on the basal parts of the branches.

One cycle generally fairly well developed with irregularly developed intermediate septa. In one specimen the septa are poorly developed in nearly all the calices. The two directives generally prominent. The sides of the corallites are distinctly striate, with fine granulations on striations. Between striations walls are perforate.

In one specimen the under side of the corallum has very poorly developed corallites, even far up on the branches.

Variety *gracilis* grades gently into the *brachiata* variety. The latter has longer and stouter branches which thin out more abruptly, and which perhaps do not branch quite so profusely. The calices are slightly longer, with thicker walls and correspondingly better developed septa.

One distinctive character common to the whole species is the crowded appearance of the septa due to the large number of small septa taking up the space between the larger. This is most pronounced on the basal portions.

Von Marenzeller's *Acropora eminens* appears to be very close to this species.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Variety *gracilis.*

Nos. 1 and 2. Aua line, 786 to 790 feet from shore.
Nos. 3 and 4. Aua line, 600 to 625 feet from shore.
No. 5. Aua line, 526 to 550 feet from shore.
Nos. 6 and 10. 150 feet off mouth of big brook, killed by fresh water and silt.
No. 7. Aua line, 400 to 424 feet from shore. This specimen seems to approach *A. virgata* (Dana).
No. 8. Aua line, 700 to 724 feet from shore.
No. 9=No. 38 of Dr. Mayor's photographed series. Aua line.

Variety *brachiata.*

Nos. 1 and 2. Aua line, 600 to 624 feet from shore.
No. 3. Aua line, 460 to 484 feet from shore.
No. 4. Aua line, 526 to 550 feet from shore.
No. 5. Aua line, 700 to 724 feet from shore.
Nos. 6 and 7. Aua line, 766 to 790 feet from shore.

Distribution.—Indo-Pacific Ocean; Fiji Islands; Sulu Sea; Torres Straits; New Ireland; New Hanover; Sumatra; Singapore; Ceylon; Amboina; Samoa.

Acropora exigua (Dana).

Plate 9, figs. 1*a*, 1*b* (Dana's type, No. 288 U. S. N. M.), 2.

1846. *Madrepora exigua* Dana, U. S. Expl. Exped., p. 469, plate 38, figs. 2, 2*a*, 2*b*.
1893. *Madrepora exigua* Brook, Cat. Genus Mad., p. 125. (With synonymy.)

I am referring 3 specimens to this species. They resemble very closely Dana's type of *Madrepora exigua*, which is No. 288 in the U. S. National Museum, with the exception that two of them have somewhat larger and thicker branches.

The following is a description of the species:

Corallum arborescent and spreading-ramose. Branches 4 to 10 mm. in diameter, slowly tapering.

Axial corallites rarely over 2 mm. in diameter, may be 4 mm. long; sides strongly costulate; 6 primary septa well developed and secondaries insignificant.

Radial corallites labellate, 0.5 to 1.25 mm. in diameter, openings generally circular. Walls may be 2 mm. high on upper parts of branches and become much shorter farther down. Septa very poorly developed, often only directives visible. Walls strongly costulate but seldom echinulate. The continuation of the costæ on to the cœnenchyma may be decidedly echinulate. Between the labellate corallites appear, occasionally, immersed or subimmersed smaller ones.

The distinguishing features of the species are its narrow, slow-tapering branches and the characteristics of the radial corallites.

Brook (op. cit., p. 125) speaks of the radial corallites as being "chiefly roundnariform, with a few of the more prominent ones labellate." By far the majority are labellate in the type and in the specimens collected by Dr. Mayor.

Stations:

Pago Pago Harbor, Tutuila, Samoa:
Nos. 1 and 2. 150 feet off mouth of big brook, killed by fresh water and silt.

Suva Harbor, Fiji Islands:
No. 3=22F (Mayor). Tide-pool on barrier reef off mouth of Suva Harbor. This specimen has radial corallites slightly more crowded.

Distribution.—Fiji Islands; New Hebrides; Solomon Islands; Samoa.

Acropora hebes (Dana).

Plate 9, figs. 3*a*, 3*b*.

1846. *Madrepora hebes* Dana, U. S. Expl. Exped., Zooph., p. 468, plate 35, fig. 5.
1893. *Madrepora hebes* Brook, Cat. Genus Mad., p. 128.
1918. *Acropora hebes* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 174, plate 73, figs. 2, 2*a*; plate 74, figs. 1, 2, 2*a*, 2*b*; plate 13, fig. 6.

Dr. Mayor collected a very large and excellent suite of specimens belonging to this species. The species has already been adequately decribed, and thus it is unnecessary to redescribe it here. The Samoan specimens are closer to Dana's type than are the Murray Island ones described by Vaughan, since the diameter of the radial corallites is less. The average diameter of the radial corallites is 1.5 mm., in contrast to 2.5 mm. in the case of the Murray Island corals.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 6. Aua line, 700 to 724 feet from shore.
Nos. 7 to 10. Aua line, 766 to 790 feet from shore.
Nos. 11 to 20. Aua line, 812 to 836 feet from shore.
Nos. 21*a* and 21*b*=Nos. 14S and 14D (Mayor). Two halves of same colony taken from quiet, shallow water about 600 feet from shore on the Aua Reef flat. No. 14S was grown in highly agitated water on the edge of a reef-patch off Aua. No. 14D was placed in quiet water 51 feet deep off the Aua Reef patch. The latter died without growing and still has the growth-form characteristic of typical *A. hebes*. The shallow-water half has assumed an irregular, gnarled appearance, totally unlike natural *hebes*. The branches are short, stout, and stunted. The branchlets are thick and fused together so as to approach a massive shape. The radial corallites are large and closely crowded.
No. 22. Station unknown.
Nos. 23 and 24. 150 feet from mouth of big brook, killed by fresh water and silt.

It is quite noticeable that there is a difference in the growth-forms of these specimens according to their stations. Those from the Aua line, 700 to 724 feet from shore, have long, slender, spreading-ramose branches; those 766 to 790 feet from shore have approximately the same growth-form; those 812 to 836 feet from shore, however, have their branches shorter and more crowded, and there is a tendency for numerous branchlets to form, especially at the branch-tips.

Distribution.—Fiji Islands; Great Barrier Reef; Samoa Islands.

Acropora teres (Verrill).

Plate 10, figs. 1*a*, 1*b* (type No. 377 U. S. N. M), 2*a*, 2*b*,; figs. 3*a*, 3*b* show Dana's type of *A. cribripora*, No. 298 U. S. N. M.; Mayor's "Growth-Rate of Samoan Corals," plate 6, figs. 19, *a*, *b*.

1866. *Madrepora teres* Verrill, Proc. Essex Inst., vol. 5, p. 20.
1893. *Madrepora teres* Brook, Cat. Genus Mad., p.198.

Verrill's type of *Acropora teres* from Ousima is No. 377, U. S. National Museum. It appears to be much worn and only the lower part of the branches remains.

The Samoan specimen is a large, arborescently branched one, with the branches laxly dividing. The branches are long, round, slightly tapering; the largest is 20 cm. long and 12 mm. in diameter at the base. The branchlets are slender, more rapidly tapering, with apices generally rounded.

The axial corallites are 2.5 to 3 mm. in diameter. At times they are scarcely exsert and again they may be exsert as much as 3 mm. Wall usually rounded and porous; 6 fairly prominent septa of first cycle alternate with small intermediates. Where exsert the wall is strongly costulate.

The radial corallites vary greatly from 0.25 to 1 mm. in diameter; average 0.75 to 1 mm.; numerous in places and at others more scattered, as in type. Those on the branchlets and on the upper part of the corallum are provided with thin, labellate lower lips which are either slightly ascending or spreading perpendicular to stem. Slightly farther down they become immersed; by far the major part of the corallum possesses immersed corallites. The septa are very poorly developed, with generally only the upper directive visible.

The coenenchyma is vermiculate, sharply scabrous, and possessed of fine granulations.

The radial corallites average slightly smaller than those of the type and in places are more crowded. In the type they are placed about 1.5 mm. from each other, a distance which is also often observable in the Samoan specimens. Verrill likens this species to *A. virgata* (Dana), but the resemblance is only superficial.

A. cribripora (Dana), the type of which is No. 289, U. S. National Museum, is very close to this species. I am keeping them separate until more specimens are available, mainly because of the large, more crowded radial corallites of the former. The specimens which Brook referred to *A. cribripora* certainly do not belong there. The species is peculiar for its lack of septa in its radial corallites (usually only the upper directive is present), whereas Brook's specimens contain 6.

Station.—Pago Pago Harbor, Tutuila, Samoa. No. 1=No. 19 (Mayor). Placed at the concrete planting-station, Aua Reef, in water about 2 feet deep at low tide, on hard, rocky bottom. About 750 feet from shore near outer edge of reef.

Distribution.—Ousima; ? China (Brook); Samoa.

Acropora nobilis (Dana.)

Plate 11, fig. 1; fig. 2 shows part of Dana's type of *A. secunda*, No. 323, U. S. N. M.

1846. *Madrepora nobilis* Dana, U. S. Expl. Exped., Zooph., p. 481, plate 40, fig. 3.
1893. *Madrepora nobilis* Brook, Cat. Genus Mad., p. 135.
1902. *Acropora nobilis* Verrill (typical), Corals of the Genus Acrop., p. 233.

Verrill (Bull. Mus. Comp. Zool., 1864 ,vol. 1, p. 40) stated that he had carefully examined the types of *A. nobilis* and *A. secunda* and had come to the conclusion that the latter should be regarded simply as a variety of the former. Quelch (*Challenger* Reef Corals, p. 150) followed Verrill and referred to *A. nobilis* some specimens which closely fitted Dana's description of his *A. secunda*. He, however, questioned the correctness of this. Brook (op. cit., p. 135) kept the two species separate. Verrill in his "Corals of the Genus *Acropora*," page 233, defended his stand and suggested that Brook's specimens of *A. secunda* were not *secunda*, but belonged to a new species. He proposed the name *secundella* for this new species.

Dana's types of *A. nobilis* and *A. secunda* are in the U. S. National Museum. Verrill may possibly be correct in combining these two species, and yet the types are so distinct that I am inclined to keep them apart. *A. nobilis* is a much larger, sturdier species with stems many times thicker. In *A. nobilis* the radial corallites are very unequal in size. Some are large dimidiate, others smaller, labellate, with a thin wall, and others immersed. In *A. secunda* their sizes are much more constant. The axial corallites of the latter may be exsert 3 or 4 mm., whereas in the other species they are in general not so prominent. The radial corallites of *A. secunda* are more appressed than those of *A. nobilis*, which often stand perpendicular to the branch. The coenenchyma of the latter is much more spongy-reticulate than that of the former.

It is hard to say without a good photograph whether Brook's *A. secunda* is or is not a different species, but I am inclined to believe that his description does not come too far from Dana's type (No. 323, U. S. Nat. Mus.). It is of course wrong to place it in a different subgenus than *A. nobilis*, as he has done.

The Samoan collection contains one large branch with several smaller ones, which have probably been broken from the same corallum. The large branch is nearly as much as 4 cm. in diameter. One curious feature concerning this specimen is that the radial corallites make no pretense at similarity of position. They face in all directions. That is to say, the thick lip of one corallite may face the proximal

end of the branch, while that of its nearest neighbor may be turned at any angle to it, and, indeed, may be completely reversed. This characteristic is most common on the lower portions of the branch.

Station.—Pago Pago Harbor, Tutuila, Samoa. Rough water, 10 feet deep.

Distribution.—Singapore; Ceylon; Java; Samoa.

Acropora samoensis (Brook).

Plate 11, figs. 3*a*, 3*b*. Also illustrated in Dr. Mayor's paper on "Growth-Rate of Samoan Corals." Plate 11, fig. 4 shows Dana's type, No. 332, of *A. humilis*.

1893. *Madrepora samoensis* Brook, Cat. Genus Mad., p. 143, plate 6, fig. c; plate 31, fig. A.
1901. *Madrepora samoensis* Studer, Zool. Jahrb., 5. Heft, p. 395.

Dr. Mayor collected 5 beautiful examples of this species. All possess a rounded, incrusting base. They are not as large as Brook's described type; the largest measures about 12 cm. high and 16 cm. broad. The branching is very irregular. At times the branches increase in length towards the center of the corallum and in other specimens they become shorter at the center. In the latter case they are 2 to 4 cm. long at the center and as much as 9 cm. long around the edge; the dimensions are reversed in the other case. Brook's description is very good.

Dana's *Madrepora humilis*, the type of which is No. 332, U. S. National Museum, has a growth-form very similar to this species. At first glance it is difficult to distinguish any differences between them. The two main differences, however, are:

(1) The space in between the large radial corallites is taken up by numerous small, subimmersed or immersed ones in *A. samoensis*. This is never the case in *A. humilis*, which has radial corallites of nearly the same size.

(2) The walls and the cœnenchyma of *A. samoensis* are much more porous and delicate than those of *A. humilis*, the texture of which is rather firm.

Dana's illustrations do not give a correct idea of *A. humilis*. They show the radial corallites as being appressed and rather isolated. This is not at all the case, as the corallites are arranged exactly as the large ones of *A. samoensis*. There seems to be no doubt that the specimens which Brook placed with *A. humilis* belong to some other species. It is only natural that Brook should have made this mistake because of Dana's poor illustrations. Plate 11, figure 4, shows Dana's type of *A. humilis*.

A specimen illustrated in Dr. Mayor's paper "Growth-Rate of Samoan Corals," plate 4, figs. 11 *a*, *b*, appears to belong to *A. humilis*. I have hesitated from definitely placing it there because of its stouter branchlets.

Stations:

Pago Pago Harbor, Tutuila, Samoa:
Nos. 1 and 2=Nos. 16 and 12 (Mayor). Aua Reef flat in agitated water, about 700 feet from shore.
Nos. 3 and 4. Aua line, 700 to 724 feet from shore.
No. 6. Aua line, 600 to 624 feet from shore, water 9 inches deep.
Suva Harbor, Fiji Islands:
No. 5=No. 3F. Tide-pool on barrier reef.

Distribution.—Samoa Islands; Fiji Islands.

Acropora valida (Dana).

Plate 12, figs. 1*a* (type No. 272 U. S. N. M.), 1*b*, 1*c*. See also Mayor's "Growth-Rate of Samoan Corals."

1846. *Madrepora valida* Dana, U. S. Expl. Exped., Zooph., p. 461, plate 35, fig. 1.
1893. *Madrepora valida* Brook, Cat. Genus Mad., p. 168.

The following is a description of this species:

Corallum cespitose, measuring 7 cm. in height, 12 cm. in width and 5 cm. across the base. The branches are 10 to 16 mm. thick at the base and keep approximately the same diameter throughout their length. Apices of branches from 2 to 2.5 cm. apart. Near the top each branch usually sends off two or more short, stout branchlets.

The axial corallites are 2.5 to 3 mm. across, the apertures measure about 0.75 mm. in diameter, exsert 1.5 to 2 mm. Wall rounded, spongy. Six well-developed septa usually meet in the center of the calice; secondaries less developed.

Radial corallites large, stout, unequal, and appressed tubiform. They are truncated obliquely and thus have elliptical apertures. Walls thick, especially on outer side, and rounded. Length of larger corallites 3 to 8 mm., diameter averages 2 mm., few immersed on basal parts of corallum. First cycle of septa fairly well developed, with directives very prominent. Under surface of outer branches flattened and nearly naked. Walls of septa covered with very fine echinulations, which at times run in rows.

There are 5 specimens of this species in the collection. No. 1 is a large specimen with branches 7 cm. long and much more even than in Dana's type. No. 2 is the one described, and shown on plate 12, fig. 1*c*. No. 3 varies somewhat from the others by its thicker corallite walls.

This species resembles *A. variabilis* Klunzinger, but is separated from it mainly by the character of the radial corallites. In *A. variabilis* they are tubular, with small, circular apertures, and walls generally equally thick all around the openings. In *A. valida* the inner wall is usually much thinner than the outer, the apertures elliptical, the corallites often having a nariform appearance.

Stations:

Pago Pago Harbor, Tutuila, Samoa.—
No. 1=No. 33 (Mayor). Aua line, about 700 feet from shore.
No. 2. Aua line, 766 to 790 feet from shore. Center of branched *Acropora* zone.
No. 4. Aua line 766 to 790 feet from shore.
No. 5=No. 51D (Mayor). Grown at depth of 2 fathoms in agitated water.
Rose Island; Samoa.—
No. 3. Edge of reef-flat near lagoon. Shallow water about 1 foot deep at low tide.

Distribution.—Fiji Islands; Tongatabu; Torres Straits; Mergui Archipelago; Singapore; Samoa.

Acropora canaliculata (Klunzinger).

Plate 12, fig. 2.

1879. *Madrepora canaliculata* Klunzinger, Korallthiere des Rothen Meeres, part 2, p. 12, plate 1, fig. 3; plate 4, fig. 10; plate 9, fig. 8.

Von Marenzeller (1906, Riffkorallen des Rothen Meeres) thinks it very probable that this species should be referred to the synonymy of *A. scherzeriana* Brueggemann. He says the plates of Klunzinger's work do not give an exact conception of the species as it is represented in the Berlin Museum example 2129. He likens the latter example in growth-form to his No. 15649 (Taf. 12, fig. 27) of *Acropora scherzeriana*, which has longer and more slender branches than *A. canaliculata* represented by Klunzinger. The lone specimen collected by Dr. Mayor corresponds very well in form of growth with von Marenzeller's specimen No. 15649, except that it has somewhat shorter branches, and must therefore be close to the Berlin Museum example 2129.

In the U. S. National Museum there are several specimens of *Acropora canaliculata* from Paumotus, and also some specimens of *A. scherzeriana* from Cocos-Keeling described and pictured by Vaughan in Carnegie Institution of Washington Publication 213. The Fiji Island specimen collected by Dr. Mayor corresponds to those from Paumotus in all respects except that its branches are more slender and longer.

I am keeping the species separate until more examples can be studied, although I believe probably they should be united.

Station.—Suva, Fiji. Barrier reef, shallow water.

Distribution.—Red Sea; Paumotus; Fiji Islands.

Acropora fructicosa (Brook).

1893. *Madrepora fructicosa* Brook, Cat. Genus Mad., p. 138, plate 18, fig. A.

One good-sized colony and a small fragment of this beautiful and very regular species were collected by Dr. Mayor. He used the large specimen for a growth experiment. It was removed from a position 600 feet from shore on the Aua Reef flat, and one half of it was grown in a highly agitated, breaker-washed location on the edge of a reef-patch, while the other half was planted in water 42 feet deep. The shallow-water part thrived, while the deep water half died without growing. It can be noticed that the rough-water half has had its branches slightly stunted because of its location.

The latter half fits Brook's description and plate of *M. fructicosa* perfectly, except that it is not so large. It measures 6 cm. in height and 15 cm. in width.

This species is very similar to *A. acervata* (Dana), the type of which is No. 271, U. S. National Museum. I have kept them separate because I find that the radial corallites of *A. fructicosa* are perhaps more regular, and the septa are not as well developed. In *A. acervata* the primary septa are all well developed and the secondaries fairly so. In *A. fructicosa* generally only the directives are well developed, the other primaries very irregular, and the secondaries often entirely missing. In the corallites towards the ends of the branches frequently only the directives can be seen. Brook's description and illustration are very good.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1*a* and 1*b*=Nos. 4S and 4D (Mayor). Two halves of same colony taken from about 600 feet from shore on Aua Reef flat. No. 1*a* was grown in highly agitated, breaker-washed situation on the edge of a reef-patch off Aua. No. 1*b* was planted in quiet water 42 feet deep.

No. 2. Aua line, 850 to 874 feet from shore.

Distribution.—Torres Straits; Great Barrier Reef; Samoa.

Acropora corymbosa (Lamarck).

Plate 13, figs. 1*a*, 1*b*, 1*c*. Also Mayor's "Growth-Rate of Samoan Corals."

1893. *Acropora corymbosa* Brook, Cat. Gen. Mad., p. 97.
1906. *Acropora corymbosa* von Marenzeller, Denksch. K. K. Akad. Wiss. Wien, vol. 80, p. 32, plates 1, 2, 3.
1918. *Acropora corymbosa* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 171, plate 67, fig. 1.

Corallum corymbose, flattened on top. Branches projecting upward, marginal ones obliquely; those in center of corallum 35 mm. long, marginal ones 65 mm; Diameter at base of simple branchlet 5 or 6 mm. Branches profusely divided. proliferous corallites with buds (making minute branchlets) frequent near apices of larger branchlets.

Axial corallites 1.5 to 2 mm. in diameter; project about 1.5 mm.; walls fragile, costulate, very porous; fossæ wider than thickness of walls; six primary septa fairly well developed, secondaries scarcely even visible.

The radial corallites are rather numerous and fairly regularly placed; usually labellate; ascending slightly less than 45°. The walls are very fragile and porous, with distinct costæ. Diameter of corallites 1 to 1.5 mm., length up to 3 mm. Septa very thin; only directives can be faintly made out in distal corallites; in those closer to the base the 6 primaries can be seen with obscure secondaries. Apertures generally subcircular, often distinctly elliptical; circular in immersed or subimmersed

corallites around basal portions. Numerous long tubular corallites with buds on underside of marginal branches. Cœnenchyma perforate, costo-echinulate.

I have described one of seven examples in the Samoan collection. The others are very similar and vary mainly in the thickness of the branches. In No. 5 the base of the simple branchlets may be 8 to 10 mm. in diameter.

These examples coincide with a specimen identified by Vaughan from Tahiti in the U. S. National Museum, and also with one collected by Dr. Fred. Baker at Fanning Island, which was referred to by Vaughan in the above-mentioned paper. They are similar to the specimens represented by von Marenzeller in his figures 7 and 7*a* of plate 3; his figure 6*a* represents the characteristics of some of the branchlets fairly well, although as a rule the Samoan branchlets are more tapering.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1 = No. 29 (Mayor). This was described. From 400 feet out from shore off Aua village. Water about 8 inches deep at lowest tides; quiet, bottom limestone reef-flat.

Nos. 2 to 6. Aua line, 766 to 790 feet from shore.

No. 7. Found growing on rock off point south of Aua village. Water about 4 feet deep at low tide, fairly quiet.

Distribution.—Red Sea; Rodriguez; Ramesvaram; China Sea; New Holland; Great Barrier Reef; Fiji; Tahiti; Makemo; Paumotus; Fanning Island; Samoa.

Acropora cymbicyathus (Brook).

Plate 13, figs. 2*a*, 2*b*. Also illustrated in Mayor's "Growth-Rate of Samoan Corals."

1893. *Madrepora cymbicyathus* Brook, Cat. Gen. Mad., p. 86

The two specimens collected by Dr. Mayor correspond to Brook's description, except in the diameter and length of the axial corallites. They average 2 mm. in diameter, whereas Brook's specimens average 2.5 mm. They are exsert about 1.5 mm., and Brook describes them as being 2 mm. exsert.

This species is very similar to *Acropora nasuta* (Dana), the type of which is No. 260, U. S. National Museum. As a rule, the walls of the radial corallites are thinner and more fragile in the latter species. Verrill (1902, Corals of the Genus *Acropora*, p. 257) reports one of Dana's types of *nasuta* in the museum of Yale University as belonging to the variety *crassilabia* of Brook. This variety has decidedly thick walls. Thus there is a good deal of variation in this respect within the species. Usually the septa are better developed in *A. nasuta*, but this also is subject to variation. The main feature which distinguishes the two species is that the radial corallites of *A. cymbicyathus* are more appressed. The distal ones stand at an angle of 30° to 45° to the branch, and lower down they are even more appressed. They frequently spread out at nearly 90° in the other species.

Station, Pago Pago Harbor, Tutuila, Samoa:

No. 1 = No. 18 (Mayor). From about 700 feet from shore off Aua village. Water quiet, 1 foot deep at low tide; bottom hard, rocky broken limestone.

No. 2 = No. 36D (Mayor). Raised at depth of 2 fathoms off Trading Point. Rough water.

Distribution.—Fiji; Samoa.

Acropora hyacinthus (Dana).

Plate 13, fig. 3; plate 14, figs. 1*a* to 1*d*. Also well illustrated in Dr. Mayor's "Growth-Rate of Samoan Corals."

1846. *Madrepora hyacinthus* Dana, U. S. Expl. Exp. Zooph., p. 444, plate 32, fig. 2.
1893. *Madrepora arcuata* Brook, Cat. Gen. Mad., p. 102, plate 12.
1901. *Madrepora arcuata* Studer, Zool. Jahrb., 5 Heft, p. 395.

Dana's plate 32, figure 2, shows simply a fragment of the type specimen, No. 246, U. S. National Museum, and gives no true idea of the characteristics of the species. Plate 13, figure 3, of this paper is a full-sized photograph of the type and gives a better conception of it. Dr. Mayor collected a splendid suite of 16 examples of this species, which illustrates the wide variation exceedingly well.

The specimens vary a good deal in the size and shape of the corallum and in the thickness of the branchlets. The largest specimen (No. 3) measures 33 cm. in diameter and 14 cm. in height; the smallest is 5 cm. wide and 6 cm. in height. The large specimens are all either flabellate or vasiform, extending from a round pedicel; the smaller ones are arborescent, cespitose, or subhemispherical.

From the study of the specimens I am led to believe that when young the branches grow in such a way as to give the corallum a cespitose, bushy shape. At this stage the branchlets with their corallites are just as numerous on the underside of the peripheral branches as on the upper. As the colony gets older the peripheral branches grow rapidly in an upward oblique direction, while those in the center cease to grow. Thus what was at one time the convex portion of the corallum now becomes concave. As further growth occurs the peripheral branches fuse with each other to form a more or less perfect platform, and on the underside the branchlets with their corallites become so appressed to the main, fused branches that the under surface is comparatively smooth. On the upper surface the branchlets grow upwards with increasing angle from the margin towards the center of the corallum, where they are nearly perpendicular to the platform. This method of growth is shown by plate 2, figs. 1*a*, 1*b*, of Dr. Mayor's paper on "Growth-Rate of Samoan Corals." Plate 5, figure 14*a*, shows specimen No. 1 = No. 14 (Mayor) on April 10, 1917. Figure 1*c* of plate 14 of the present paper shows the same specimen on the date it was collected, June 11, 1918. Figure 1*a* shows one of the young specimens (No. 10) in the collection and figure 1*b* shows a slightly older one in which the corallum is turning from the cespitose to the vasiform stage. Several other figures in Dr. Mayor's paper illustrate the species.

Dana's type represents a specimen which has turned from the cespitose stage into the vasiform stage, but whose branchlets of the underside of the peripheral branches, which are just in the act of fusing, have not as yet become appressed.

The Samoan specimens illustrate every stage of growth. It is perfectly clear that Brook's type of *M. arcuata* is a fully developed example of *A. hyacinthus*. Two of the specimens (Nos. 1 and 2) of this collection fit Brook's excellent description and illustration of *A. arcuata* perfectly. No. 3 shows a variation in the thickness of the branchlets; those at the margin measure about 4 mm., while towards the center they may be as much as 6 mm. in diameter. In No. 4 the branchlets average from 4 to 5 or 6 mm. in thickness. This corresponds with Dana's type. On Nos. 1 and 2 the branchlets are thinner and average 4 mm., as do those of Brook's type of *A. arcuata*. The corallite walls in all the specimens are porous.

There is a specimen of this species in the U. S. National Museum from the Philippines.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1, 2, 3, 4=Nos. 14, 34, 1, 8, and 9 (Mayor). From 700 feet out on Aua Reef flat; bottom rocky, depth about 1 foot, water agitated.
Nos. 5 and 6. Aua line, 700 to 724 feet from shore.
No. 7. From growth station No. 1 at Double Point. Water 1 foot deep at low tide.
No. 8. From Square No. 3. Aua line, 50 to 75 feet from shore. Coarse sandy bottom. 1.5 feet deep at low tide.
Nos. 9 and 10. 150 feet off mouth of big brook. Killed by fresh water and silt.
Nos. 11 and 12. Aua line, 766 to 790 feet from shore.
Nos. 13 to 16. Aua line, 850 to 874 feet from shore.

Distribution.—Fiji; Philippines; Samoa.

Acropora latistella (Brook).

Plate 15, figs. 1*a*, 1*b*.

1893. *Madrepora latistella* Brook, Cat. Genus Mad., p. 112, plate 9, fig. B.

There is one specimen from the Fiji Islands in the collection. The axial corallites are not quite as wide and exsert as those of the type. They measure 2 to 2.5 mm. in diameter and are from 1 to 1.5 mm. exsert, as contrasted to 2.5 to 3 mm. diameter and 2 mm. exsert in the type. The walls of the radial corallites are strong and well built. One of the outstanding features is the fact that the septa are remarkably well developed. Many of the radial corallites are spreading at nearly 90° to the branch, while the others are ascending. Striations of the walls echinulate only at base.

Station.—Fiji Islands. No. 1=No. 26F (Mayor). Shallow tide-pool on barrier reef off mouth of Suva Harbor.

Distribution.—Port Denison; Thursday Island; Fiji Islands.

Acropora syringodes (Brook).

Plate 15, figs. 2*a*, 2*b*. Also Mayor's "Growth-Rate of Samoan Corals."

1893. *Madrepora syringodes* Brook, Cat. Gen. Mad., p. 177, plate 33, fig. E.
1918. *Acropora syringodes* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 185, plate 83, figs. 1, 1*a*, 1*b*, 1*c*, 1*d*.

Dr. Mayor collected 3 specimens which belong to this species. They differ from the type in the diameter of the radial and axial corallites. The average diameter of the axial corallites is 2 mm. and of the radial corallites 1.5 mm., as opposed to 2.75 mm. and 2 mm. in the case of the type. The main feature of the species is the possession of the long, closely appressed, tubular, radial corallites. Near the distal part of the branchlets they may or may not become more spreading.

The branches are exceedingly fragile and become broken very easily. The Samoan specimens are much more typical than those described by Vaughan. Plate 15, figure 2*a*, shows a full-size view of No. 3. Figure 2*b* is a view of one of the branches. The other two examples are similar.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1=No. 43D (Mayor). Depth of 2 fathoms in agitated water.
Nos. 2 and 3=Nos. 7 and 16 (Mayor). Off Double Point, agitated water; bottom rocky; depth 1 foot at lowest tide.

Distribution.—Great Barrier Reef; Samoa; South Seas.

Acropora prolixa (Verrill).

Plate 16, figs. 1*a*, 1*b*, from Samoa; 1*c*, type No. 414 U. S. Nat. Mus.; 1*d*, Dana's type of *A. echinata* from the Sulu Sea, No. 276 U. S. Nat. Mus.

1866. *Madrepora prolixa* Verrill, Communications Essex Inst., Salem, vol. 5, p. 22.
1902. *Acropora prolixa* Verrill, Trans. Conn. Acad. Sci., vol. 11, p. 237, plate 36, figs. 3, 3*a*; plate 36A, figs. 3, 3*a*; 36F, fig. 14.

The collection contains one good-sized specimen and a fragment of this species. The corallum of the former is erect, arborescent, reaching height of 15 cm. The branchlets possess numerous long, slender, tubular, proliferous corallites which have shorter radial corallites extending from them. In the terminal portions of the corallum the axial corallites have several short, appressed radial corallites below them. The average diameter of the normal radial corallite is 1.25 mm. They may be as much as 1 cm. long, but probably average about 6 mm., not including the appressed ones, which of course are much shorter. They are usually strongly contracted at the aperture, although this is not true in many cases, especially near the top of the corallum. Six distinct septa are visible; very seldom are more distinguishable. The cœnenchyma and the walls of the corallites are covered with fine granulations which are generally arranged to form striations, but in some parts, however, the striations are indistinct. Immersed corallites are scattered over the branches, although on the largest branch not a single one appears for a distance of 5 cm. from the top.

Verrill's type of *Madrepora prolixa* is No. 414, U. S. National Museum. The Samoan specimens agree with it in every way. Brook (1893, Cat. Genus *Madrepora*, p. 187) doubtfully placed *M. prolixa* with *M. longicyathus* Milne Edwards and Haime. They are certainly very much alike, but since Verrill had the opportunity of comparing his species with a part of the type of *M. longicyathus* and pronounced them different, we will certainly have to consider them so until we can get more proof to the contrary than Brook had.

One of Dana's types of *A. echinata* is from the Sulu Seas and is No. 276, U. S. National Museum. I can see no difference between it and Verrill's type of *A. prolixa*. It is not the one which Dana described and figured. The latter is No. 275, U. S. National Museum, and is illustrated by Vaughan (Bull. 59, U. S. National Museum, 1907, plates 49 and 50). I believe that the Sulu Sea specimen really belongs to *A. prolixa*, as there is quite a difference between it and the described type. It is barely possible that *A. prolixa* belongs to the synonymy of *A. echinata*, but I doubt it very much. Typical *echinata* is not a quiet-water form and *prolixa* an agitated-water form, as one might conjecture. Of the two Samoan specimens, one was grown in rough water and the other in deep, quiet water, and still there is no difference between them.

A. rayneri (Brook) appears to be so near to *prolixa* that it is doubtful whether the two should be separated.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Water about 1 fathom deep and active off edge of Utelei Reef, near Goat Island.

No. 2. Dredged in 5.5 fathoms inshore of the experiment reef-patch north of the end of Aua Reef.

Distribution.—Ousima (Verrill); Samoa.

Acropora quelchi (Brook).

1893. *Madrepora quelchi* Brook, Cat. Gen. Mad., p. 90, plate 32, figs. D, E.
1907. *Madrepora quelchi* Bedot, Madreporaires D'Amboine, p. 256, plate 41, figs. 225 to 234.

The Samoan collection contains one young specimen. The corallum is irregularly arborescent. The septa of the radial corallites are not as well developed as is usually the case in the species. In all other respects it is in accord with the type.

There is a specimen of this species from the Philippine Islands in the U. S. National Museum, collected by E. A. Mears.

Station.—Pago Pago Harbor, Tutuila, Samoa. Aua line, 766 to 790 feet from shore.

Distribution.—Amboina; Solomon Islands; Philippine Islands; Samoa.

Acropora africana (Brook).

1893. *Madrepora africana* Brook, Cat. Gen. Mad., p. 83, plate 35, fig. B.

One specimen of this distinctive species was collected by Dr. Mayor. It corresponds to Brook's description and plate in nearly every detail. It differs in that the diameter of the axial corallites averages from 2.25 to 3 mm. instead of from 3 to 3.5 mm., and that the septa in the immersed corallites are not quite so well developed as he describes them. Brook says that the arrangement of the radial corallites is very irregular. I find this to be the case on the branches of the same size as the type (3 to 3.5 cm.), but on the larger branches there is a tendency for the larger corallites to group themselves in fairly regular longitudinal rows.

One of the outstanding features of the species is the large, open, radial corallites, nearly devoid of septa, except for the poorly developed directives.

Station.—Rose Island, Samoa. On the edge of the reef-flat in the shallow lagoon just east of the entrance to Rose Atoll lagoon.

Distribution.—Southern part of Indian Ocean; Ceylon; ?Solomon Islands; Rose Island, Samoa.

Acropora leptocyathus (Brook).

Plate 17, figs. 1*a* to 1*d*. Also well illustrated in Mayor's "Growth-Rate of Samoan Corals."

1893. *Madrepora leptocyathus* Brook, Cat. Gen. Mad., p. 159, plate 16, fig. c.

This species shows many variations in the different specimens belonging to it collected from Samoa. They are all agreed, however, as regards the following major characteristics:

(1) Broad, flat base.

(2) Rather short branches usually simple, rising erect in the center of the corallum, and branching obliquely outward towards the periphery. All rise to about the same level in the same specimen.

(3) Apices of branches same distance apart in all specimens, i. e., usually 1.7 cm.

(4) Axial corallites 2 to 3 mm. in diameter, scarcely exsert.

(5) Radial corallites crowded, somewhat unequal. Numerous immersed ones on basal plate.

(6) Corallum rather dense; surface finely reticulate and echinulate; walls striato-echinulate.

I am referring 12 specimens to this species. They vary among themselves in respect to the thickness and length of the branches and the character of the radial corallites.

No. 1 has rather thick, short branches (1.5 cm. diameter at base and 2.5 cm. high). The branches are angular at their bases, but become conical higher up. The crowded radial corallites appear rather even because of the numerous large ones. Closer examination, however, shows many smaller ones of various lengths crowded in between the large corallites. Diameter of larger ones 1.5 mm.; tubular with oblique apertures; walls slightly thicker than in other specimens. 12 septa imperfectly made out; directives prominent. Whole corallum having a neat appearance.

No. 6 has branches 1 to 1.5 cm. in diameter and 2 to 3 cm. in height. Large corallites stand out nearly at right angles to the branches; often 3 mm. long and 1 to 1.5 mm. in diameter; not so numerous as in No. 1, and this corallum has much rougher appearance. Larger corallites are tubo-nariform and trough-shaped; wall thin.

In No. 8 the branches are long and narrow, 1 cm. in diameter and 3 cm. in height, nearly same thickness towards ends as at basal portions. Radial corallites much shorter than in preceding (1.5 mm.); tubo-nariform; wall thin.

No. 9 differs from the others mainly by its long (2.5 mm.), rather thick, cylindrical, radial corallites, which are often truncated perpendicularly to the striations

of the walls but generally somewhat obliquely. This colony was taken from the shallow water of the Aua Reef flat and divided into two parts, Nos. 9*a* and 9*b*= Nos. 3S and 3D (Mayor). No. 9*a* was planted in concrete on the breaker-washed edge of a reef-patch off Aua, and grown in strongly agitated, very rough water. No. 9*b* was planted at a depth of 51 feet off a reef-patch off Aua. The latter half died without growing, while the former thrived.

This species is very similar to *A. bæodactyla* (Brook).

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 3. Aua line, 850 to 874 feet from shore.

No. 4=No. 13 (Mayor). From 700 feet out on reef-flat off Aua village. Rocky bottom; water 7 feet deep at low tide, agitated.

Nos. 5 and 6=Nos. 35 and 22 (Mayor). From about 700 feet offshore on Aua Reef flat off Aua village. Water agitated; bottom hard, broken limestone, 1 foot deep at low tide.

Nos. 7 and 8. 150 feet off mouth of big brook; killed by fresh water and silt.

Nos. 9*a* and 9*b*=Nos. 3S and 3D (Mayor). As described above.

Nos. 10*a* and 10*b*=Nos. 8S and 8D (Mayor). Two halves of coral taken from shallow water about 600 feet from shore on the Aua Reef flat. No. 10*a* was planted in concrete on the breaker-washed edge of a reef-patch off Aua, where it grew from July 25, 1919, to June 12, 1920. It developed stouter branches than it had in 1919, and some of them had become fused together. No. 10*b* was planted in water 42 feet deep and died without growing.

No. 11=No. 32 (Mayor). Taken from outer edge of reef in breakers and planted in quiet water 400 feet from shore on Aua Reef flat. Bottom rocky, water about 8 inches at low tide.

No. 12=No. 1 (Mayor). From growth station No. 1, Double Point.

Distribution.—Samoa.

Acropora massawensis von Marenzeller.

Plate 18, figs. 1*a* to 1*c*.

1906. *Acropora massawensis* von Marenzeller, Denksch. K. K. Akad. Wissensch. Wien, vol. 80, p. 54, plate 17, figs. 49, 50; plate 18, figs. 49*a*, 50*a*.

The 6 specimens referred to this species show much variation in growth-form. No. 1 (plate 18, fig. 1*a*) represents a fragment of what was probably a large, comparatively laxly branching specimen. The two main branches are 10 cm. long. They divide irregularly, and near the top the branchlets show a tendency towards prolification. This latter characteristic is marked in all of the specimens. No. 2 (plate 18, figs. 1*b*, 1*c*) is a bushy-headed, cespitose clump with a broad basal plate, 5.5 cm. high and 11 cm. in diameter; prolification at summits of branches very noticeable. No. 3 is a still smaller clump (3.5 cm. high and 7.5 cm. diameter) with branches very close together, and with 2 or more proliferous corallites at the top of each branch surrounded by buds. This gives a stumpy appearance to the branches. The following is a description of No. 2:

The axial corallites are from 2.5 to 3 mm. in diameter with openings 0.75 to 1 mm. Twelve septa can be made out in a few calices, but on the whole they are poorly developed.

The radial corallites are long, slender, tubular, and appressed. Toward the summits they stand out somewhat more than farther down the branches. The average length of the larger corallites is 4 to 5 mm. and the diameter about 1.75 mm. They are commonly arranged in vertical rows on the branches. Toward the base they are somewhat thicker and shorter, passing through a warty stage into an immersed one. Due to the appressed condition the outer wall is always longer than the inner, which may be entirely absent. The inner wall is frequently nearly as thick as the outer, the aperture most frequently elliptical, although at times round. The corallites near the summits are nariform and slightly compressed laterally. The calicular margins are rather sharp and very infrequently arched. The septa, with the exception of the directives, are generally rather poorly developed. Cœnenchyma fairly dense and echinulate, walls striato-echinulate.

This appears to me to be a well-founded species and certainly seems quite distinct from *A. plantaginea* (Dana) (*non* Lamarck) = *A. secale* (Studer) Verrill, to which von Marenzeller likened it.

Plate 18, figures 49*a* and 50*a*, of von Marenzeller's work show numerous small, warty, immersed or subimmersed corallites interspersed among the larger ones, even rather far up on the branches. These are not very noticeable in four of the Samoan specimens, but Nos. 5 and 6 show them perfectly.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 4. Aua line, 850 to 874 feet from shore.

Nos. 5*a* and 5*b* = Nos. 13S and 13D (Mayor). Two halves of same colony taken from Aua Reef-flat about 600 feet from shore. No. 5*a* was placed in concrete in rough water at edge of Aua Reef patch. The corallites are slightly more compressed than in the other specimens. No. 5*b* was placed at depth of 51 feet in quiet water. It died without growing.

No. 6*a* = No. 9S (Mayor). Same conditions as No. 5*a*.

No. 6*b* = No. 9D (Mayor) is missing.

Distribution.—Massowa; Samoa.

Acropora rotumana (Gardiner).

1898. *Madrepora rotumana* Gardiner, Proc. Zool. Soc. London, No. 17, p. 258, plate 23, fig. 2

The two specimens of the Samoan collection correspond exactly to Gardiner's excellent description and illustration. They represent thick, horizontally growing branches which have fused to form broad plates, upon the upper surfaces of which are scattered conical elevations of various sizes. As Gardiner has said, these elevations are "really formed by the end twigs having turned upwards and having budded out fresh twigs at their bases." The undersurface contains numerous short, wart-like, subimmersed or immersed corallites, which, however, are not nearly so crowded as the corallites on the upper surface.

As Gardiner has mentioned, this species is very similar to *A. smithi* (Brook) in the general appearance of the upper surface. It is, however, always pedicellate and never incrusting, as is the case in *A. smithi*. Both of these species resemble *A. conigera* (Dana) somewhat, but are distinct by their sharper-pointed elevations, their much more crowded and thicker-walled radial corallites, and better-developed septa.

I believe it barely possible that *A. rotumana* and *A. smithi* belong to the same species.

Stations.—Pago Pago Harbor, Tutuila, Samoa. Nos. 1 and 2. Aua Reef; pure agitated water in shallow tide-pools near seaward edge.

Distribution.—Rotuma; Samoa Island.

Acropora palifera (Lamarck).

1893. *Madrepora palifera* Brook, Cat. Gen. Mad., p. 131. (With synonymy.)

1918. *Acropora palifera* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 178, plates 78 and 79; also plate 13, fig. 8. (With synonymy.)

The collection contains 5 examples of this species, which has been adequately described and figured by many authors. There is one point, however, that I wish to stress. I find that the variation in the development of the septa is very great. Dana's type of *A. labrosa* (No. 315, U. S. National Museum), which Brook referred to the synonymy of *A. palifera* (Lamarck), generally shows 6 well-developed and comparatively thick primaries with thinner secondaries. Some of the Murray Island specimens which Vaughan referred to this species show septa with the same degree of development as Dana's type, while others are very weakly developed and at times hardly distinguishable. In the Samoan specimens they are fairly well developed, but irregularly.

No. 4 is evidently a fragment of the basal plate of a good-sized specimen, and contains no lobes. It possesses the wart-like corallites with smaller apertures characteristic of this portion of the corallum.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 and 2. Shallow tide-pools on seaward edge of Utelei Reef.
No. 3. 2 fathoms depth off Aua Reef patch, fairly quiet water.
No. 4. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
No. 5. Aua Reef flat, 700 feet from shore, rough water, rocky bottom, about 1 foot deep at low tide.

Distribution.—New Guinea; Solomon Islands; China Sea (Tizard Bank); Diego Garcia; Amboina; Manila Bay; southern Philippines; Sulu Sea; Murray Island; Cocos-Keeling Islands; Samoa Islands.

Acropora crateriformis (Gardiner).

1898. *Madrepora crateriformis* Gardiner, Proc. Zool. Soc. London, No. 17, p. 258, plate 23, fig. 1.

There are 3 good-sized fragments of this distinctive species in the collection. They correspond very well to Gardiner's description and figure. One of them is incrusting some dead coral, which gives an irregular hump to the surface.

Stations, Pago Pago Harbor, Tutuila, Samoa.—Nos. 1 to 3, Aua line, 850 to 874 feet from shore.

Distribution.—Funafuti; Samoa.

Acropora vanderhorsti, new species.

Plate 18, fig. 2. Also Mayor's "Growth-Rate of Samoan Corals," plate 9, figs. 24 *a*, *b*.

Corallum subarborescent, laxly branching from small incrusting base. The main branches are 16 to 22 cm. long and 2 mm. in diameter at their base.

The axial corallites are cylindrical, 2.5 to 3 mm. in diameter, and 3 to 4 mm. exsert. The wall is very porous, with distinct costæ. The fossa is 0.85 mm. in diameter. There are two cycles of septa. The directives usually meet and the other members of the first cycle nearly reach to their point of fusion. The second cycle is less developed.

The radial corallites are very unequal, the longest ones occurring near the distal portions of the branchlets. The largest are tubular and stand at an angle of about 85° to 45° with the stem. They are often curved back slightly, and appear to be a little broader at their top than at their base. The outer wall is longer than the inner. The apertures are suboblique; the inner wall is much thinner than the outer and generally is absent for one-third of the length of the corallite. The septa are 12 in number, but all are rather poorly developed, with the exception of the two directives. The wall is porous and distinctly costulate with small echinulations. Between the longest corallites are many smaller ones of the same pattern and different lengths. Farther down the stem the radial corallites are shorter, and more frequently do subimmersed and even completely immersed corallites appear.

The cœnenchyma is very porous, reticulate, and echinulate. Costæ of corallite walls do not reach out into cœnenchyma.

This coral is somewhat like *A. listeri* (Brook), but differs mainly in its decidedly costulate, radial corallite walls and more porous cœnenchyma. In this latter respect it is very similar to *A. nobilis* (Dana).

Station.—Pago Pago Harbor, Tutuila, Samoa. From about 700 feet from shore on Aua Reef flat. Agitated water, bottom rocky, with broken limestone, about 1 foot deep at low tide.

Acropora tutuilensis, new species.

Plate 19, figs. 1*a* to 1*e*. Also Mayor's "Growth-Rate of Samoan Corals."

There are 4 specimens of this species in the collection, which represent fragments of what evidently were large plate-like or vasiform colonies. Nos. 1 and 2 were dredged in 7.5 to 13 fathoms. No. 3 was taken from the Aua line, 850 to 874 feet from shore. The peripheral branches have fused so as to make a more or less solid platform. On the upper surface of Nos. 2 and 3 branchlets extend obliquely upward, but there are no upright branchlets on No. 1.

In No. 2 the branchlets average 2.5 cm. in length and 8 mm. in diameter; distance between apices 1.5 mm. The axial corallites are cylindrical, with a thick costulate wall; diameter 2 mm., exsert 2 to 3 mm. There are 6 well-developed septa. The radial corallites are variable in length, larger ones 3 to 5 mm. long; numerous small, subimmersed or immersed ones between. The larger corallites are at times arranged in more or less distinct, longitudinal rows on the branchlets, and ascend at an angle of about 45° or less with the branchlet. They are long, tubiform, and with lower lips longer than upper.

The lower lip often curves back, but frequently curves upward also; the margin is rather sharp, never rounded and thick. Very little difference in thickness of upper and lower lip. The aperture is usually gutter-shaped or oblique. The septa are very poorly developed, and generally the upper directive is the only distinct one. Wall strongly costulate with echinulations. Cœnenchyma very porous. The underside of the corallum is nearly perfectly flat and possessed with appressed tubular corallites and small subimmersed ones.

No. 3 differs from the preceding by having thicker branchlets (10 to 12 mm.) and somewhat compressed radial corallites.

No. 1 represents a fragment of a plate of flattened, fused, horizontally growing branches 14.5 cm. long, 8.5 cm. wide, and 1.5 cm. thick. No branchlets arise from the upper surface. The lower surface is irregularly covered with appressed corallites, some of which are short and wart-like and others are as much as 3 or 5 mm. in length. Very rarely is a completely immersed one seen on the underside. The upper surface is covered with ascending corallites of widely varying lengths; there are numerous long, proliferous ones, some of which have buds, between which are long normal corallites, and many immersed ones with decided margins. The normal corallites are from 3 to 5 mm. in length and 1.3 in diameter; all are ascending; those near the periphery bent slightly forward. Margins sharp, never rounded; apertures oblique or gutter-shaped. Septa poorly developed; most prominent one is upper directive. Corallum porous; surface reticulate, wall striate with striæ echinulate.

There is a very irregularly branching specimen grown in agitated water 2 fathoms deep which I am also placing with this species.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 and 2. Dredged in 7.5 to 13 fathoms from Taema Bank, south of Pago Pago Harbor.

No. 3. Aua line, 850 to 874 feet from shore.

No. 4=No. 47D. Grown in agitated water 2 fathoms deep.

Acropora pagoensis, new species.

Plate 20, figs. 1*a* to 1*d*.

The specimen consists of an elongate, prostrate, and flattened branch with a few scattered, variously sized, suberect branchlets on the upper surface. The tallest of the branchlets is 2 cm. in height and 8 mm. in diameter at the base. Between the branchlets the comparatively wide expanse of stem is covered with

closely placed radial corallites which are suberect or bending slightly distally. The under surface possesses a comparatively few scattered, subimmersed corallites with naked cœnenchyma between them.

The axial corallites are of the same size as the large radial ones, about 2.5 mm. in diameter and 2 mm. exsert. There are two cycles of well-developed septa, the primaries broader than the secondaries, and the two directives meeting in the center of the calice. Although the wall is rather spongy, it has the appearance of stability. Outer surface of walls costulate.

The radial corallites are generally arranged in longitudinal rows on the branchlets. Between the branchlets the upper surface of the branch is taken up by crowded radial corallites of fairly equal size. Occasionally there appears a longer, proliferous corallite 4 to 6 mm. in height and 2.5 mm. in diameter. Also a few smaller subimmersed or immersed ones can be seen. The average-sized calice measures 2.5 mm. across and is 2 to 3 mm. long. The wall is substantial, the margin of the lower lip rather sharp and at times bent back slightly. The apertures are large and open. The lower lip is longer than the upper; corallites are tubular or may be slightly compressed to become tubo-nariform or gutter-shaped. Walls striato-echinulate. The septa are remarkably well developed; 6 broad primaries alternate with narrower intermediates; the directives usually fuse lower down in the calice.

The underside is rather flat and naked, except for the few scattered, subimmersed corallites mentioned above. The cœnenchyma is scabrous and very echinulate.

This species is in many ways similar to *A. eurystoma* (Klunzinger). It can easily be separated by its smaller axial corallites and much better developed septa. The latter characteristic is very striking, there always being two exceedingly well developed cycles of septa in every calice.

Station.—Pago Pago Harbor, Tutuila, Samoa. Dredged in 7.5 to 13 fathoms from Taema bank, south of Pago Pago Harbor.

Family PORITIDÆ Dana.

Genus PORITES Link.

1807. *Porites* Link, Beschreib, Natur. Samml. Rostock, p. 162.
1905. *Porites* Bernard, Porites of the Indo-Pacific Region, pp. 303, 35 plates.
1918. *Porites* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 188. (With synonymy.)

Type species: *Madrepora porites* Pallas.

Porites is without doubt one of the most difficult of coral genera. Bernard found it a nearly hopeless task to arrange the specimens of the British Museum according to species, and thus originated his locality-number scheme which he used in the above-mentioned publication. Vaughan, by following a carefully worked-out plan, which he outlines on page 189 of his Murray Island report, has succeeded admirably in applying a specific classification to the specimens he studied.

The following papers deal with the general morphology of the poritid skeleton.

BERNARD, H. M. On the structure of *Porites*, with preliminary notes on the soft parts. Jour. Linn. Soc. London. vol. 27, pp. 487-503, plate 35, 1900. *Porites* of the Indo-Pacific Region, Cat. of Madrepor. Brit. Mus. (Nat. Hist.), vol. 5, 1905.

VAUGHAN, T. W. Recent Madreporaria of the Hawaiian Islands and Laysan. U. S. Nat. Mus. Bull. 59, pp. 169–217, 1907.

H. M. Bernard's work on the poritid corals (review). Science, n. s., vol. 26, pp. 373–378, Sept. 20, 1907.

I am considering 8 species of *Porites* in this paper and have tried to follow as nearly as possible Vaughan's method of treatment.

Porites lobata Dana.

1846. *Porites lobata* Dana, U. S. Expl. Exp., Zooph., p. 562, plate 55, fig. 1.
1907. *Porites lobata* Vaughan, Bull. 59, U. S. Nat. Mus. p. 196, plate 81, figs. 1, 1*a*, 1*b*; plates 82, 83; plate 84, figs. 1, 1*a*, 1*b*, 2; plate 85, fig. 1. (With synonymy.)

Vaughan, in the above-mentioned paper, recognized six formæ of this species. He further divided one of these formæ, forma *centralis*, into 5 subformæ, which he designated as *alpha*, *beta*, *gamma*, *delta*, and *epsilon*. All of the original specimens of these formæ, including Dana's type specimen of the species, are in the U. S. National Museum. The necessity of this rather profuse division bears testimony of the enormous variation within the species. Although the formæ are distinct from each other, the general characteristics are decidedly similar enough to unite them into one species. In studying these specimens as classified by Dr. Vaughan, one can not help admiring the excellent manner in which he treated them.

Following his plan, I wish to add another forma to the list, forma *nodulosa*, which is the Samoan collections representative of the species.

Porites lobata forma nodulosa, new forma.

Plate 21, figs. 1*a*, 1*b*.

The following is a description of one of the ten representatives of the forma:

Corallum irregularly nodular, glomerate, rounded on all sides; dimensions, 6 cm. long, 4 cm. wide, 3.2 cm. thick.

Calices polygonal, usually pentagonal, diameter of mature ones 1.4 mm. to 2 mm. On upper surface calicular cavities are rather deep and thin-walled, but much shallower and slightly thicker-walled on under surface.

On the upper surface there may be between the palus and the wall from 1 to 3 denticles (usually 2), which are moderately tall and spinulose. These denticles are caused by processes from one trabecula. The pali are perhaps slightly taller than the denticles and are very similar in appearance. The ring of synapticulæ joining the pali is rather deeply seated in the calice. The peripheral synapticular ring may or may not be complete. The trimurate structure is often present. The septal faces are rather roughly granulate. The columella is a compressed style with sharp echinulations, and at times reaches to nearly the height of the pali, but usually is much shorter. It is often joined by irregular radii to the septa.

On the under surface the calices are shallower and the trimurate character of the walls much more noticeable because of the completeness of the peripheral ring of synapticulæ. The septa are much thicker and more roughly spinulose; the columella reaches to same height as pali and denticles. The calices, including the walls, give very much the appearance of a revolving wheel with thick spokes.

This forma resembles in respect to the number of denticles the forma *infundibulum* of Vaughan. It does not have, however, the sloping margins of the septa, as does the latter forma. It is probably closer to forma *centralis* in general calicular arrangements than to any of the others.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 5. Aua line, 700 to 724 feet from shore. Branched *Acropora* zone.
Nos. 6 to 10. Aua line, 766 to 790 feet from shore.

Distribution of *Porites lobata*.—Hawaiian Islands; Fanning Island; Fiji Islands; Samoa Islands.

Porites lutea Milne Edwards and Haime.

Plate 21, figs. 2*a* to 2*c*, 3. Also illustrated in Mayor's "Growth-Rate of Samoan Corals."

1846. *Porites conglomerata* Dana, U. S. Expl. Exp., Zooph., p. 561, plate 55, figs. 3, 3*a*.
1918. *Porites lutea* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 198, plate 88, figs. 1, 1*a*, 1*b*. (With synonymy.)
1918. *Porites haddoni* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 197, plate 87, figs. 1, 1*a*, 1*b*. (With synonymy.)

In the above-mentioned paper Dr. Vaughan discussed *Porites lutea* and placed the *P. fidjiensis secunda* and *P. fidjiensis decima* of Bernard in its synonymy. The Samoan collection contains a good-sized suite of specimens belonging to this species. The species is a very difficult one to deal with, because of the variation within it, and also because of the fact that the name *lutea* has been recklessly applied by many authors. For these reasons it has been difficult to ascertain exactly what *P. lutea* is really like.

On page 244 of Bernard's Catalogue of *Porites* he states that in all probability Milne Edwards and Haime's description of *P. lutea* was based upon Dana's *P. conglomerata* (op. cit., p. 561). Dana's specimen of the latter species, which is No. 683, U. S. National Museum, is therefore, as Vaughan has observed (op. cit., p. 199) the type of *P. lutea*. Bernard's plates and description of *Porites fidjiensis secunda* corresponds to this type specimen very well.

The great variation within the species occurs in the following features:

(1) *The wall.*—In typical *P. lutea* the wall consists of an irregular median ridge of fused trabeculæ, on each side of which there is a row of granules or flakes joined together by a rather thick synapticular ring. In this case the entire partition between the calicular openings appears rather thick and ragged. In some specimens, however, the walls are more delicately fashioned. They consist of a thin, raised, median ridge, within and below which is a slender ring of septal granules joined together by synapticulæ and separated from the median ridge by a ring of pores. These two types of walls may appear on the same colony. The median ridges often zigzag, but many times are perfectly straight.

(2) *The pali.*—In different parts of the same specimen and in different specimens the pali may vary a good deal in shape and size. They may consist of slender, closely granulated, upright protuberances; they may be in the form of ridges compressed in the plane of the septa; they may be V-shaped above the laterals; or they may be very insignificant, pointed elevations. As a rule, the pali are distributed according to Bernard's illustration 3B, although occasionally they may be arranged as in 3C.

(3) *Amount of granulation.*—In places, especially at the basal portions of the corallum, the walls and septa may be thickly covered with flaky granulations, which produce rather a dense appearance. In other parts of the corallum they may be remarkably free of granulations.

(4) *The columella tubercle.*—The columella tubercle may be well developed and prominent or very small and insignificant. Frequently it consists of a narrow, compressed, granulated plate, but it is often styliform.

(5) *Depth of calicular depression.*—Within certain limits the depth of the calices does not offer a specific difference because of the great variation in this respect. The growth experiments performed by Dr. Mayor demonstrate this fact. According to these experiments, deep, quiet water seems to promote a very smooth surface and shallow calices, while rough water appears to cause the deeper calices to occur. This is not a general truth, however, because several of the specimens in the collection which were grown in quiet water have calices of the normal depth.

Vaughan described a new species, *P. haddoni* (op. cit., p. 197, plate 87, figs. 1, 1*a*, 1*b*), and referred Bernard's *P. Great Barrier Reef* (42) 23 to its synonymy. Bernard's specimens show a palar formula equivalent to his figure 3C. In other words, in the trident there is one large palus above the point where the two laterals curve around and fuse with the ventral directive. In Vaughan's type of *P. haddoni* this is occasionally the case, but in the majority of calices the pali are arranged as

shown in Bernard's figure 3B, i. e., there are smaller pali above all three septa of the trident and the joining of the septa takes place farther down by means of the inner synapticular ring. There is, then, some doubt as to whether Bernard's specimens can be included in the synonymy of *P. haddoni*, although they seem to agree in all other respects.

The palar arrangement, as illustrated by Bernard's figure 3B, is rather constant in all specimens of *P. lutea* that I have examined, including Dana's type of *P. conglomerata*. I have examined all the specimens of *P. haddoni* in the U. S. National Museum and find that they are so similar to *P. lutea* that I believe they represent a variety of the latter. The Samoan collection contains a number of specimens belonging to this variety.

I am separating typical *P. lutea* from the *haddoni* variety by—

(1) *The walls.*—Typical *P. lutea* has walls such as are described above, while the *haddoni* variety possesses the more delicately fashioned type, also previously mentioned. Around the basal parts of the corallum in the latter the corallite walls often appear exactly like those of typical *lutea*. As a rule, the walls of the latter are zigzag, while those of the variety are usually straight. This varies, however, in different parts of the corallum.

(2) *The pali.*—As a rule, I believe the pali are taller in the variety and can easily be distinguished by the naked eye.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Porites lutea typical:

No. 1 = No. 1 (Mayor) of the 440-foot station, Aua line, Aua Reef flat. Coral was 45.5 inches in circumference in April 1917, and it was 52.5 inches in circumference on July 12, 1918.

No. 2 = No. 47 (Mayor). From the reef-flat about 300 feet from shore off Utelei village; bottom hard limestone; water quiet, 10 inches deep at lowest tide.

Nos. 3 and 4. Aua line, 526 to 550 feet from shore.

No. 5 = No. 45 (Mayor). Found growing about 150 feet from shore off Utelei village. Rock limestone reef-flat; water about 8 inches deep at lowest tide; water quiet.

No. 7 = No. 46 (Mayor). From about 200 feet from shore off Utelei village; quiet water about 10 inches deep at lowest tide; bottom hard limestone.

Nos. 8 to 12. Aua line, 600 to 624 feet from shore.

Porites lutea var. *haddoni* Vaughan:

No. 1. Aua line, square No. 4, 100 to 125 feet from shore. Water about 2 feet deep at lowest tide; bottom coarse sand and rocky limestone.

No. 2. Aua line, 50 to 75 feet from low-tide line; water 2 feet deep at low tide. Broken limestone, coarse sandy bottom. Square No. 3.

Nos. 3 and 15. Aua line, 600 to 624 feet from shore.

Nos. 4, 5, 6, 7, 8 = Nos. 48, 49, 50, 51, 52 (Mayor). Found growing off Fagaalu village.

Nos. 90 and 96 = Nos. 18S and 18D (Mayor). 18D grown in water 51 feet deep off a reef-patch off Aua. 18S grown in shallow breaker water.

Nos. 10, 11. 150 feet off mouth of big brook. Survived in fresh and silted water.

No. 12. Station unknown.

No. 13. Aua line, 526 to 550 feet from shore.

Nos. 14*a* and 14*b* = Nos. 19S and 19D (Mayor). Two halves of colony taken from 400 feet from shore on Aua Reef flat. No. 14*a* = 19S was grown in rough water in breakers for a year. No. 14*b* = 19D was grown at a depth of 51 feet in quiet water. The latter half has much larger but more superficial calices. The whole corallum has an exceedingly smooth surface. The shallow water half has slightly smaller calices than in the normal *haddoni* variety and they are sunken normally.

Distribution of Porites lutea.—Fiji Islands; Murray Islands; Samoa.

Porites murrayensis Vaughan.

Plate 22, figs. 1*a*, 1*b*.

1918. *Porites murrayensis* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 192, plate 84, figs. 4, 4*a*, 4*b*, 5; also plate 13, figs. 12, 14.

The specimens which Vaughan described in the above work show very little variation. He summarized the characteristics of the species as follows:

"Growth-form massive; calices with deep fossa, 1 to 1.5 mm. in diameter; wall elevated, interrupted in places; pali, the formula complete, or reduced on the directives and on the laterals of the triplet; columella tubercle frequently absent."

The Samoan specimens show a good deal of variation in different parts of the same colony and between different colonies. These variations appear in the following features:

(1) *Length of septa.*—In the type specimens the septa are rather short and the axial fossæ, therefore, comparatively wide. This is true in the Samoan specimens in places, but in general they have slightly longer septa than the Murray Island ones.

(2) *Depth of columellar pit.*—Usually there is a vertical drop of the inner septal margins into a deep columellar pit. On the undersides of some specimens the pit is not nearly so deep, and in a few calices a styliform columella may be exposed. This is true not only on the lower parts, but may apply to the entire corallum in the case of specimens which were subjected to adverse conditions. In normal specimens the columella is either poorly developed or entirely absent.

(3) *Thickness of wall.*—On the underside of some specimens the wall becomes thickened, with a corresponding shrinkage of the calicular fossa.

(4) *Development of pali.*—As in the type specimens, the pali are usually insignificant, but in places they may be prominent, especially those before the lateral pair. This is not restricted to the lower areas of the corallum, but may occur at any place on the surface.

The majority of the Samoan specimens are massive, nodular forms, while some are incrusting lithothamnion and thus take on irregular rounded shapes, according to the object which they incrust. They agree with the type specimens very well in general, with the exception of the above-mentioned features.

As Dr. Vaughan pointed out, the species is very close to *P. brighami* Vaughan. I do not feel, however, that the Samoan specimens offer a bridge adequate enough to unite them. Plate 22, figure 1, of Bernard's Catalogue of Australian *Porites* illustrates a coral which appears to be close to this species; also plate 4, figure 1, (Fiji Island) Bernard looks like *P. murrayensis*.

Stations, Pago Pago Harbor, Tutuila, Samoa;

Nos. 1 to 3. Aua line, 526 to 550 feet from shore.
No. 4. 150 feet off mouth of big brook. Survived in fresh and silted water.
No. 5. Square No. 3, Aua line; water 2 feet deep low tide; broken limestone, coarse sandy bottom, 50 to 75 feet from low-tide line.
No. 6. Square No. 4, Aua line, 100 to 125 feet from shore. Water 2 feet deep at low tide; bottom coarse sand and rock.
Nos. 7 to 14. Aua line, 600 to 624 feet from shore.
No. 15=No. 22D (Mayor). From Aua Reef flat, in shallow, quiet water. Grown at depth of 51 feet off Aua Reef patch in quiet water. The whole upper surface has the appearance of the under surface of a normally grown specimen.

Distribution.—Torres Strait; Samoa; ? Fiji.

Porites pukoensis Vaughan.

1907. *Porites pukoensis* Vaughan, U. S. Nat. Mus. Bull. 59, p. 195, plate 95, figs. 1, 2; plate 94.
1918. *Porites pukoensis* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 202, plate 90, figs. 1, 1*a*, 1*b*, 2.

There is one small specimen in the collection from Rose Island, Samoa. It corresponds very well to those in the U. S. National Museum from the Hawaiian Islands and Fanning Island. In general, there are two intermediate denticles or granules between the palus and the wall. The species has been excellently described and figured in the above publications.

Station.—Rose Island, Samoa. In shallow water on reef in pools 6 inches deep at low tide and surrounded by lithothamnion.

Distribution.—Hawaiian Islands; Fanning Island; Rose Island, Samoa.

Porites andrewsi Vaughan.

Plate 22, figs. 2*a*–2*c*. See also illustrations in Mayor's "Growth-Rate of Samoan Corals."

1918. *Porites andrewsi* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 203, plate 14, fig. 16, and plate 91, figs. 1, 1*a*, 2, 2*a*. (With synonymy.)

The Samoan collection contains a splendid suite of over 30 specimens. Variation is in general comparatively small and, as expressed by Dr. Vaughan, "consists mostly in the form of the colony, whether the branches are or are not interfused, and whether crooked or rather straight; and in the degree of development of the flaky reticulum and its associated denticles."

Dichotomous branching is by far the most common; near the summits the branches usually divide into two short, blunt, divergent branchlets. Even in the case of the specimens whose branches are interfused this tendency to form short summit branchlets is apparent. Several colonies which were divided and one half placed in shallow, agitated water and the other half in deep water show little variation in growth-form.

The wall and the peripheral synapticular ring with the outer denticles often form a flaky reticulum if thickened. In some specimens this reticulum is much more developed than in others, and as a rule is better developed on the basal parts of the corallum than above. Where the cœnenchyma is wide the calices are rounder and more superficial. The halves of corals grown in deep water show a decidedly better developed flaky reticulum than the corresponding halves of shallow, agitated water habitat. In the latter examples the walls are more elevated and the calices less superficial.

There is remarkably little variation in other calicular characters. The columella may vary somewhat in size, but is normally distinct.

One specimen does show a remarkable difference between the shallow-water and deep-water growths. Plate 19, figures 24D*a* and 24D*b* of Dr. Mayor's paper on the "Growth-Rate of Samoan Corals" show the specimen in 1919, when it was first placed in its deep-water habitat, and in 1920, after one year's stay there. In 1919 it had the appearance and characteristics of any ordinary specimen of *Porites andrewsi;* in 1920, when it was removed, it had changed considerably. The following is a description of it now:

Corallum arborescent, about 11 cm. high and 12 cm. in diameter. Composed of twisted, subcylindrical branches which fuse 3 or 4 cm. from the top of the corallum and then separate again, giving off furcate, snake-like, irregularly inflated branchlets with blunt, rounded tips. The branches measure 14 mm. in diameter at the base; the branchlets near the summit are 6 mm. in diameter where not inflated and as much as 10 mm. when inflated. On most branches living tissue was confined to only that portion of the corallum above the place where fusion occurs, or, in a few cases, it may extend to the basal portions. The irregularly twisted, snake-like branchlets are rather delicate.

The surface is very smooth, the calices are not only superficial on the basal portions of the corallum, but are just as shallow near the ends of the branchlets. In all parts of the corallum the calices are uniformly placed with the subcircular calicular openings about 0.75 mm. apart.

The septa are not at all clearly cut, being rather obscured by the septal granules and pali. There are 6 prominent, bushy pali surrounding a fairly distinct, granular columella. Often the columella can not be clearly seen, but usually it can be distinguished in the midst of the taller pali. Between the pali and the septal granules there is a comparatively deep depression. There appear to be at least 2 septal granules between this depression and the wall, but they are fused and with other granules extend out over the wall. The mural summit is indefinite. The outer synapticular ring is completely fused with the wall and thus adds considerably to the thickness of the latter. The mural trabeculæ end in irregularly shaped, rough, frosted denticles which are incompletely fused and give the summit of the wall a somewhat scabrous appearance.

The roughly granulated columella springs from a dense platform made by the lateral fusion of the radii which join with the septa.

The *Porites capricornis* of Rehberg [1] is very similar to this deep-water specimen, and yet it is difficult to form a definite opinion from Rehberg's inadequate description. He says that some of the calices are slightly sunken, but that they are mostly superficial. I find them all to be superficial. He speaks of the columella as being hard to recognize. I find this so in parts of the corallum, but generally it can be seen fairly distinctly. The color is a very light tan and not black, as in his specimen. The remarkable growth-form, however, is exactly as Rehberg's figure shows. This is so distinctive that they in all probability belong to the same species.

As Vaughan observed (op. cit., p. 205), *P. andrewsi* is very similar to *P. cylindrica* Dana. He separated them because the septal granules of the latter "are smaller, less regularly developed, and not arranged in conspicuous rings separated by circular depressions, as in *P. andrewsi*." The Samoan collection of *P. andrewsi* contains no specimens which might serve to link the two species.

Besides the differences mentioned by Vaughan, the calicular fossa of *P. andrewsi* is slightly deeper than is the case in the other species.

A branching form from Samoa was reported by Ortmann (Zool. Jahrb. 3, 1888, p. 157) and was compared to *P. decipiens* Brueggemann. Studer reported *P. decipiens* from the Samoa Islands (Zool. Jahrb. Syst. 14, 1901, p. 390.) Bernard's notes on *P. decipiens* can be found in his volume on the Indo-Pacific Porites, page 93, under Porites Caroline Islands (4) 1. I believe it to be quite possible that *P. andrewsi* belongs to the synonymy of *P. decipiens*, and still this question can not be decided until the type of the latter is redescribed. The growth-form and the size of the calices are similar. In both species the calices are shallow everywhere, but more superficial near the base than higher up. I believe that the difference in respect to the thickness of the septa and prominence of the pali and columella may be due to the fact that in all probability Brueggemann described only the calices near the tips of the branchlets.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 to 3. Aua line, 400 to 424 from shore.
Nos. 4 to 7. Aua line, 460 to 484 feet from shore.
No. 8. Aua line, 526 to 550 feet from shore.
Nos. 9 to 18. Aua line, 600 to 624 feet from shore.
Nos. 19 to 22. 150 feet off mouth of big brook. Killed by fresh water and silt.
Nos. 23 to 26 = Nos. 2, 3, 4, 17 (Mayor). Aua Reef, 400-foot station, 400 feet from shore, on the rocky floor of the reef-flat off Aua village. Water about 8 inches deep at lowest tide.

[1] 1892. Neue und wenigbekannte Korallen, p. 46, plate 3, fig. 7.

No. 27=No. 6 (Mayor). Growing naturally on rocky floor of the reef-flat, about 700 feet off Aua village.

Nos. 28*a* and 28*b*=Nos. 7S and 7D (Mayor). Two halves of same colony taken from shallow water of Aua Reef flat. No. 28*a* was grown in very rough water in breakers at edge of Aua Reef patch. The branches grew much thicker than they probably would have under normal conditions. No. 28*b* was raised at a depth of 42 feet, off Aua Reef patch. The branches are comparatively slender and natural in appearance. It was dead when collected.

Nos. 29*a* and 29*b*=Nos. 23S and 23D (Mayor). Two halves of same colony from about 400 feet from shore in shallow water on the Aua Reef patch. No. 29*a* was grown in rough water on the breaker-washed edge of a reef-patch off Aua; No. 29*b* was grown at depth of 51 feet off Aua Reef patch. The latter was dead when collected. There is no difference in growth-form between the two.

No. 30*a* and 30*b*=Nos. 11S and 11D (Mayor). Two halves of same coral from 400 feet from shore on Aua Reef flat. No. 30*a* was grown on the breaker-washed edge of Aua Reef patch; No. 30*b* was grown at a depth of 42 feet off Aua Reef-patch. The former has slightly thicker branches, less superficial calices, and is in a much healthier condition than the latter.

No. 31. Aua line, square No. 2. From 50 to 75 feet from shore, water about 1.5 feet deep at low tide; coarse limestone and sand bottom.

No. 32. Aua line, square No. 3. From 50 to 75 feet from shore, water 2 feet deep at low tide; broken, rocky, sandy limestone bottom.

No. 33. Aua line, square No. 5. From 200 to 225 feet from shore, water about 2 feet deep at low tide; bottom coarse limestone and sand.

No. 34=No. 24D (Mayor). Taken from relatively quiet, shallow water on Aua Reef flat, about 500 feet from shore and grown at depth of 51 feet in water without any current, from July 26, 1919, to June 12, 1920.

Distribution.—Great Barrier Reef; Fiji Islands; Tonga Islands; Samoa Islands.

Porites (Synaræa) undulata (Klunzinger).

1879. *Synaræa undulata* Klunzinger, Die Korallthiere des Rothen Meeres, II, p. 48, plate 6, fig. 12; plate 5, fig. 30.

1906. *Porites undulata* von Marenzeller, Denksch, K. K. Akad. Wiss. Wien. vol. 80, p. 66, plate 22, fig. 75. (With synonymy.)

There are 8 specimens of this species in the Samoan collection. The growth-form is exactly like the specimen called *P. Society Islands* 3 by Brook in his catalogue of Indo-Pacific *Porites*, illustrated by his figure 5 of plate 10. He refers his specimens to *Porites convexa* Verrill. An example of this latter species is in the U. S. National Museum, collected from Papeete Harbor, Tahiti. It differs quite markedly in calicular characteristics from *P. undulata*.

Studer (Zool. Jahrb. Syst. 14, 1901, p. 397) records *Synaræa danæ* Milne Edwards and Haime=*Porites contigua* Dana from Samoa. Dana's type of *P. contigua* is No. 684, U. S. National Museum. I find that this type does not belong to *Porites* at all, but is really a *Psammocora*. In all probability Studer's specimen belongs to *P. undulata*.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Aua line, 600 to 624 feet from shore.

Nos. 2 and 3. Aua line, 766 to 790 feet from shore.

No. 4. Pure water near breaker, close to seaward edge of Aua Reef.

Nos. 5, 7, and 8. Aua line, 526 to 550 feet from shore.

No. 6. Shallow tide-pools, seaward edge Utelei Reef.

Distribution.—Red Sea; Samoa.

Porites (Synaræa) horizontalata, new species.

Plate 22, figs. 3*a*, 3*b*.

The corallum is thin, explanate, horizontal, with undulating surface. It possesses no large protuberances and is smooth, except in places where the walls rise up slightly to form low, convex ridges around the calices. At the rim it is less than 1 mm. thick; farther in it becomes 6 mm. thick. In each of the three examples the larger part of the corallum is free; but it is attached at one side to a dead specimen of the same species. The underside of this dead specimen shows no attachment scar.

The calices are about 1 mm. in diameter and in general keep approximately the same distance apart (1 to 1.5 mm.) In nearly every case they are sunken between the walls, which rise gently into low, convex mounds or ridges of irregular shape. The ridges never exceed 2 mm. in height and generally they are about 1 mm. or less in this respect. The septa are 12 in number, with jagged edges. Often the same arrangement of the septa so frequently found in *Porites* can be made out. The two pairs of laterals on each side fuse together. Those of the triplet are less developed than the others. The pali are prominent, usually 6 in number, one of them smaller than the others. They are grouped around a little pin-hole fossa which often has a minute tubercle showing below the surface. Behind the pali are rough septal denticles of the same height, which pass out into the cœnenchyma. The latter is made up of flaky trabeculæ with jagged ends. The summits of the ridges and mounds are more loosely reticular than the slopes. In general the cœnenchyma has a rather substantial appearance.

The under-surface is completely covered with a rather thick epitheca, which shows lines of concentric growth.

The species is very similar to the form described by Bernard as *Porites China Sea* (19) 3, (1905, Cat. Indo-Pacific *Porites*, p. 167, plate 25, fig. 9), but the former appears to be more solid and does not possess excrescences of 3 to 4 mm. in height.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged in about 18 fathoms off Utelei Reef. Associated with *Leptoseris* Brown when alive.

No. 2. Dredged in 8 to 16 fathoms north of Aua Reef.

No. 3. Dredged from a depth of 12 to 14 fathoms near buoy A; fairly hard bottom with some mud. Dull drab in color.

Porites (Synaræa) faustinoi, new species.

Plate 23, figs. 1*a*–1*c*.

1905. *Porites Australiæ Borealis tertia* Bernard, Cat. Indo-Pacific *Porites*, p. 147, plate 22, fig. 4; plate 35, fig. 14.

I recognize 5 specimens in the collection as belonging to Bernard's *Porites North Australia* (8) 3. They are all thin, explanate fragments and in no case are the parts present by which they were attached. The tallest process from the flat base is 2.5 cm. high. Plate 23, figures 1*a*, 1*b*, 1*c*, illustrate No. 1 and give all necessary data.

Stations, Pago Pago Harbor, Tutuila, Samoa:

Nos. 1 and 2. Obtained from 3.5 fathoms depth off Aua Reef patch, in very quiet water protected from breakers. Growing on edge of a crevice.

Nos. 3 and 4. Dredged from 5.5 fathoms off north end of Aua Reef.

No. 5. Brought up in the snapper from depth of 6 fathoms, 100 feet seaward from edge of fringing reef in the small bay just west of Fagaia Bay.

Family FAVOSITIDÆ Dana.

Genus ALVEOPORA Quoy and Gaimard.

Alveopora verrilliana Dana.

1872. *Alveopora verrilliana* Dana, Corals and Coral Islands, 1st ed., p. 77, with fig.
1907. *Alveopora verrilliana* Vaughan, Bull. 59, U. S. Nat. Mus., p. 217, plate 91, figs. 3, 3*a*.

The type specimen, which has been described and figured by both Dana and Vaughan, is No. 327, U. S. National Museum. Dr. Mayor collected two good-sized representatives of the species. They differ from the type in having slightly thinner and more fragile corallite walls and septa. The corallites of the larger specimen vary from 1 to 2.5 mm. in diameter. Those of the smaller one are of the same size as the type (1 to 1.2 mm.).

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Shallow tide-pools on seaward edge of Utelei Reef.
No. 2. Aua line, 526 to 550 feet from shore.

Distribution.—Hawaiian Islands; Samoa.

Alveopora allingi, new species.

Plate 23, figs. 2*a*, 2*b*, 2*c*.

The collection contains 4 specimens, all of which were dredged from depths of 100 feet or more. They are branching, with short, bulbous, top-heavy, irregular branches.

No. 3 consists of a stem with two divergent branches. It measures 10 cm. in height and just above the basal portion the stem is 3 cm. in diameter. The branches at their bases measure 2 to 2.5 cm. in diameter and then rapidly become thicker and knob-like toward the summit. One branch measures 4.5 cm. in length and 5 cm. at its widest portion across the top. The other branch is smaller, but proportioned in the same manner. The upper surfaces of the branches are rounded, with lobations. A thin epitheca covers the complete stem and rises halfway to the summit of the branches. The surface of the epitheca possesses irregularly placed, wavy, concentric striations.

The calices are polygonal to subcircular. The fully grown ones average 5 mm. in their greater diameter and 4 mm. in their lesser. The septa are in two cycles; all are of the same size and meet in the center to form a columella. This columella is simply a tangle of the fine spiral threads of the septa and has a bird-nest appearance in the bottom of the calices. The latter are from 2 to 4 or 4.5 mm. in depth. The walls are rather thin and fragile, considering the large size of the calices. The pores in the walls are about 0.5 mm. in diameter and are arranged in regular longitudinal rows about 0.5 mm. apart.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Dredged from a depth of about 100 feet off Loa Loa.
No. 2. Dredged alive at depth of 17 fathoms on a muddy bottom between Oceanic S. S. Co. buoy and mooring-buoy A.
No. 3. Dredged from a depth of about 100 feet north of buoy A.
No. 4. Dredged alive from 12 to 14 fathoms on fairly hard bottom north of buoy A. Associated with *Leptoseris*.

Class HYDROZOA.

Order HYDROCORALLINÆ Moseley.

Family MILLEPORIDÆ L. Agassiz.

Genus MILLEPORA Linnæus.

Millepora alcicornis Linnæus.

1758. *Millepora alcicornis* Linné, Syst. nat. édit. 10, p. 791.
1846. *Millepora alcicornis* Dana, U. S. Expl. Exped., Zooph., p. 543.

The one specimen in the collection agrees perfectly with Quelch's description and figures of *M. confertissima* (Report on Reef-Corals, Chal. Exped., p. 193, plate 7, figs. 4, 4*a*). I believe the latter should be referred to *M. alcicornis*.

The species is very like *M. dichotoma* Forskål. Speaking of the similarity of the two, Klunzinger (Die Korallenthiere des Rothen Meeres, third part, p. 86) says:

"*Millepora alcicornis* Linné aus dem Antillen ist sehr ähnlich, unterscheidet sich aber dadurch, dasz die Aeste von Strecke zu Strecke handflächenartig zusammenfliessen und dann fingerartig auseinandertreten, in der Weise eines Elengeweihes; auch sind die Endläppchen gerundete und spitzer."

Vaughan (Carnegie Inst. Wash. Pub. 213, p. 206, plate 93, fig. 1) gives a good illustration of *M. dichotoma*.

Station.—Pago Pago Harbor, Tutuila, Samoa. Shallow tide-pool on seaward edge of Utelei Reef.

Millepora truncata Dana.

See Mayor's "Growth-Rate of Samoan Corals" for illustrations.

1846. *Millepora platyphyllia* Dana, including *β truncata* Dana, U. S. Expl. Exped., Zooph., p. 548, plate 52, figs. 5, 5*a*, 5*b*, 5*c*; plate 53, fig. 2.
1918. *Millepora truncata* Vaughan, Carnegie Inst. Wash. Pub. 213, p. 207, plate 93, figs. 3, 3*a*, 3*b*.

It seems to me that all the specimens referred to *M. platyphyllia* belong to the same species. As Dana's *M. platyphyllia* differs from Ehrenberg's, I am placing all of the former under *M. truncata*.

The Samoan collection contains 9 specimens which I am placing here; 5 of them are lobed as in typical *truncata*, while the others are small, young, and incrusting. I can see very little difference in the character of the pores. The species is similar to *M. incrassata* Dana, but differs from it by its smaller gastropores.

Stations, Pago Pago Harbor, Tutuila, Samoa:

No. 1. Off outer edge of Utelei Reef, near Goat Island. Depth 1 fathom.
Nos. 2 and 6=Nos. 44D and 40D (Mayor). Off Loa Loa, from depth of 2 fathoms, in agitated, pure water.
No. 3. Pure agitated water in shallow tide-pools near seaward edge of Aua Reef.
No. 4=No. 7 of the 600-foot station (Mayor). Growing naturally, on a rock 600 feet from shore, on the Aua Reef flat, in water about 1 foot deep at lowest tide in region of fairly quiet water.
No. 5. Shallow tide-pools on seaward edge of Utelei Reef.
No. 7. Aua line, 526 to 550 feet from shore.
No. 8. Aua line, 600 to 624 feet from shore.
No. 9. Aua line, 700 to 724 feet from shore.

EXPLANATION OF PLATES.

PLATE A:

Pago Pago Harbor showing the Aua line, stations at which corals were grown, and depths of borings through the reefs at Utelei and Aua. (Faces title-page.)

PLATE 1:

FIG. 1. *Pocillopora damicornis* var. *bulbosa* Ehrenberg, typical. Dana's specimen No. 718, U. S. N. M. Corallum, × 0.4.

FIG. 2. *Pocillopora brevicornis* Lamarck. Corallum, natural size.

FIGS. 3*a*, 3*b*, 3*c*. *Favia rotumana* (Gardiner), 3*a* and 3*b* natural size; 3*c* portion of calices, × 2.

PLATE 2:

FIGS. 1*a*, 1*b*. *Leptoria phrygia* (Ellis and Sol.)→*gracilis* Dana. 1*a*, corallum, natural size; 1*b*, portion, × 2.

FIGS. 2*a*, 2*b*. *Hydnophora mayori*, new species; 2*a*, whole corallum, natural size; 2*b*, branch, × 2

FIGS. 3*a*, 3*b*. *Pavona divaricata* Lamarck; 3*a* is No. 9*a* and 3*b* shows No. 9*b* of text.

PLATE 3:

FIGS. 1*a*, 1*b*, 1*c*, 1*d*, 1*e*. *Pavona frondifera* Lamarck; 1*a* is Verrill's type of *P. foliosa*, No. 413 U. S. N. M.; 1*b* is from the Philippines; 1*c* is Dana's specimen, No. 191, U. S. N. M.; 1*d* and 1*e* are Nos. 7 and 8 of the text.

PLATE 4:

FIG. 1. *Pavona decussata* Dana. No. 5 of text, from Fiji Islands.

FIG. 2. *Leptoseris gardineri* van der Horst; branch, natural size.

FIGS. 3*a*, 3*b*, 3*c*. *Coscinaræa columna* (Dana); 3*a* and 3*b*, No. 1 of text, 3*b* × 3; 3*c*, No. 4=41D (Mayor) of text.

PLATE 5:

FIGS. 1*a*, 1*b*. *Psammocora contigua* Esper; No. 6 of text; 1*b* × 4.

FIGS. 2*a*, 2*b*. *Psammocora contigua* var. *tutuilensis*, new variety; 2*b* × 4.

FIGS. 3*a*, 3*b*, 3*c*. *Psammocora samoensis*, new species; 3*a*, No. 1 of text; 3*b* and 3*c*, No. 2; 3*c* × 3.

PLATE 6:

FIGS. 1*a*, 1*b*. *Montipora vaughani*, new species; 1*b* × 4.

FIGS. 2*a*, 2*b*. *Montipora venosa* (Ehrenberg); 2*b* × 4.

FIGS. 3*a*, 3*b*, 3*c*. *Montipora tuberculosa* (Lamarck); 3*b* and 3*c* × 4.

PLATE 7:

FIG. 1. *Montipora ehrenbergii* Verrill; top view, natural size.

FIG. 2. *Montipora trabeculata* Bernard; corallum, natural size.

FIGS. 3*a*, 3*b*. *Montipora verrilli* var. *auaensis*, new var.; No. 1 of text; 3*b* × 4.

FIGS. 4*a*, 4*b*. *Montipora berryi*, new species; 4*b* × 4.

PLATE 8:

FIG. 1. *Acropora formosa* (Dana); type No. 888 U. S. N. M.; × 0.4.

FIGS. 2*a*, 2*b*. *Acropora formosa* var. *gracilis* (Dana); No. 8 of text; 2*b*, branch, × 2.

FIGS. 3*a*, 3*b*. *Acropora formosa* var. *brachiata* (Dana); No. 1 of text; 3*a* × 0.6; 3*b*, natural size.

PLATE 9:

FIGS. 1*a*, 1*b*, 2. *Acropora exigua* (Dana); 1*a*, 1*b*, type No. 288, U. S. N. M., 1*b*, branch, × 2; 2 is No. 1 of text.

FIGS. 3*a*, 3*b*. *Acropora hebes* (Dana); No. 2 of text; 3*b* is branch, × 2.

PLATE 10:

FIGS. 1*a*, 1*b*. *Acropora teres* (Verrill); type No. 377, U. S. N. M.; 1*b* is branch, × 2.

FIGS, 2*a*, 2*b*. *Acropora teres* (Verrill); No. 7 of text; 2*b* is branch, × 2.

FIGS. 3*a*, 3*b*. *Acropora cribripora* (Dana); type No. 287, U. S. N. M.; 3*b* × 2.

PLATE 11:

FIG. 1. *Acropora nobilis* (Dana); branch, × 0.8.
FIG. 2. *Acropora secunda* (Dana); branches of type No. 323, U. S. N. M.
FIGS. 3*a*, 3*b*. *Acropora samoensis* (Brook); 3*a* is fragment, natural size; 3*b*, apical calice, × 8.
FIG. 4. *Acropora humilis* (Dana); type No. 332, U. S. N. M.

PLATE 12:

FIGS. 1*a*, 1*b*, 1*c*. *Acropora valida* (Dana); 1*a* is type No. 272, U. S. N. M.; 1*b* is fragment of No. 1 of text, natural size; 1*c* is No. 2 of text.
FIG. 2. *Acropora canaliculata* (Klunzinger); branch, natural size.

PLATE 13:

FIGS. 1*a*, 1*b*, 1*c*. *Acropora corymbosa* (Lamarck); 1*a* is branch of No. 5 of text; 1*b* and 1*c* show No. 1 = No. 29 (Mayor).
FIGS. 2*a*, 2*b*. *Acropora cymbicyathus* (Brook); 2*a* and 2*b* show branches of No. 2 of text; both × 1.5.
FIG. 3. *Acropora hyacinthus* (Dana); type No. 246, U. S. N. M.

PLATE 14:

FIGS. 1*a*, 1*b*, 1*c*, 1*d*. *Acropora hyacinthus* (Dana); 1*a* is No. 10 of text; 1*b* is No. 5; 1*c* is No. 1 = No. 14 (Mayor), × 0.8; 1*d* is a portion of the underside of No. 14 (Mayor), natural size.

PLATE 15:

FIGS. 1*a*, 1*b*. *Acropora latistella* (Brook); 1*b* is branch, × 2.
FIGS. 2*a*, 2*b*. *Acropora syringodes* (Brook); 2*a* shows corallum of No. 3 = No. 16 (Mayor); 2*b* is branch of same.

PLATE 16:

FIGS. 1*a*, 1*b*. 1*c*, 1*d*. *Acropora prolixa* (Verrill); 1*a* and 1*b* are Samoan specimens, natural size; 1*c*, type No. 414, U. S. N. M.; 1*d*, Dana's type of *A. echinata* from the Sulu Seas, No. 276, U. S. N. M.

PLATE 17:

FIGS. 1*a*, 1*b*, 1*c*, 1*d*. *Acropora leptocyathus* (Brook); 1*a* and 1*b* show No. 1 of text; 1*b* is portion × 2; 1*c* is No. 9*a* and 1*d* is No. 8 of text.

PLATE 18:

FIGS. 1*a*, 1*b*, 1*c*. *Acropora massawensis* von Marenzeller; 1*a* is No. 1 of text; 1*b* and 1*c* are two views of No. 2.
FIG. 2. *Acropora vanderhorsti* new species; branch, natural size.

PLATE 19:

FIGS. 1*a*, 1*b*, 1*c*, 1*d*, 1*e*. *Acropora tutuilensis*, new species; 1*a*, 1*b*, 1*c* show No. 1 of text; 1*b* is under surface; 1*c* is portion of calices, × 2; 1*d* is top view of No. 2; 1*e* is side view of some branches of No. 2.

PLATE 20:

FIGS. 1*a*, 1*b*, 1*c*, 1*d*. *Acropora pagoensis*, new species; all show views of type; 1*c* is underside of corallum; 1*b* is portion of calices, × 2; 1*d* is portion of under surface, × 3.

PLATE 21:

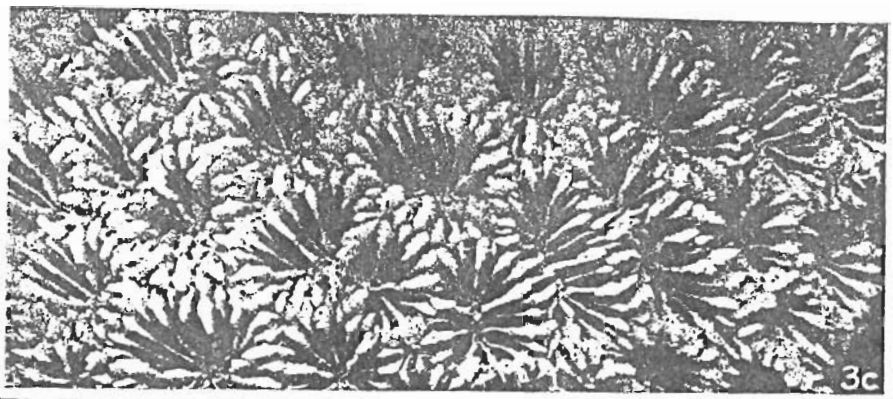
FIGS. 1*a*, 1*b*. *Porites lobata* forma *nodulosa*, new forma; No. 7 of text; 1*b* × 6.
FIGS. 2*a*, 2*b*, 2*c*. *Porites lutea* M. Edw. and H., typical; 2*a* and 2*b* show No. 11 of text; 2*b* × 6; 2*c* is No. 1, × 8.
FIG. 3. *Porites lutea* var. *haddoni* Vaughan; No. 52 (Mayor), × 8.

PLATE 22:

FIGS. 1*a*, 1*b*. *Porites murrayensis* Vaughan; No. 3 of text, 1*b*, × 6.
FIGS. 2*a*, 2*b*, 2*c*. *Porites andrewsi* Vaughan; 2*a* corallum, × 0.8; 2*b* branch, natural size; 2*c* portion showing calices, × 6; all views of No. 24D (Mayor) of text.
FIGS. 3*a*, 3*b*. *Porites* (*Synaræa*) *horizontalata*, new species; type; 3*b* shows portion, × 8.

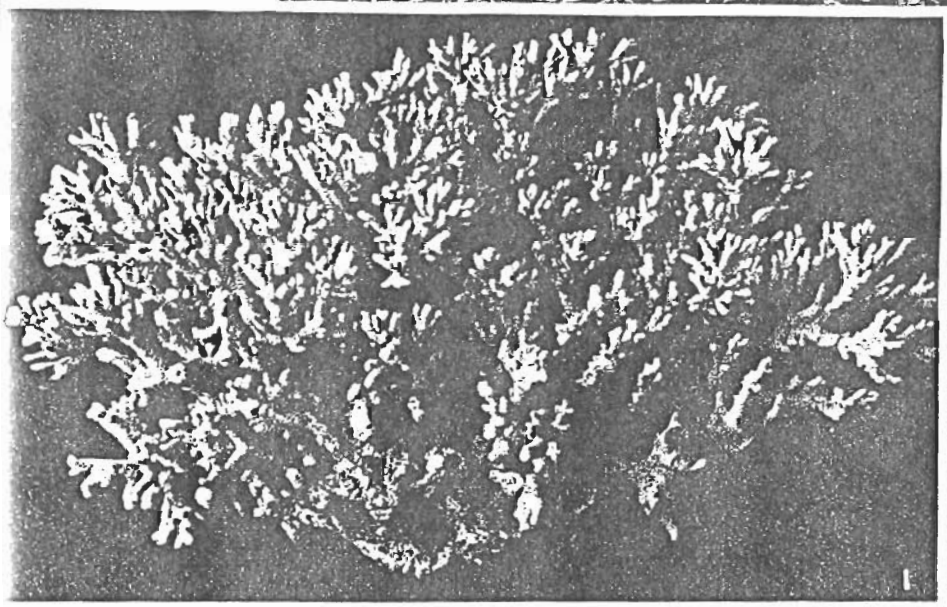
PLATE 23:

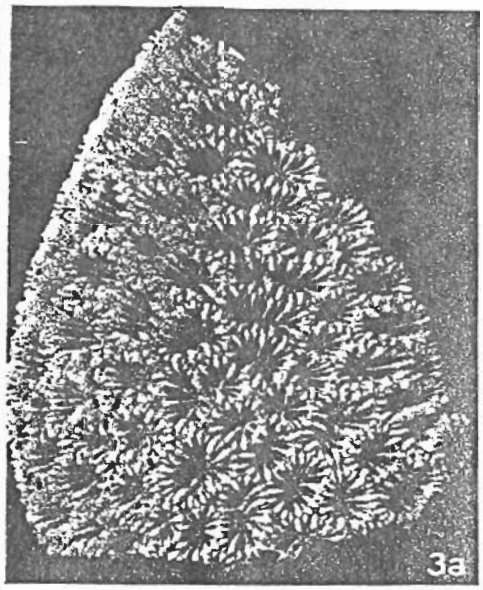
FIGS. 1*a*, 1*b*, 1*c*. *Porites* (*Synaræa*) *faustinoi*, new species; 1*a* top view, natural size; 1*b* under surface, natural size; 1*c* portion showing calices, × 6.
FIGS. 2*a*, 2*b*, 2*c*. *Alveopora allingi*, new species; 2*a* is No. 3 of text; 2*b* and 2*c* show No. 4; 2*c* × 2.

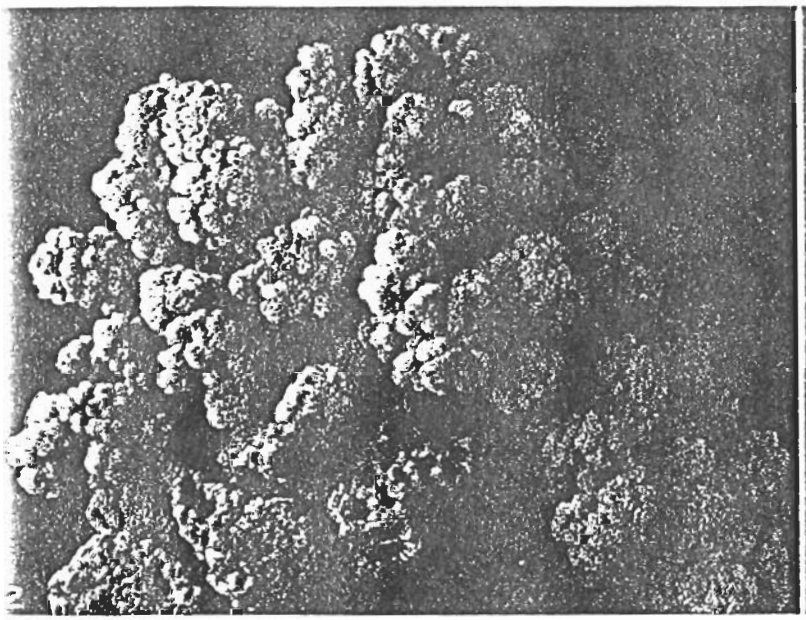


× 2.

× 0.4.







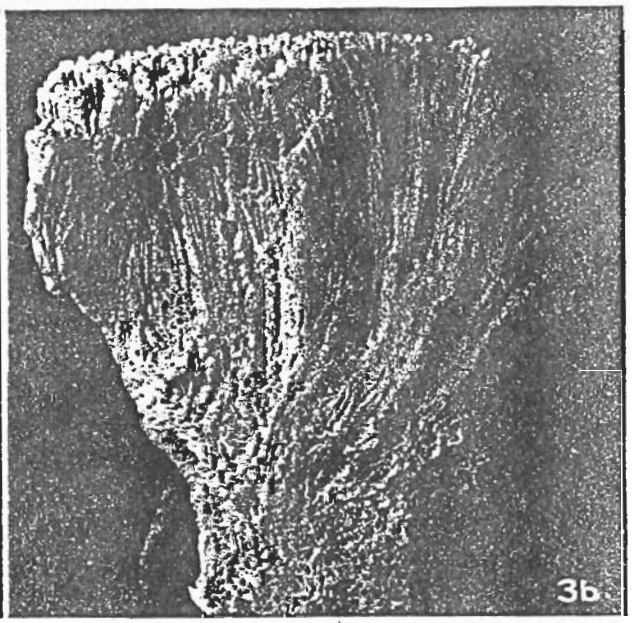
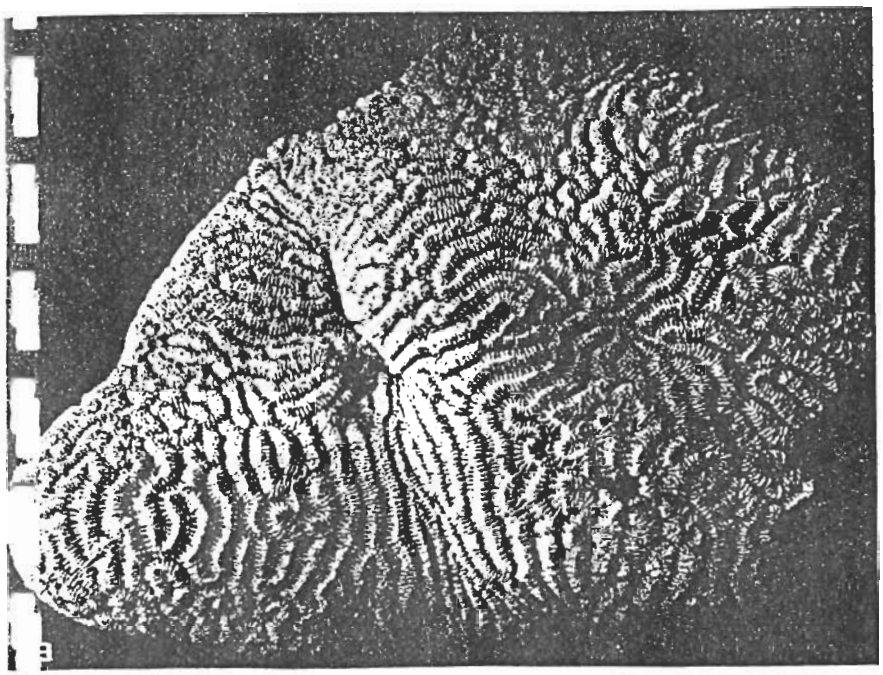
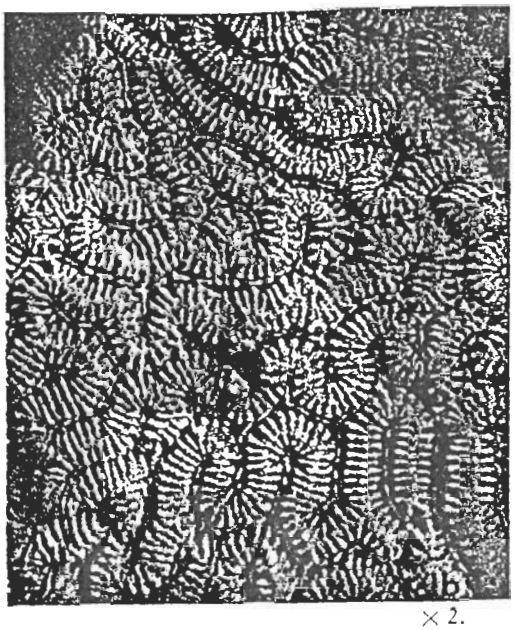


FIG. 1. *Pocillopora damicornis* var. *bulbosa* Ehrenberg. FIG. 2. *Pocillopora brevicornis* Lamarck.
FIGS. 3*a*, 3*b*, 3*c*. *Fascia rotumana* (Gardiner).





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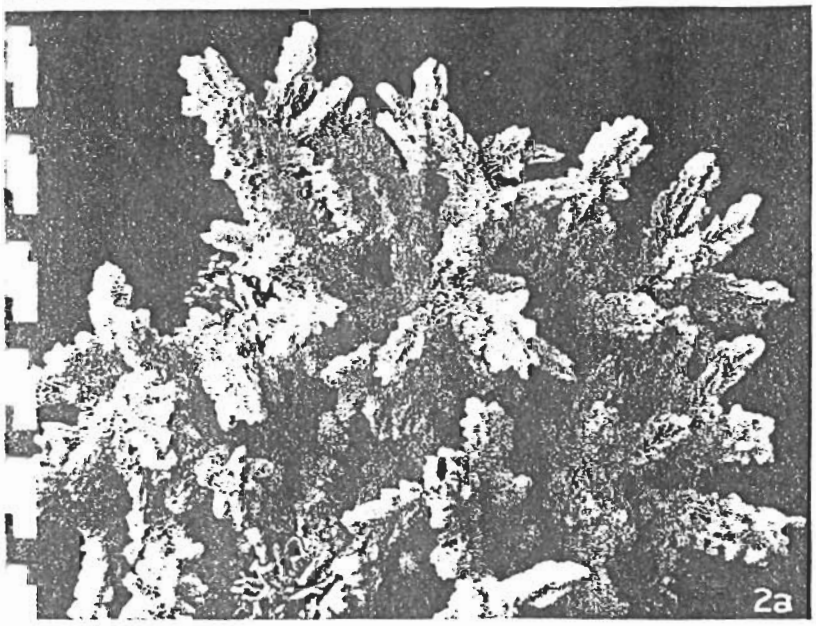

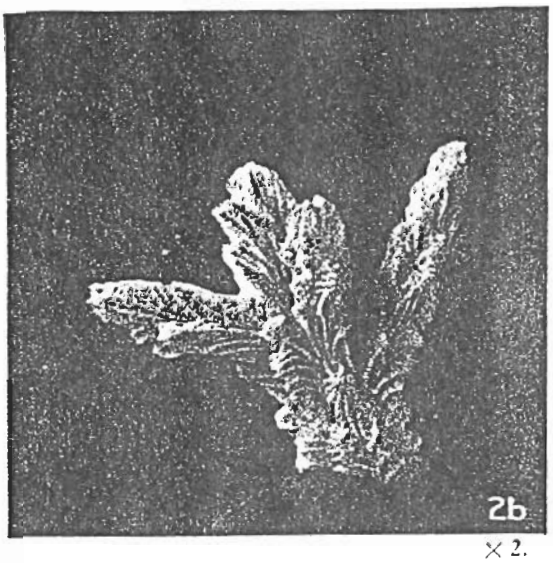

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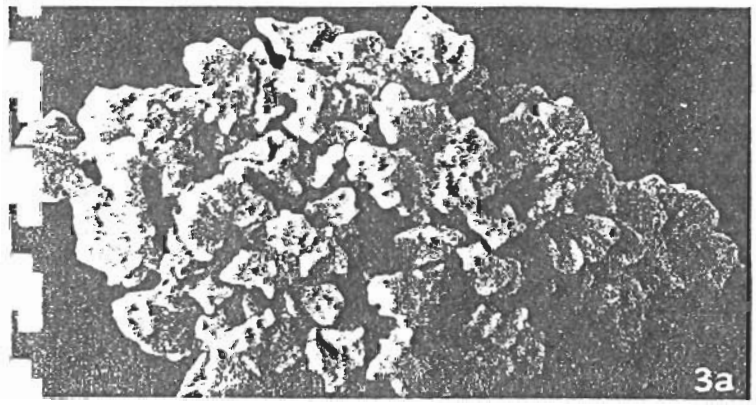
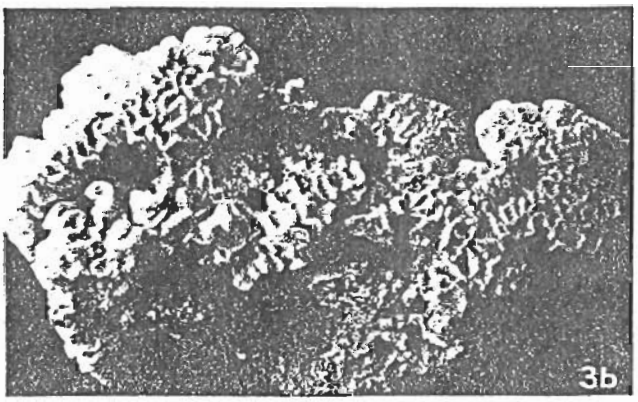
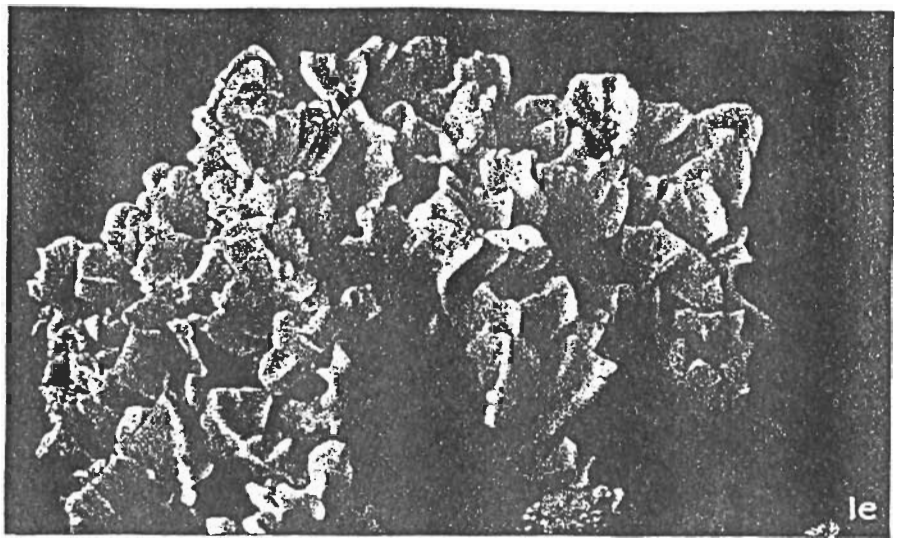
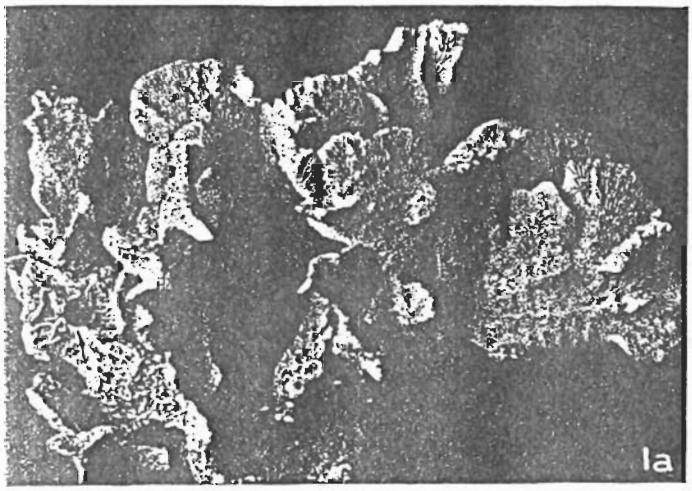
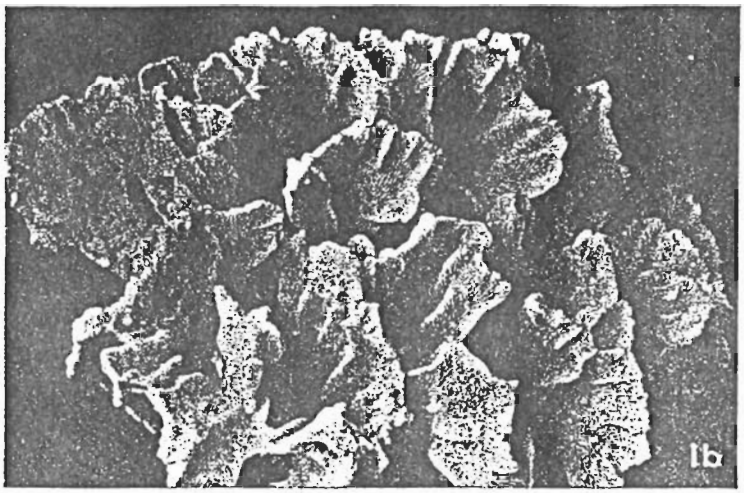


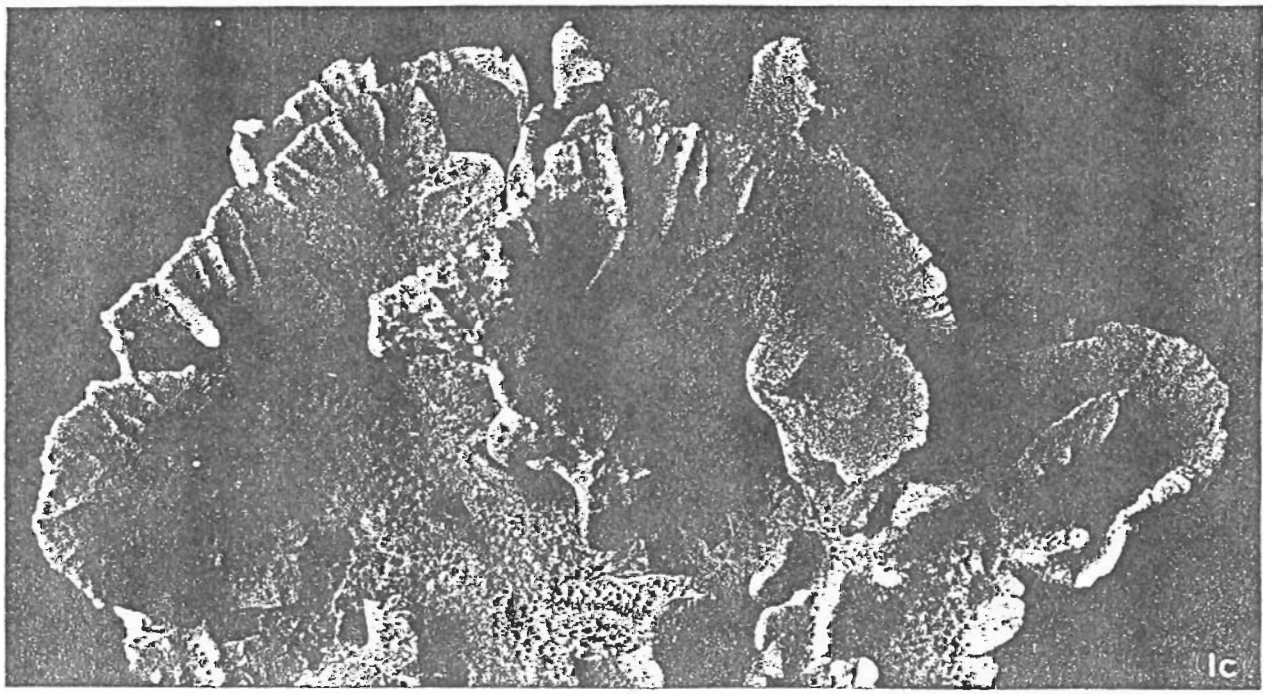


FIGS. 1a, 1b. *Leptoria phrygia* (E. and S.)—*gracilis* Dana. FIGS. 2a, 2b. *Hydnophora mayori*, new species.
FIGS. 3a, 3b. *Pavona divaricata* Lamarck.

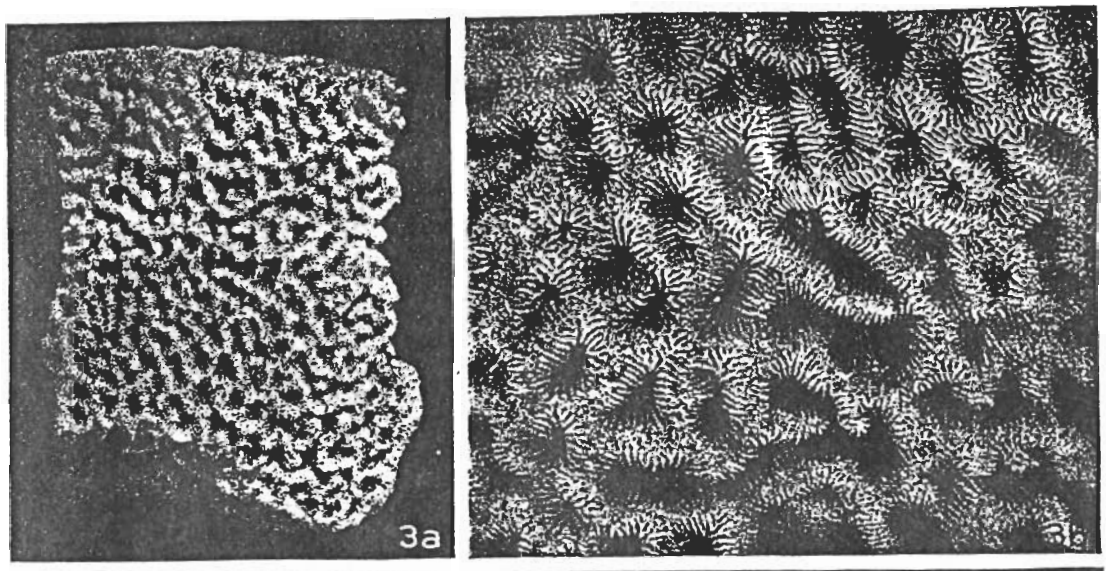








Pavona frondifera Lamarck.



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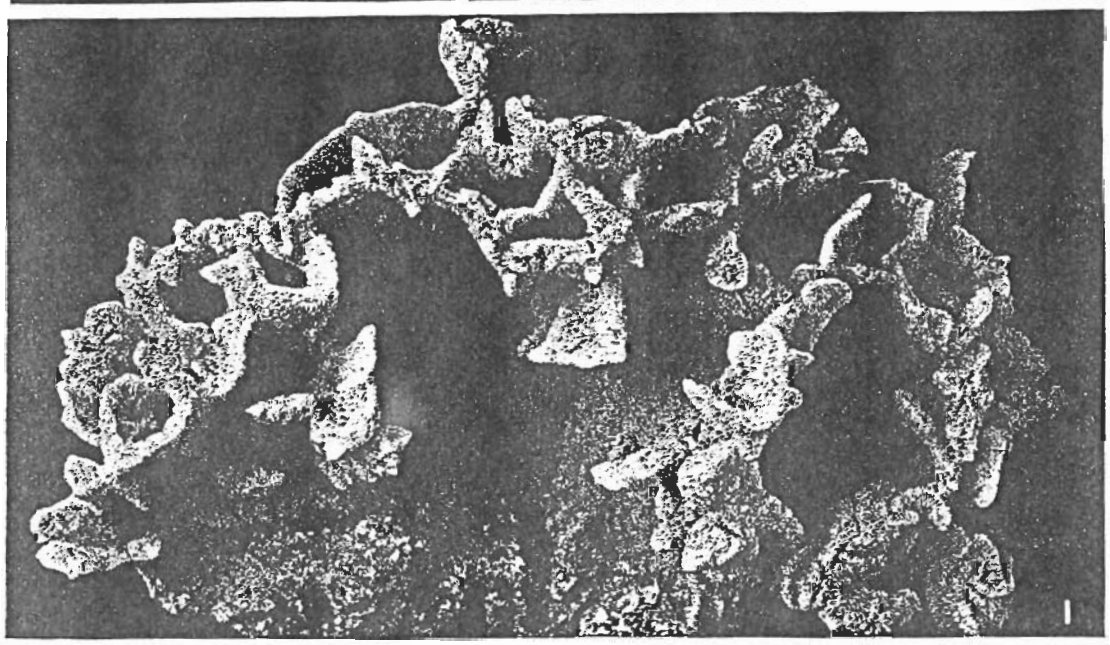
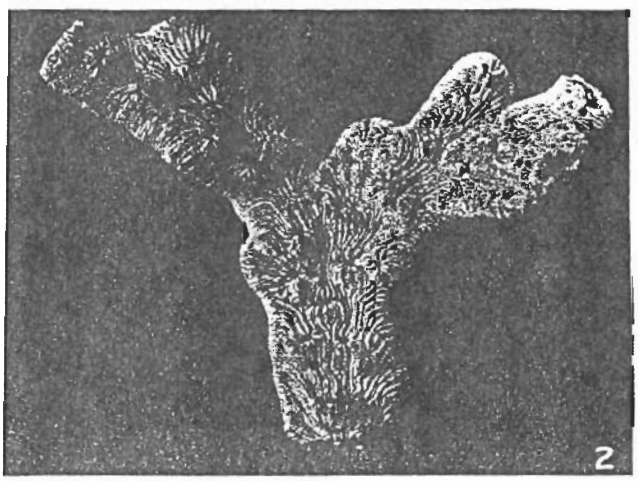




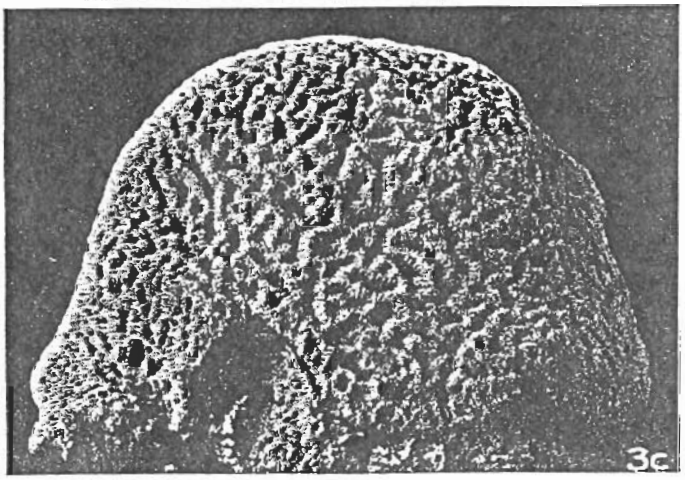
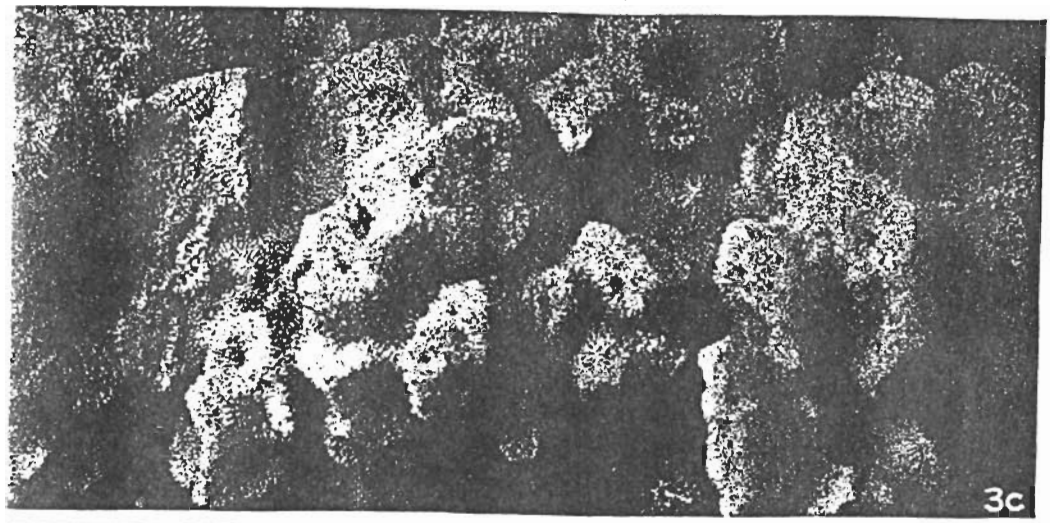


FIG. 1. *Pavona decussata* Dana. FIG. 2. *Leptoseris gardineri* van der Horst.
FIGS. 3*a*, 3*b*, 3*c*. *Coscinaræa columna* (Dana).



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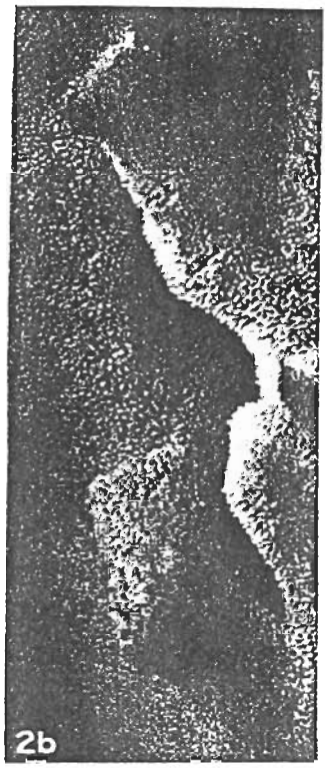

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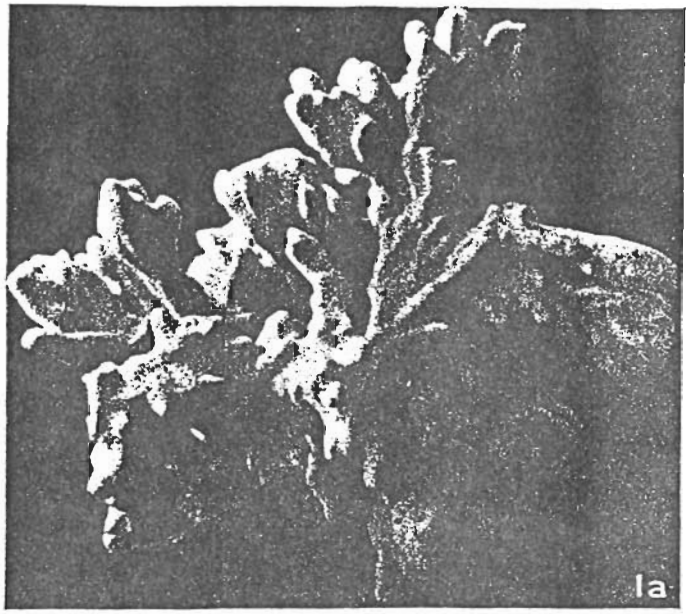

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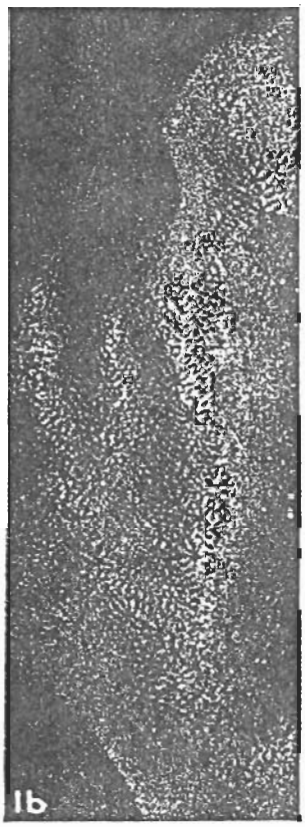
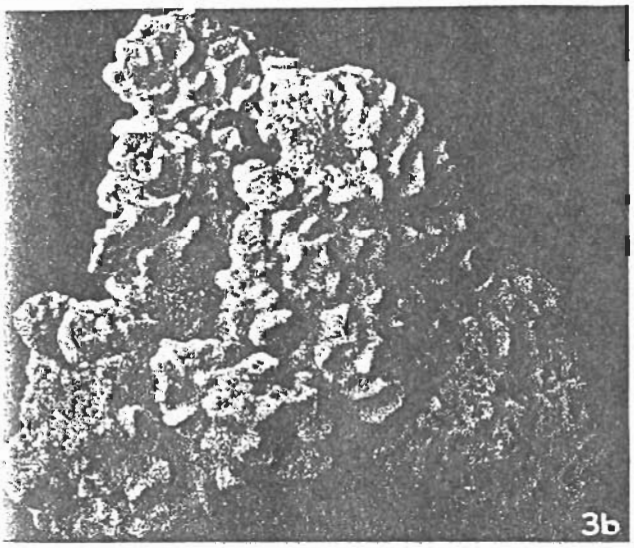
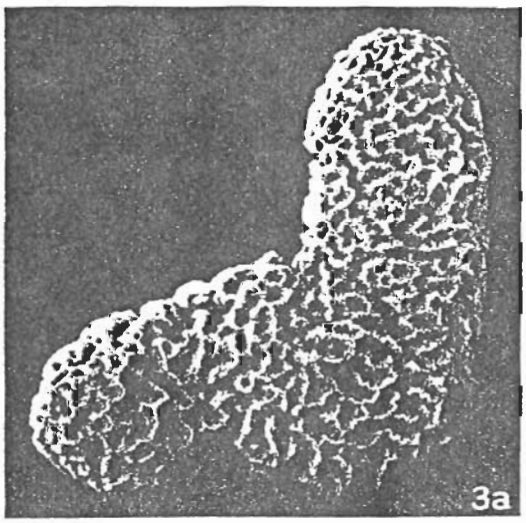
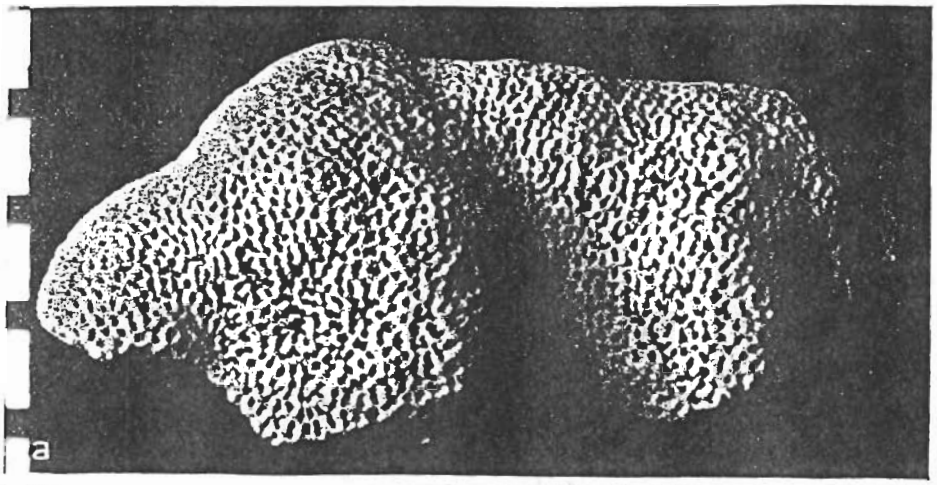






FIGS. 1*a*, 1*b*. *Psammocora contigua* Esper. FIGS. 2*a*, 2*b*. *Psammocora contigua* var. *tutuilensis*, new variety.
FIGS. 3*a*, 3*b*, 3*c*. *Psammocora samoensis*, new species.



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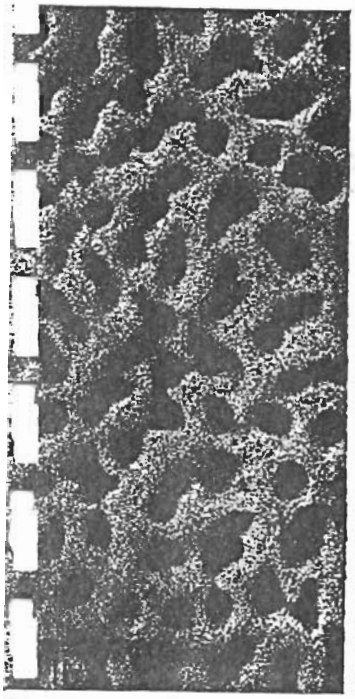

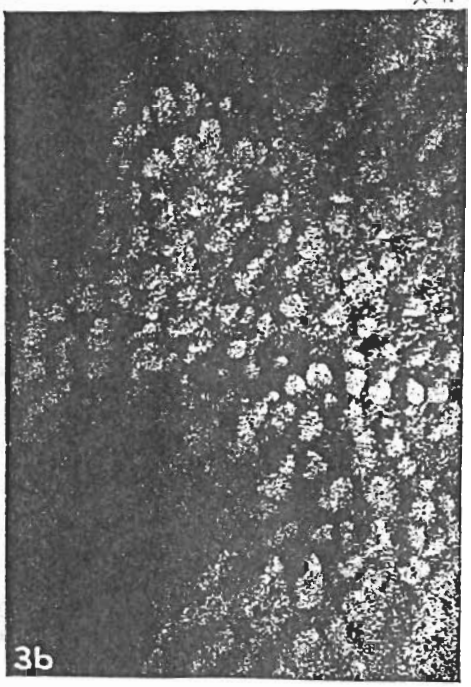

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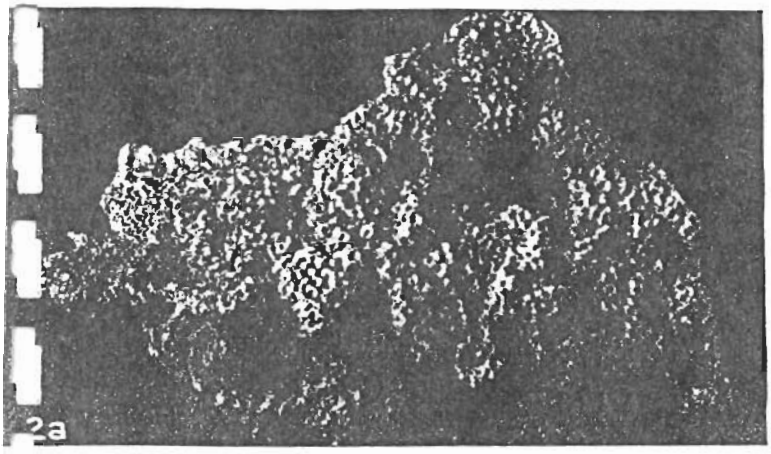
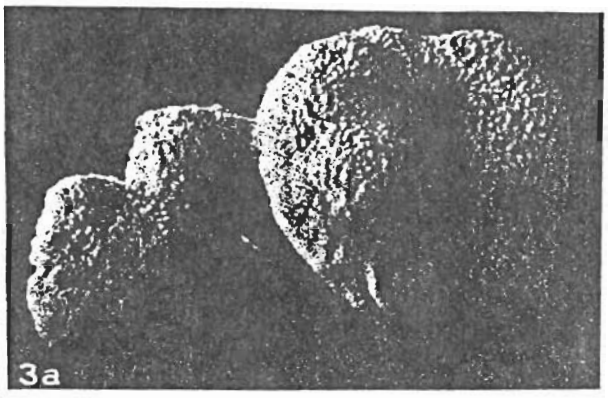
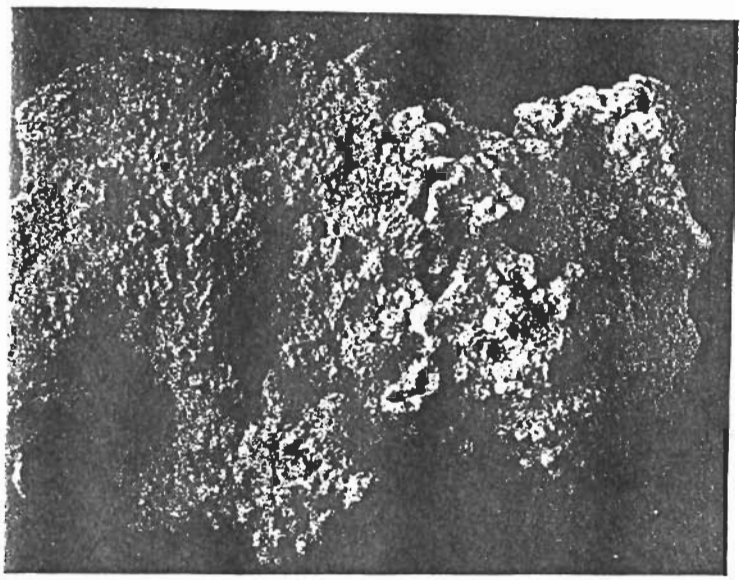
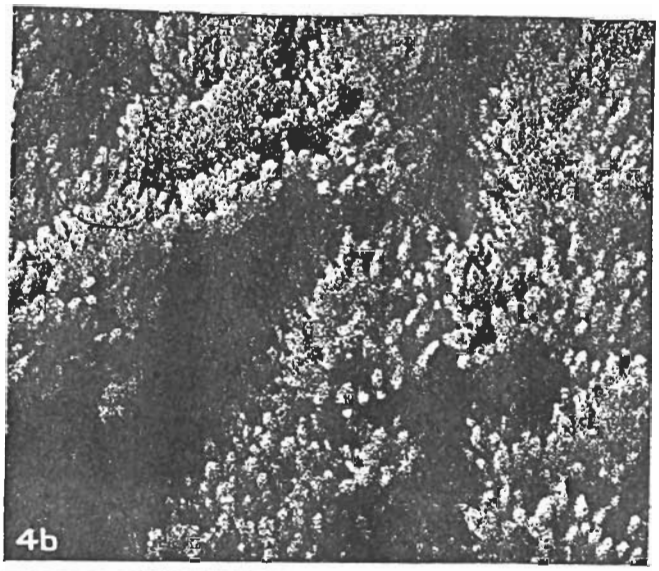




FIGS. 1*a*, 1*b*. *Montipora vaughani*, new species. FIGS. 2*a*, 2*b*. *Montipora venosa* (Ehrenberg).
FIGS. 3*a*, 3*b*, 3*c*. *Montipora tuberculosa* (Lamarck).





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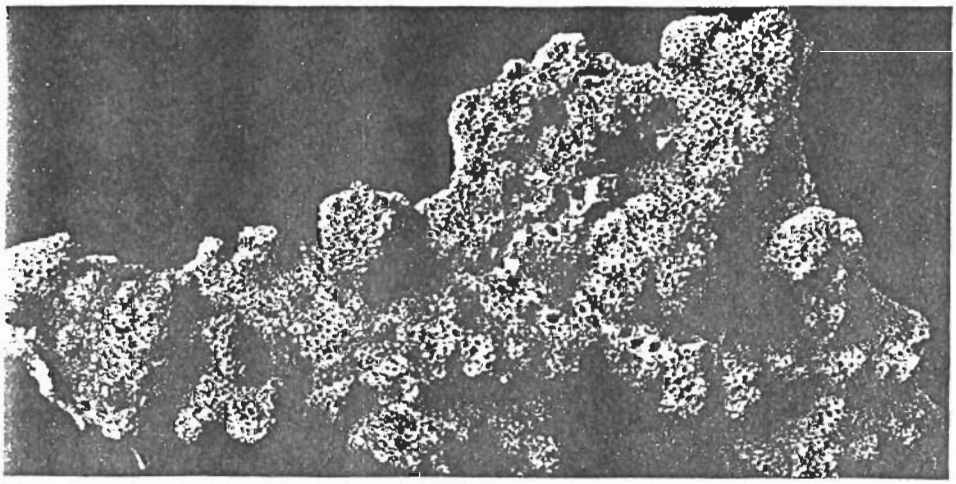

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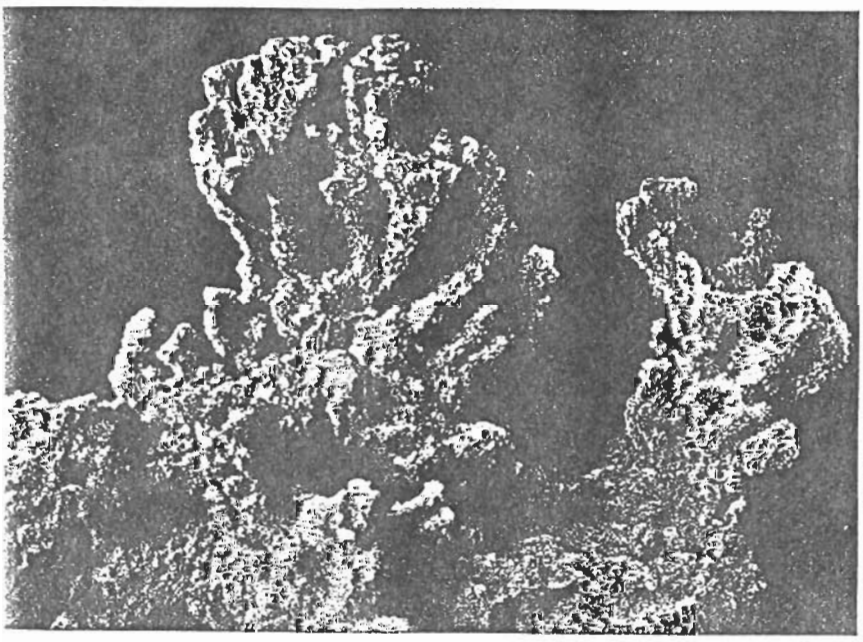


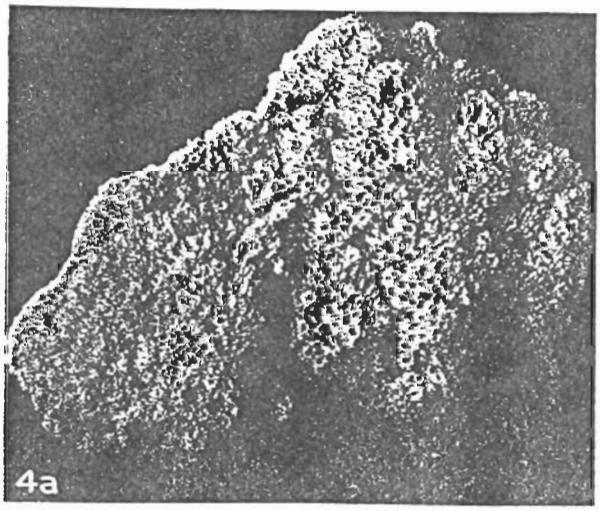
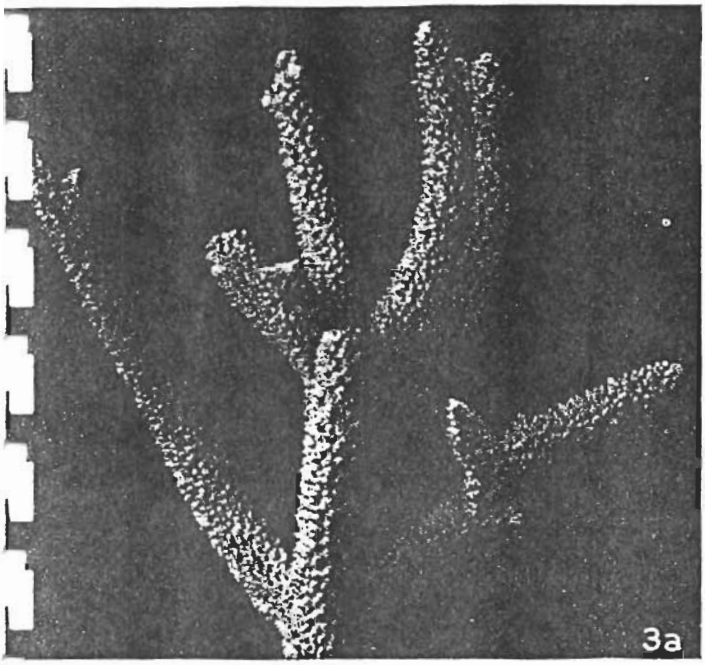
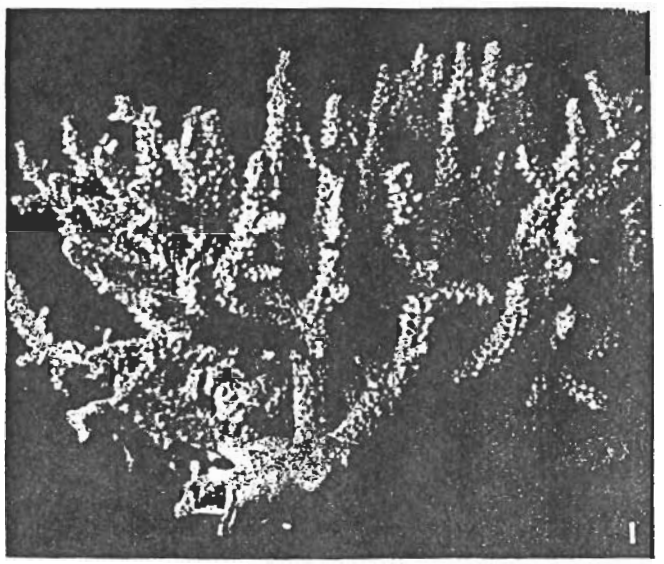


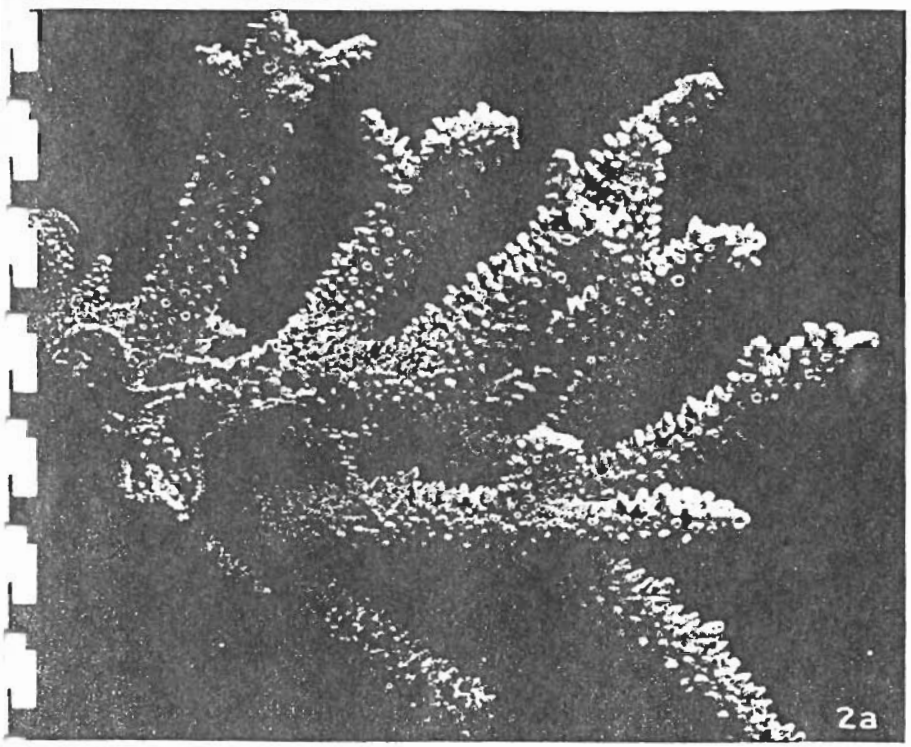
FIG. 1. *Montipora ehrenbergii* Verrill. FIG. 2. *Montipora trabeculata* Bernard. FIGS. 3*a*, 3*b*. Montipora *verrilli* var. *auaensis*, new variety. FIGS. 4*a*, 4*b*. *Montipora berryi*, new species.

× 2.

× 0.4.







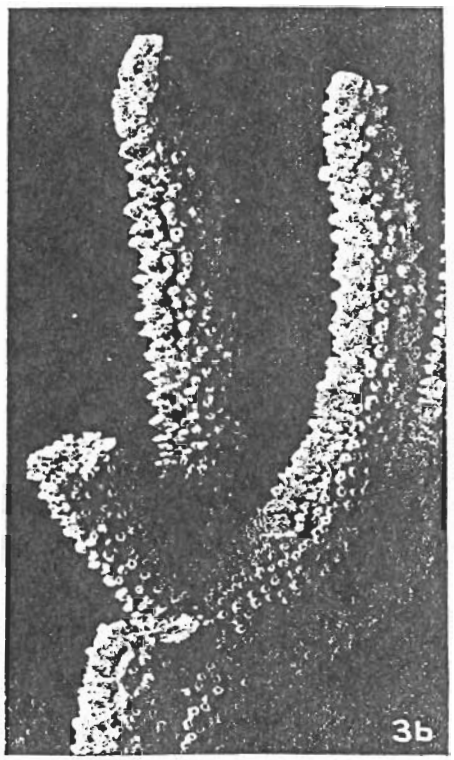
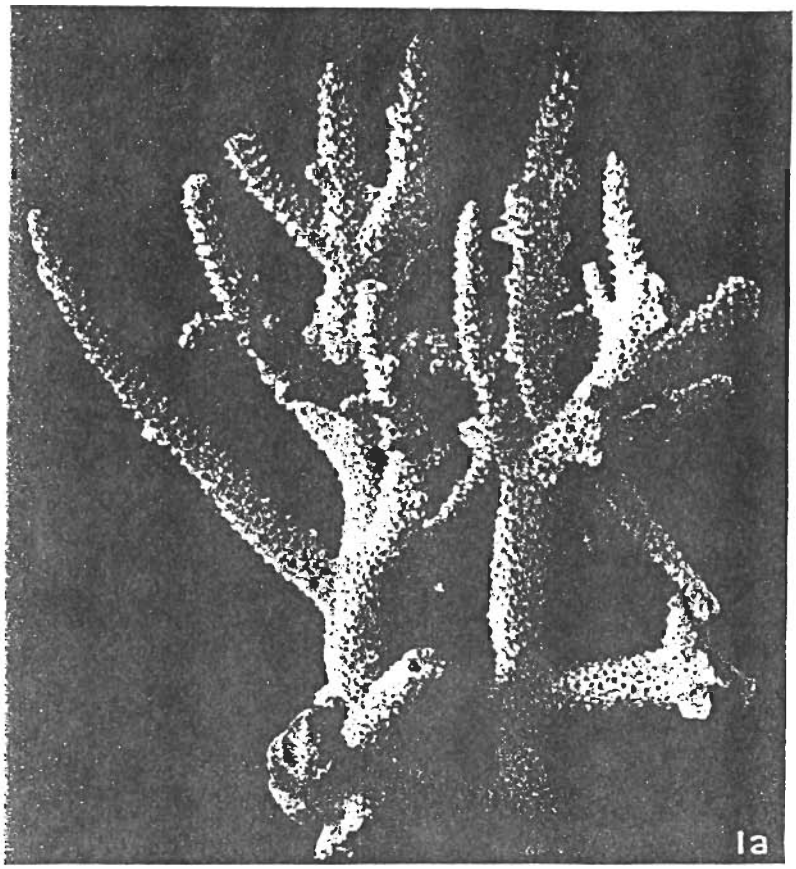


FIG. 1. *Acropora formosa* (Dana). FIGS. 2*a*, 2*b*. *Acropora formosa* var. *gracilis* (Dana).
FIGS. 3*a*, 3*b*. *Acropra formosa* var. *brachiata* (Dana).



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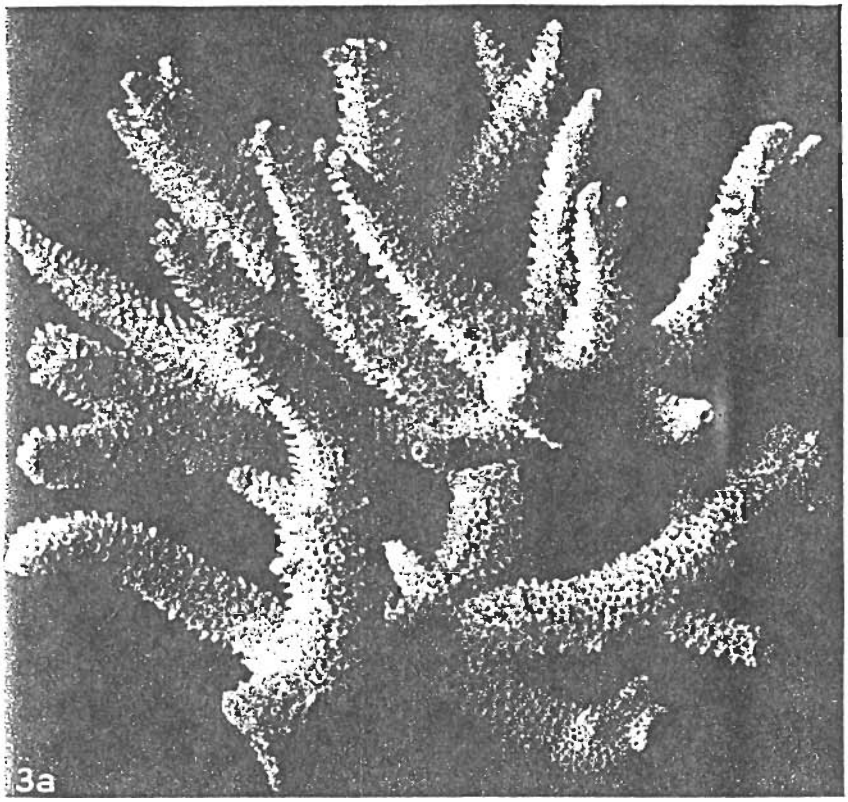
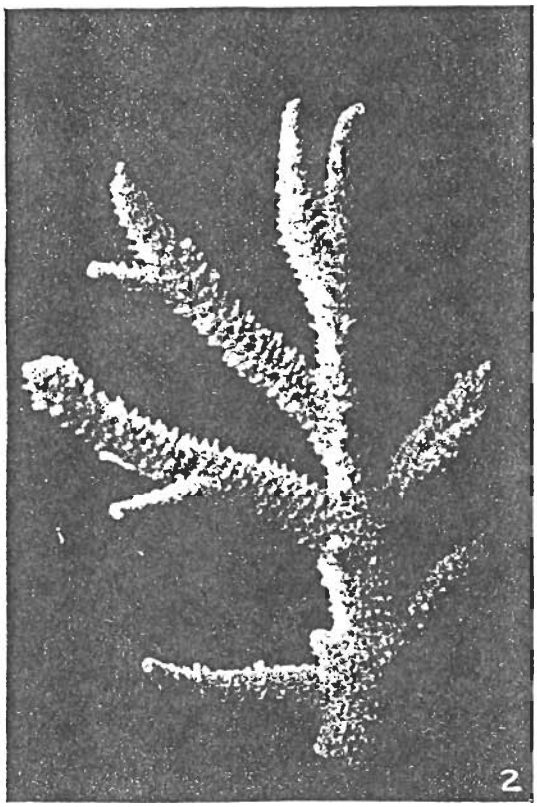
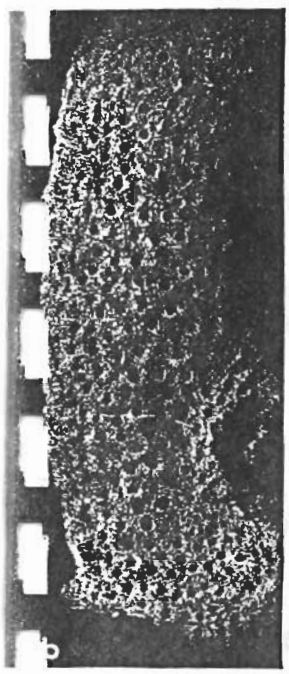
× 2.





FIGS. 1*a*, 1*b*, 2. *Acropora exigua* (Dana). FIGS. 3*a*, 3*b*. *Acropora hebes* (Dana).



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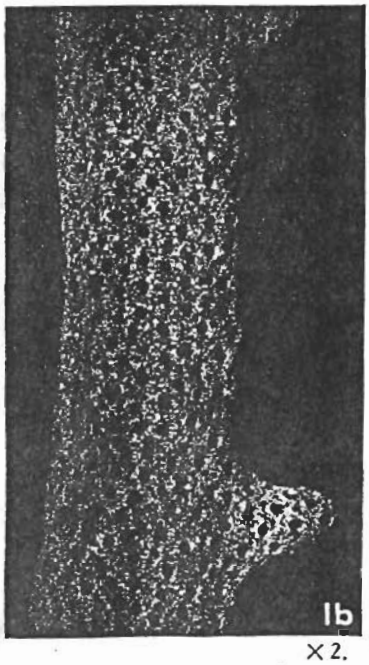

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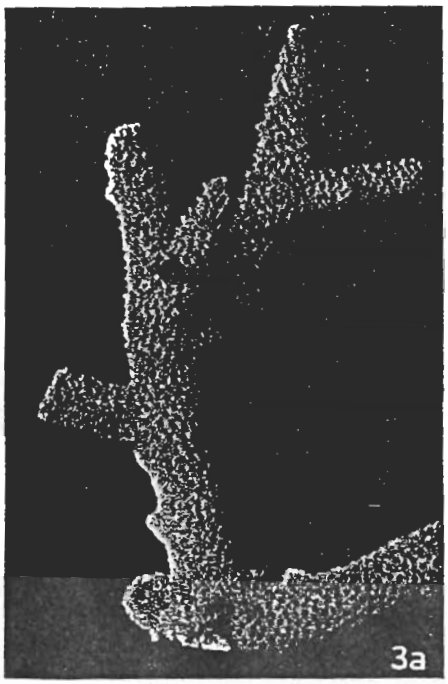
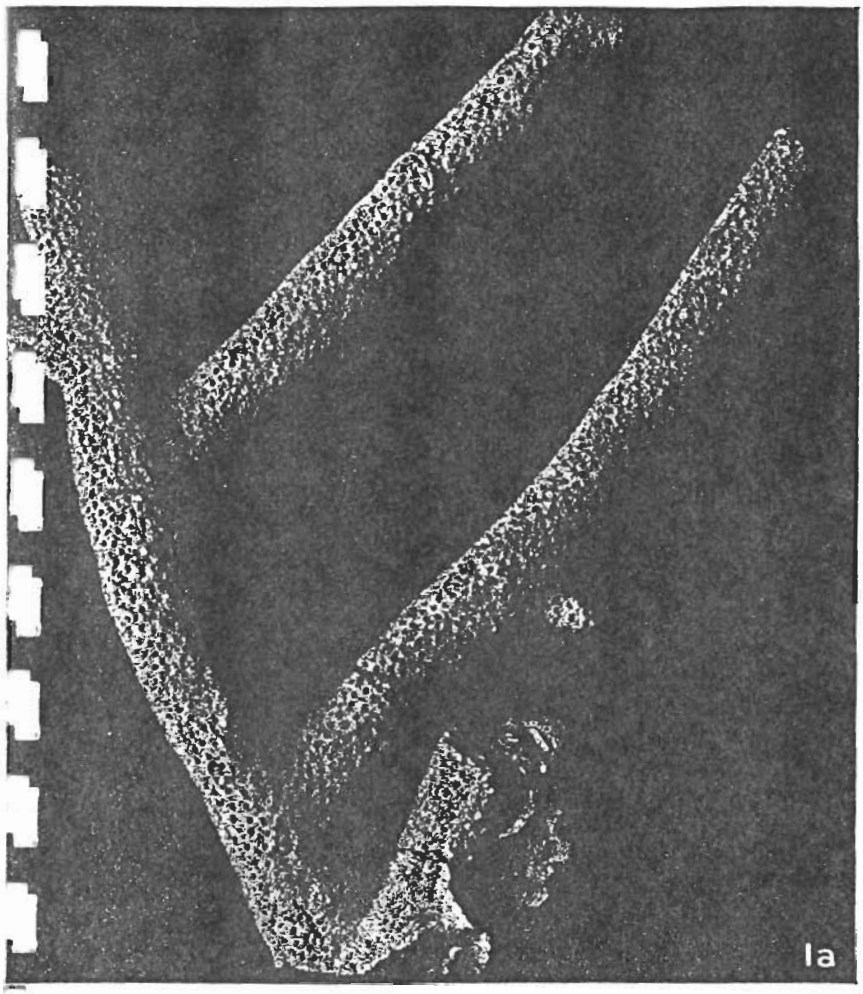
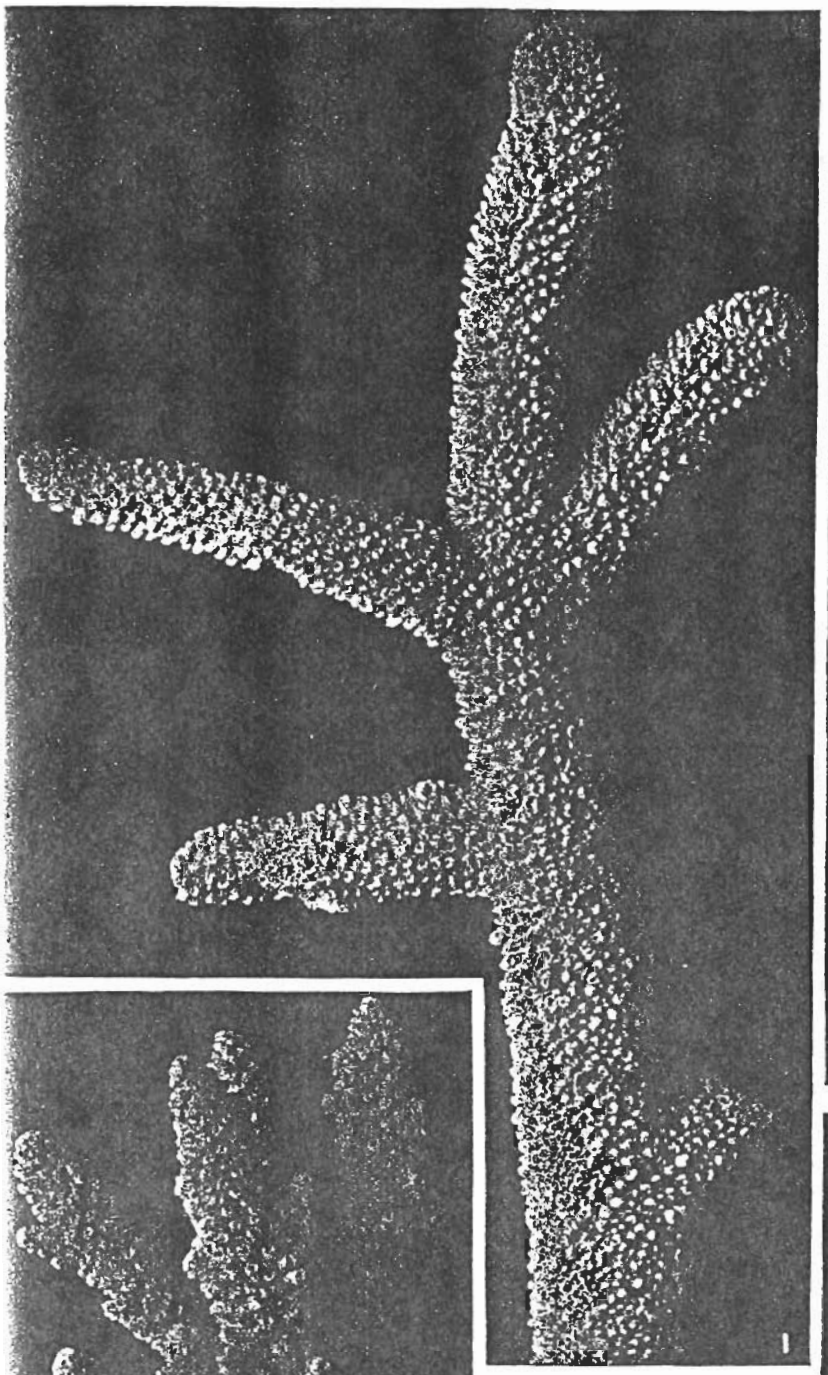
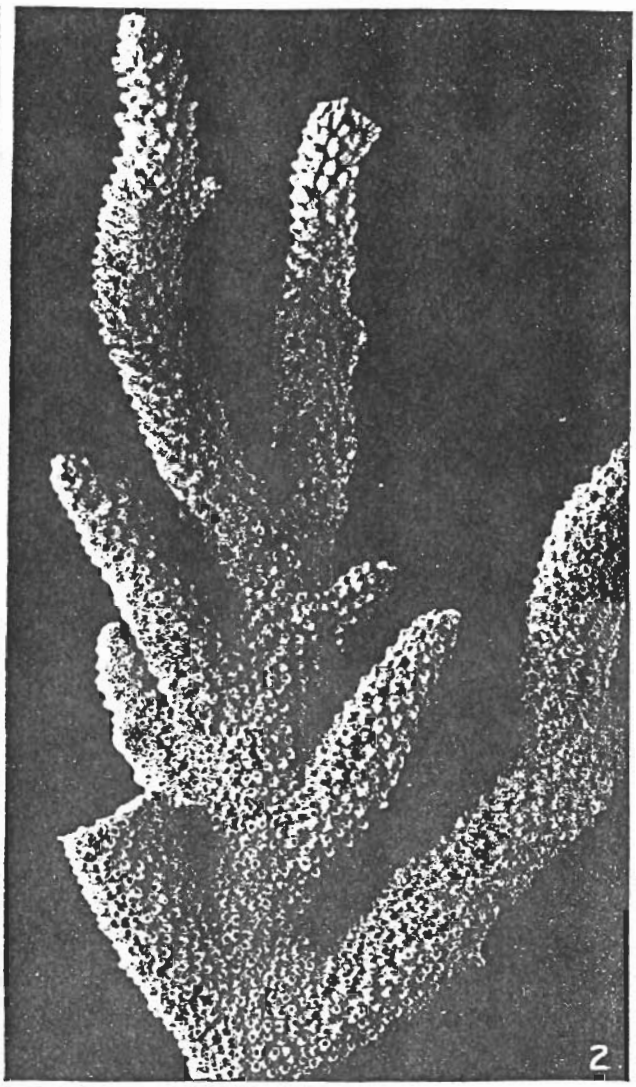
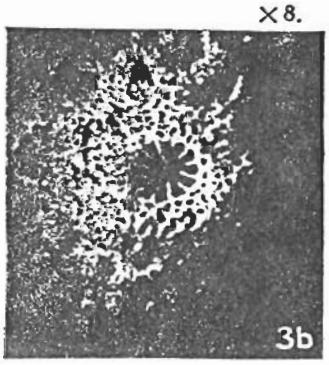




FIGS. 1*a*, 1*b*, 2*a*, 2*b*. *Acropora teres* (Verrill). FIGS. 3*a*, 3*b*. *Acropora cribripora* (Dana).







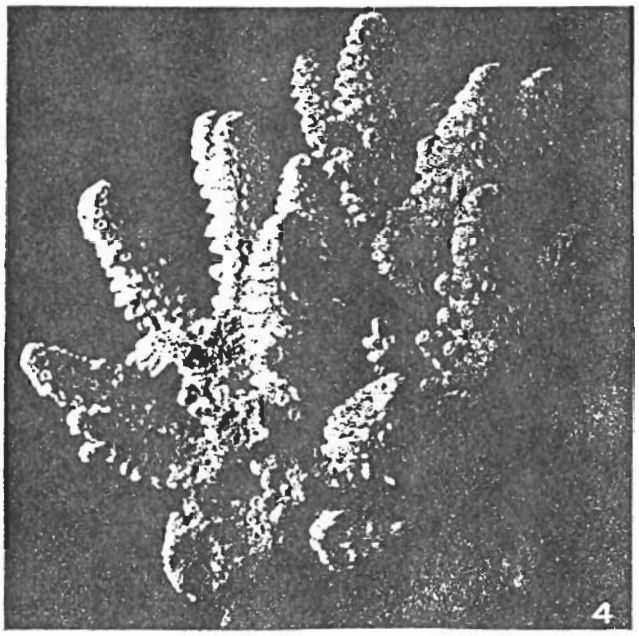
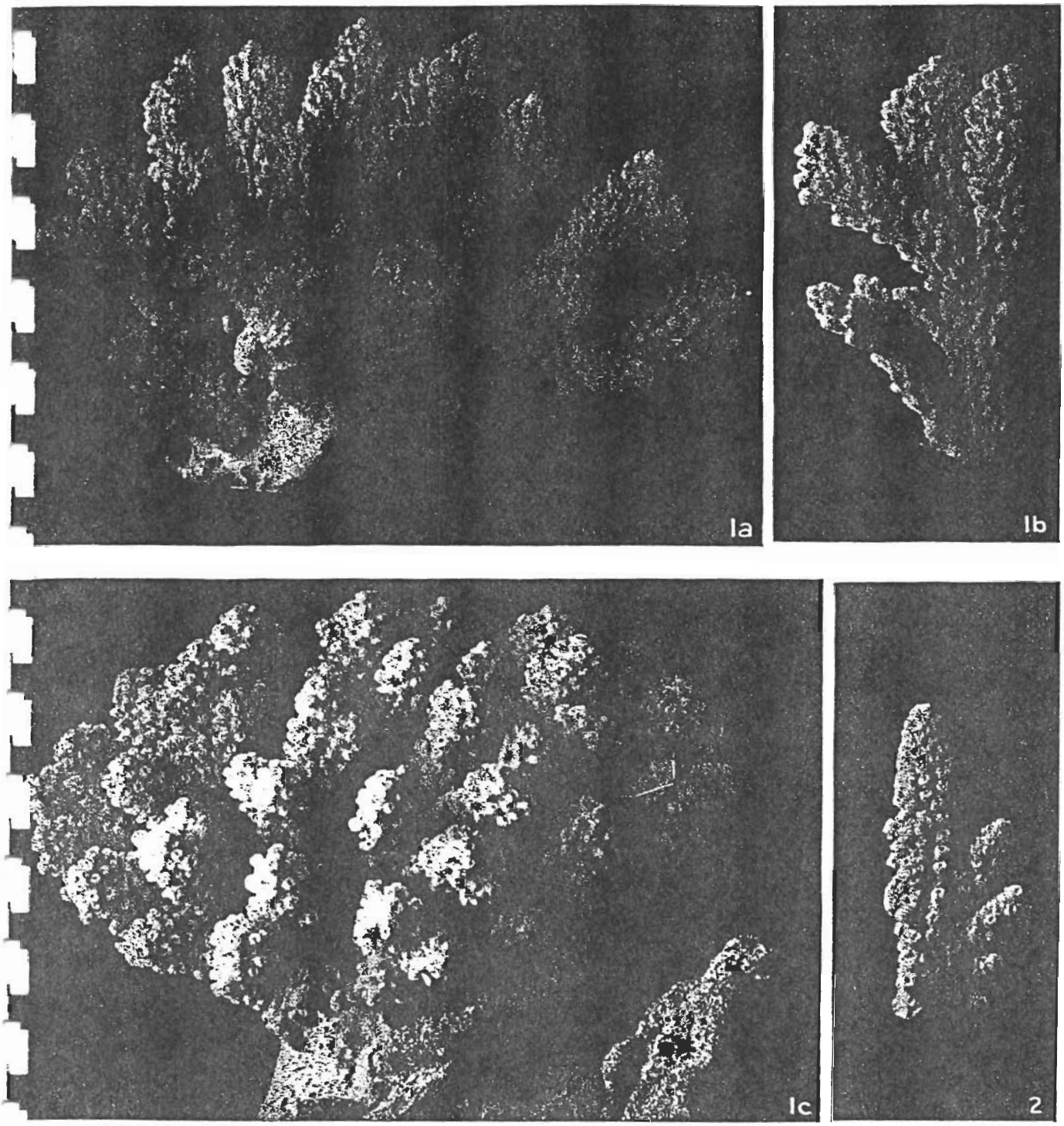
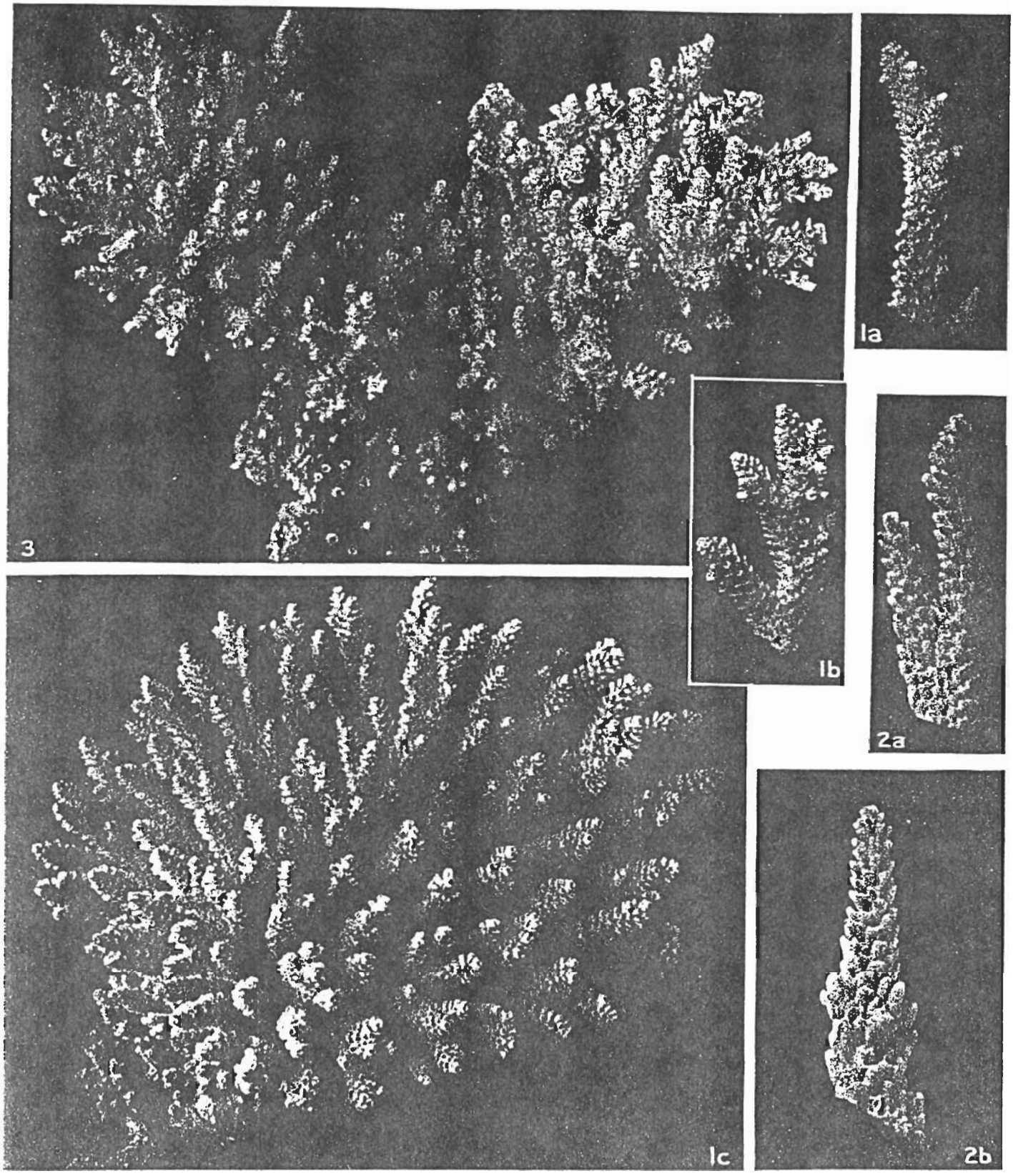


FIG. 1. *Acropora nobilis* (Dana).
FIGS. 3a, 3b. *Acropora samoensis* (Brook).

FIG. 2. *Acropora secunda* (Dana).
FIG. 4. *Acropora humilis* (Dana).



FIGS. 1*a*, 1*b*, 1*c*. *Acropora valida* (Dana). FIG. 2. *Acropora canaliculata* (Klunzinger).



FIGS. 1*a*, 1*b*, 1*c*. *Acropora corymbosa* (Lamarck). FIGS. 2*a*, 2*b*. *Acropora cymbicyathus* (Brook).
FIG. 3. *Acropora hyacinthus* (Dana).

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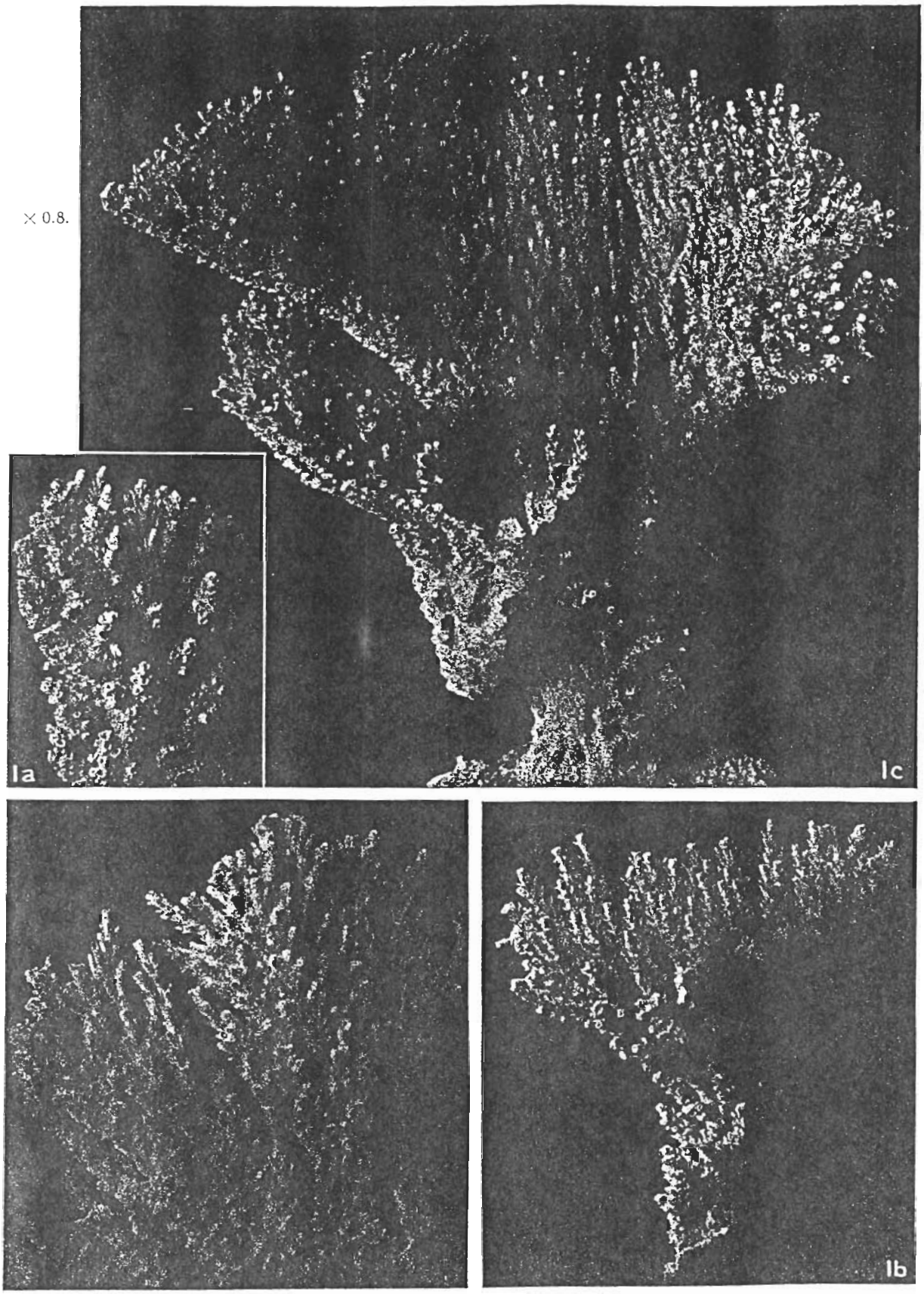
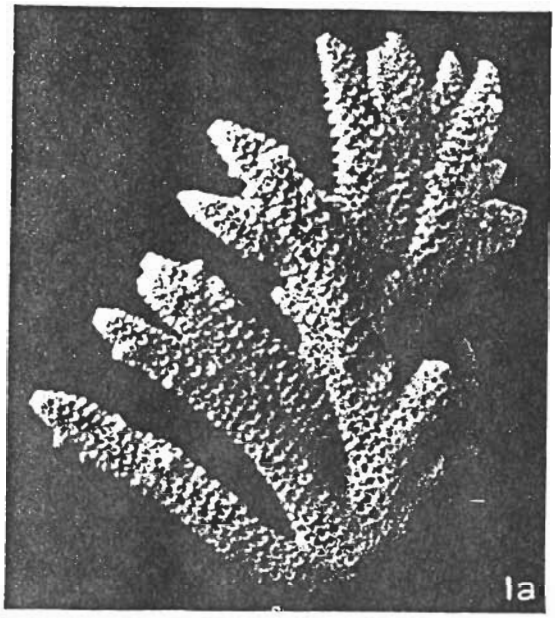
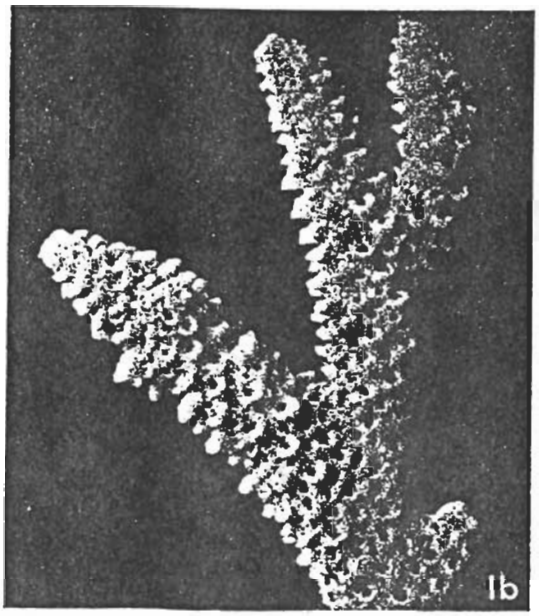


Acropora hyacinthus (Dana).





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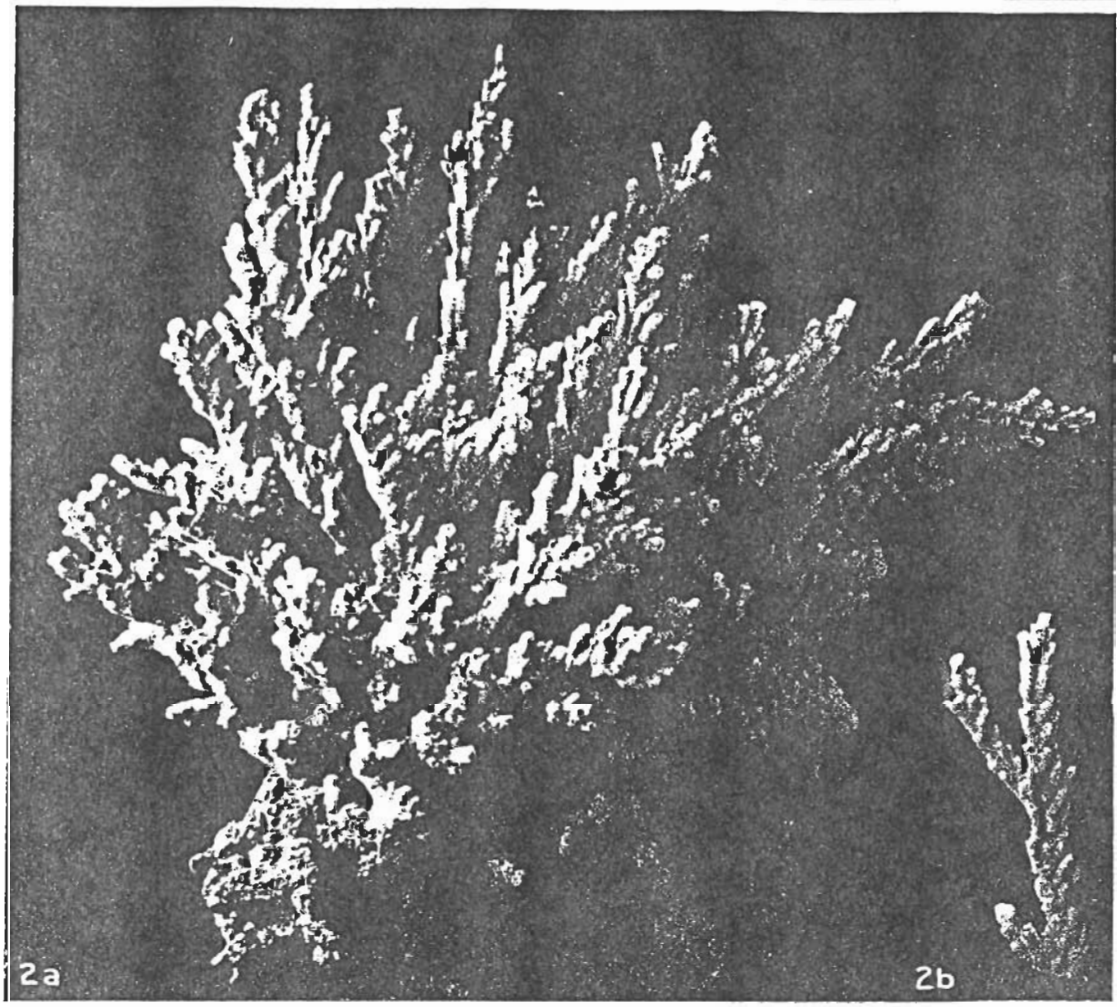
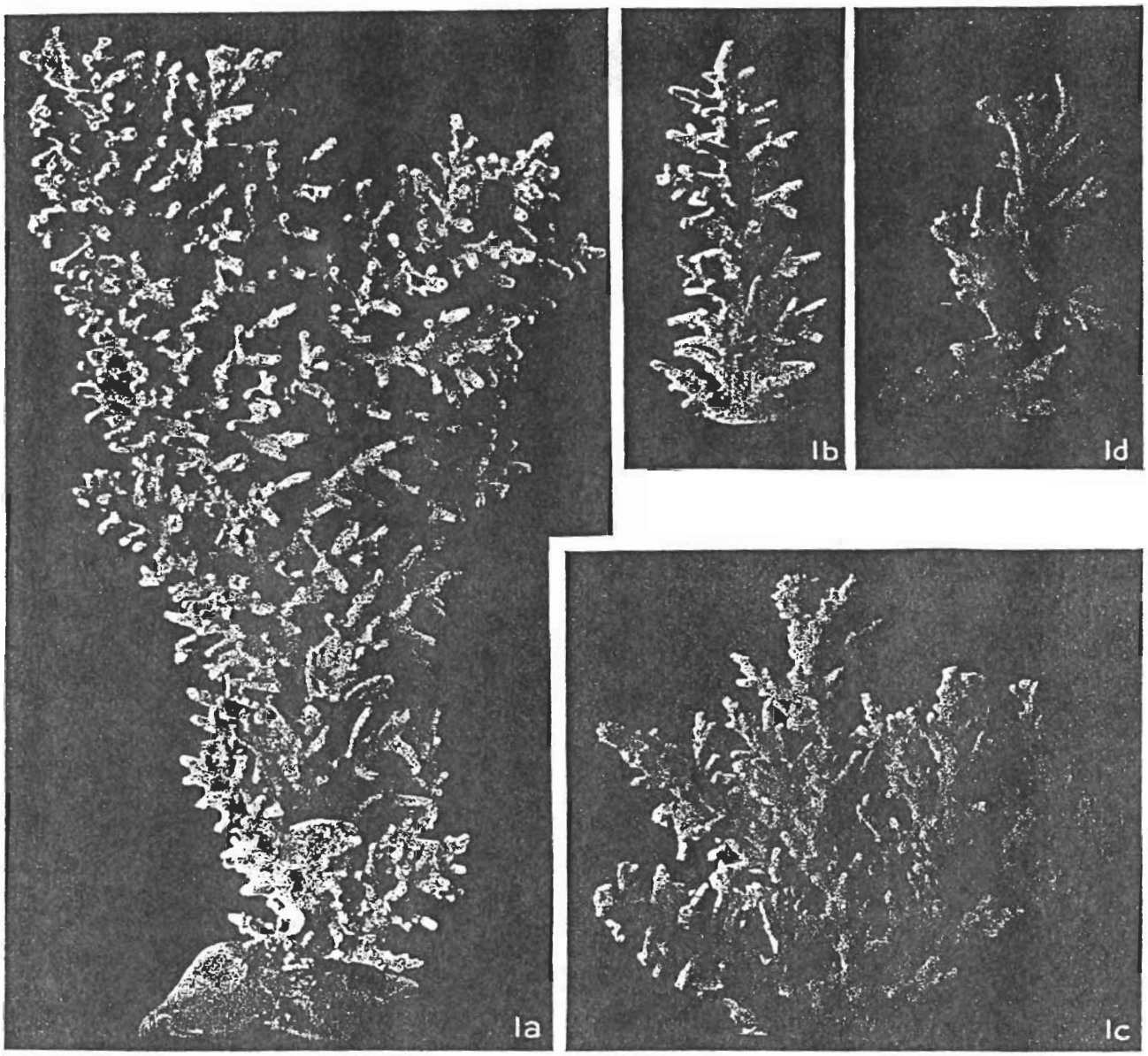
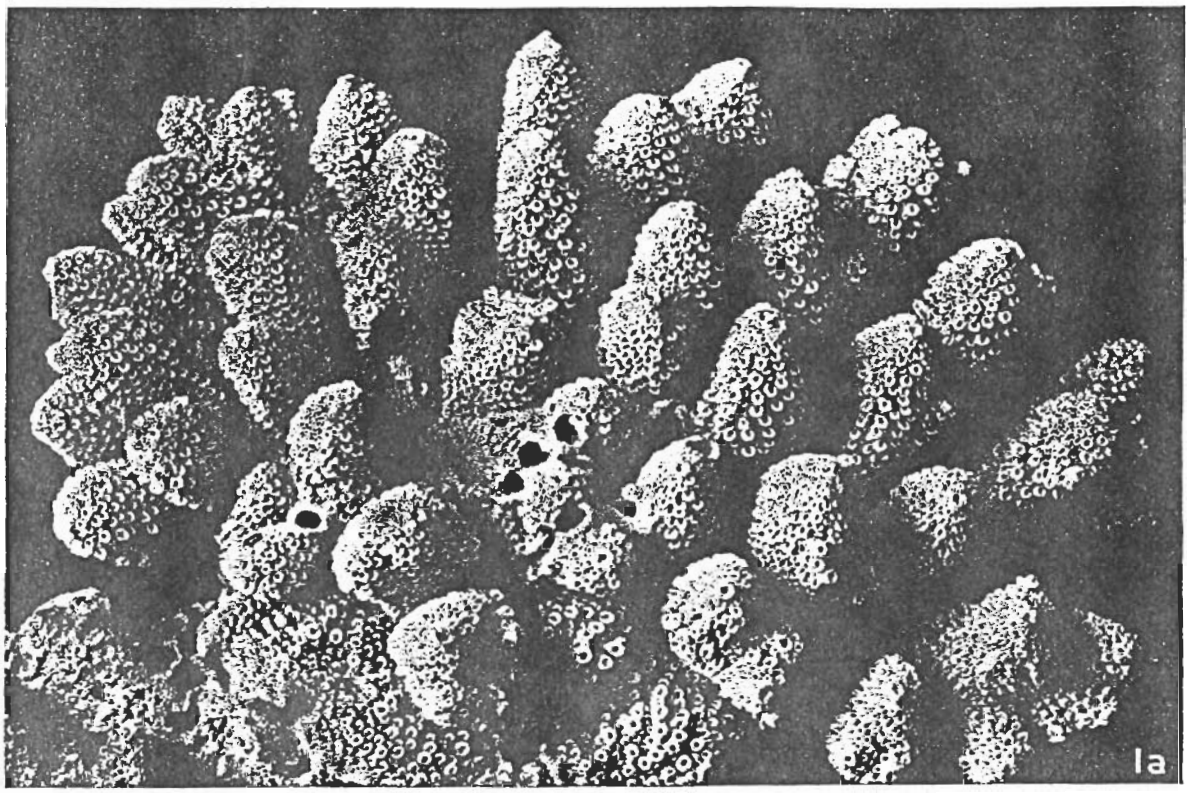
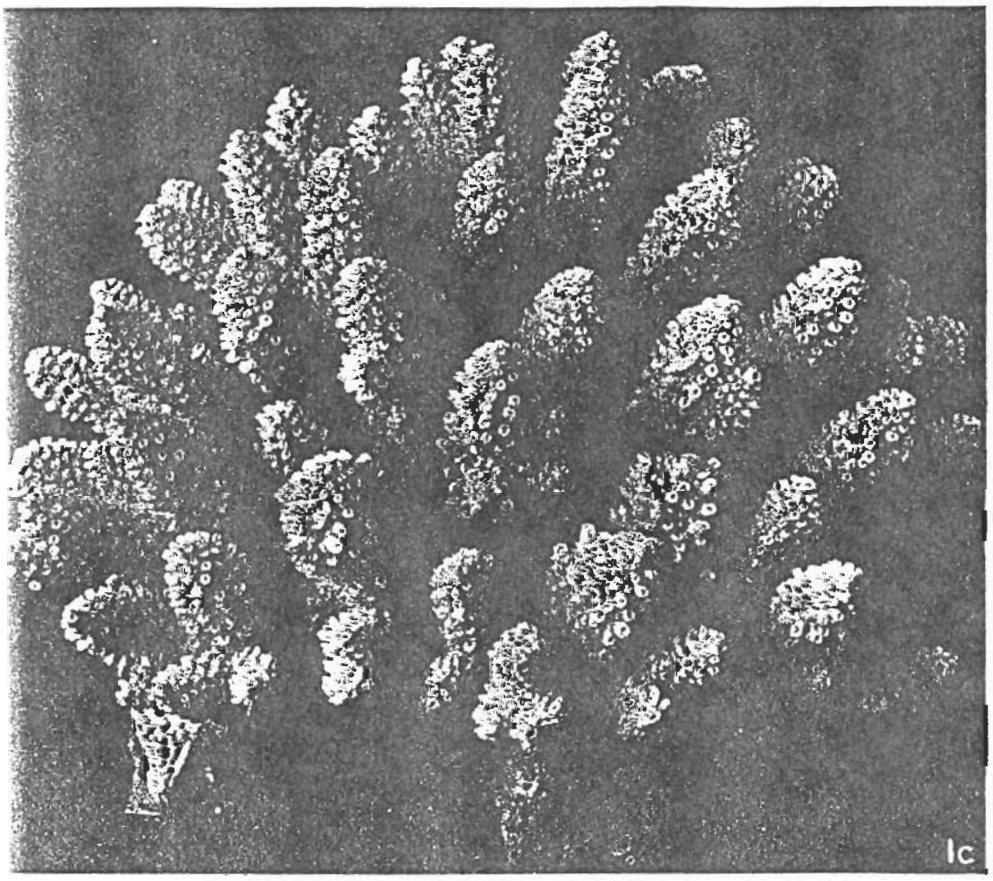


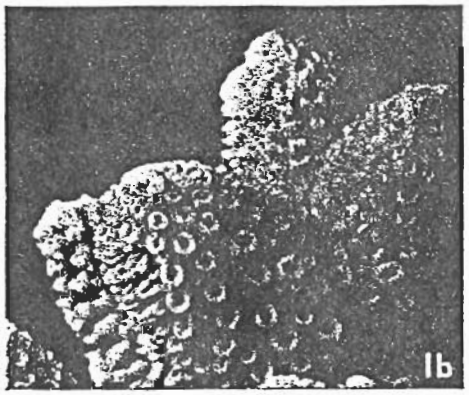
FIGS. 1*a*, 1*b*. *Acropora latistella* (Brook). FIGS. 2*a*, 2*b*. *Acropora syringodes* (Brook).

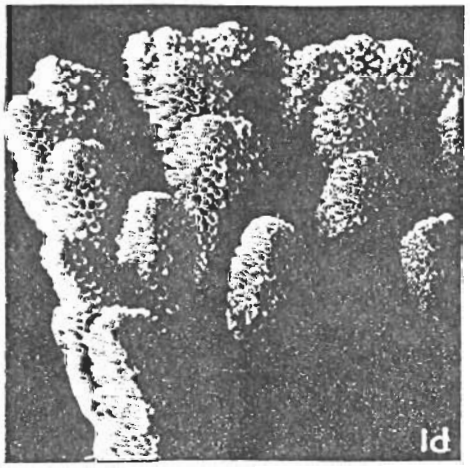


Acropora prolixa (Verrill).

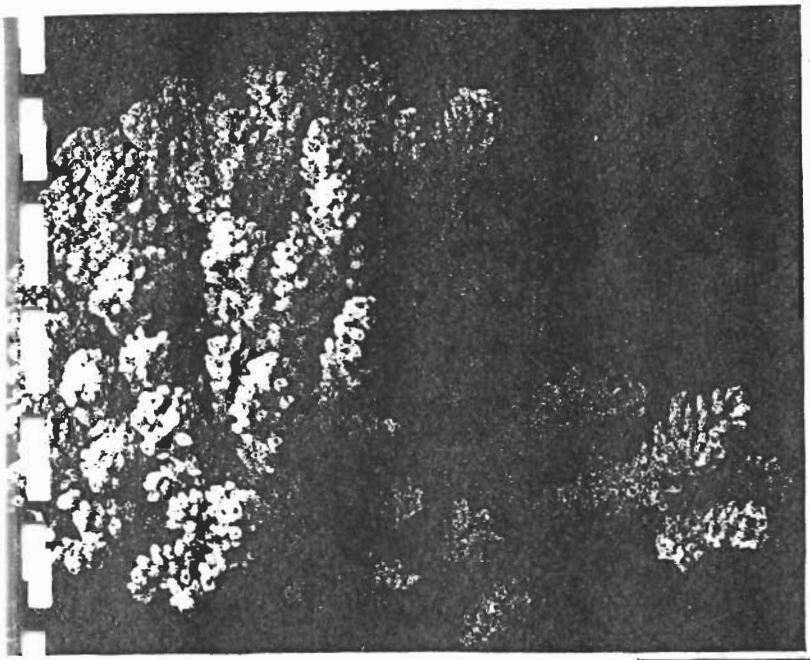


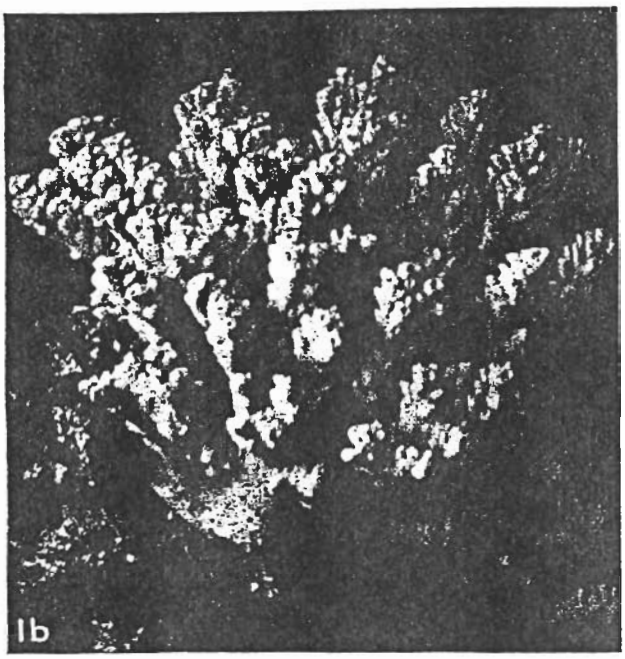


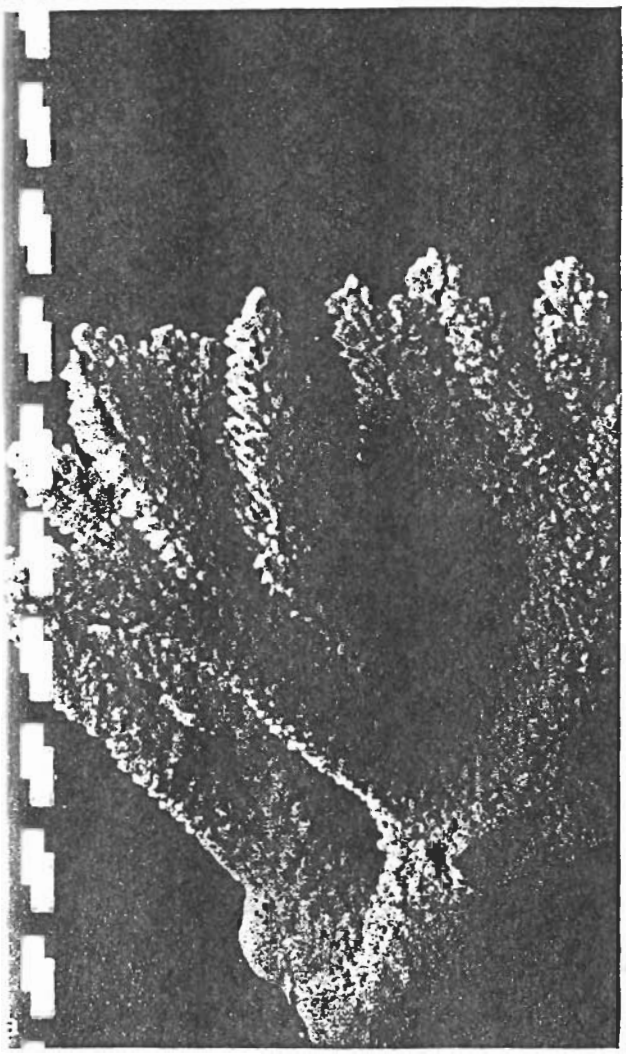


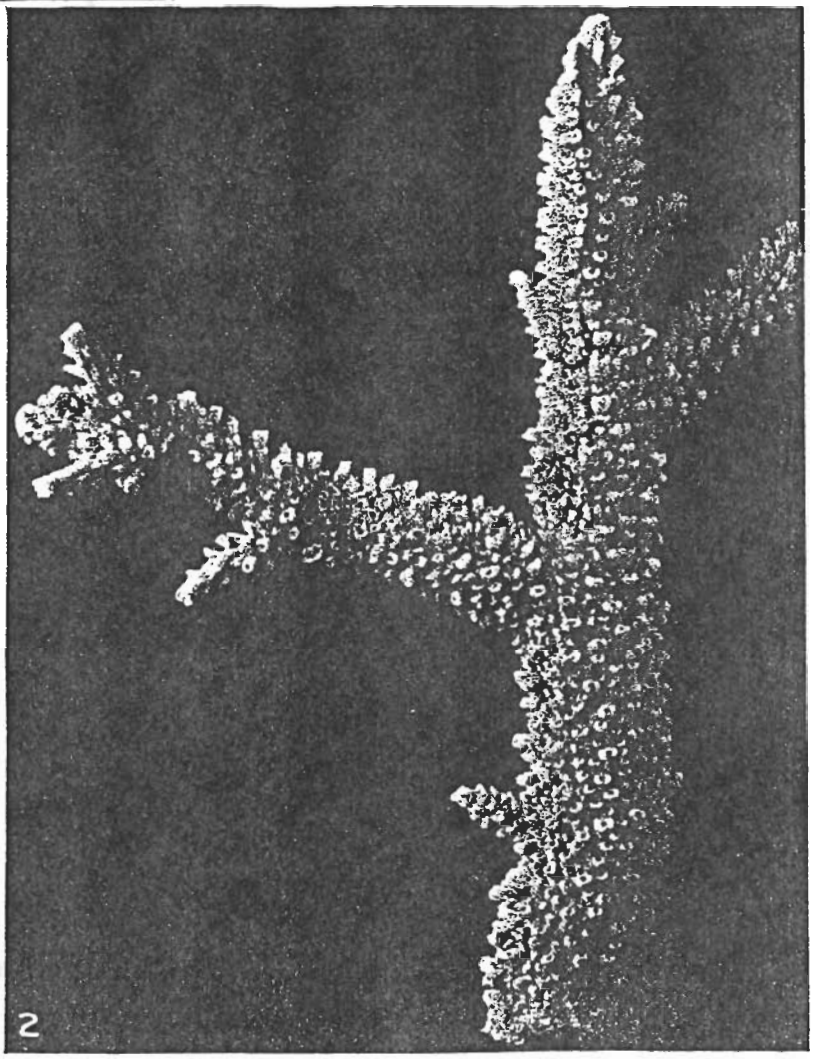


Acropora leptocyathus (Brook).

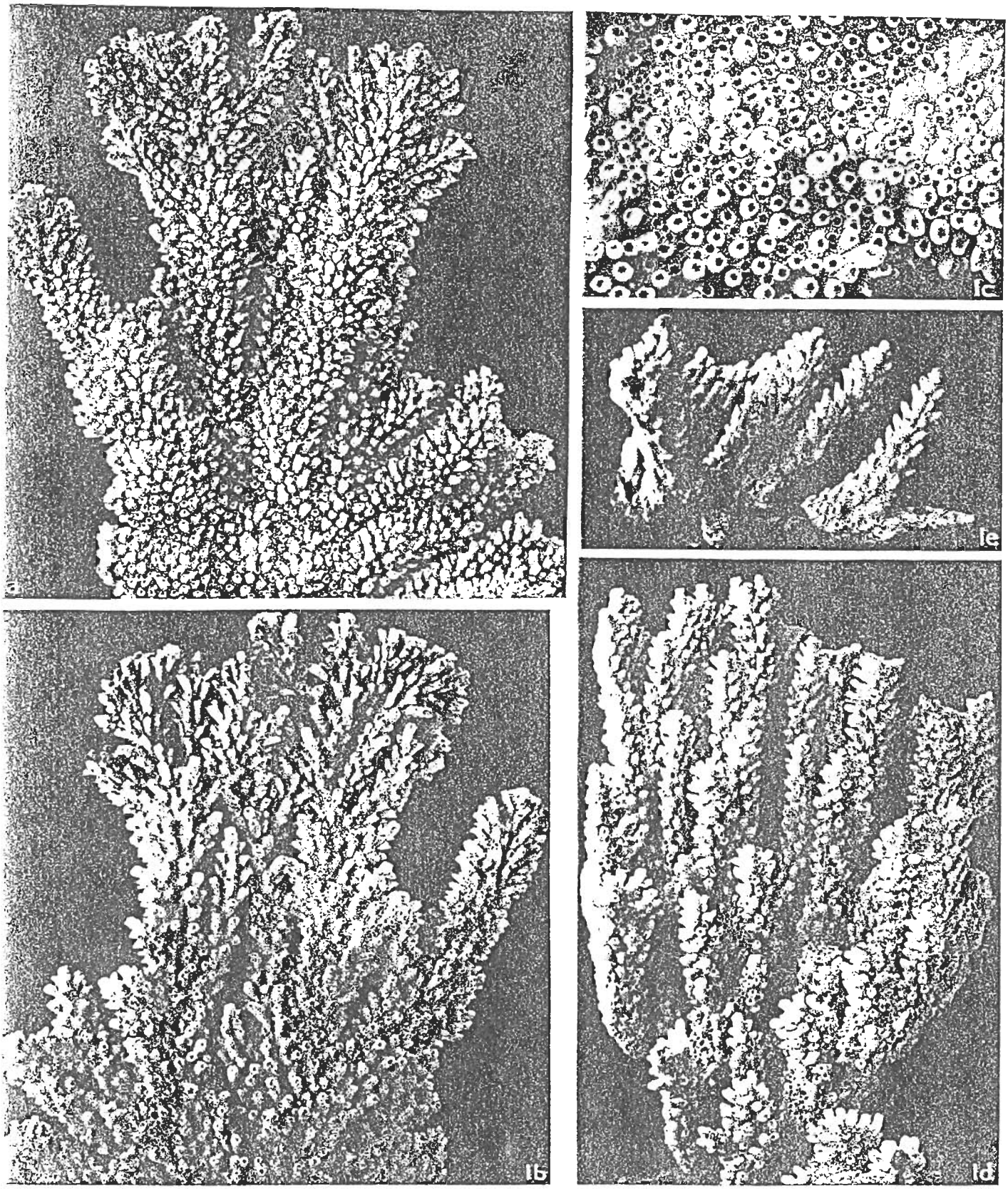




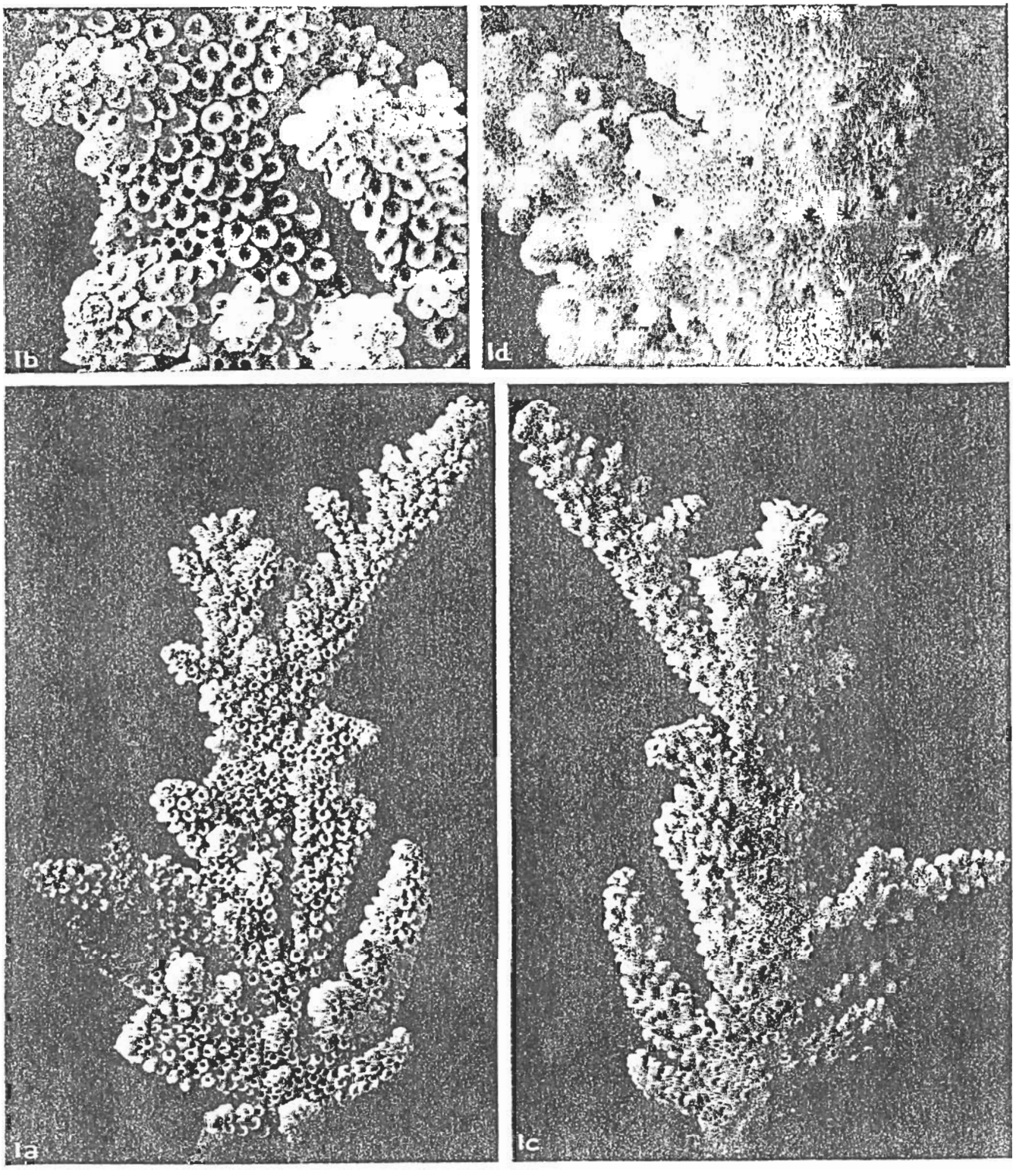




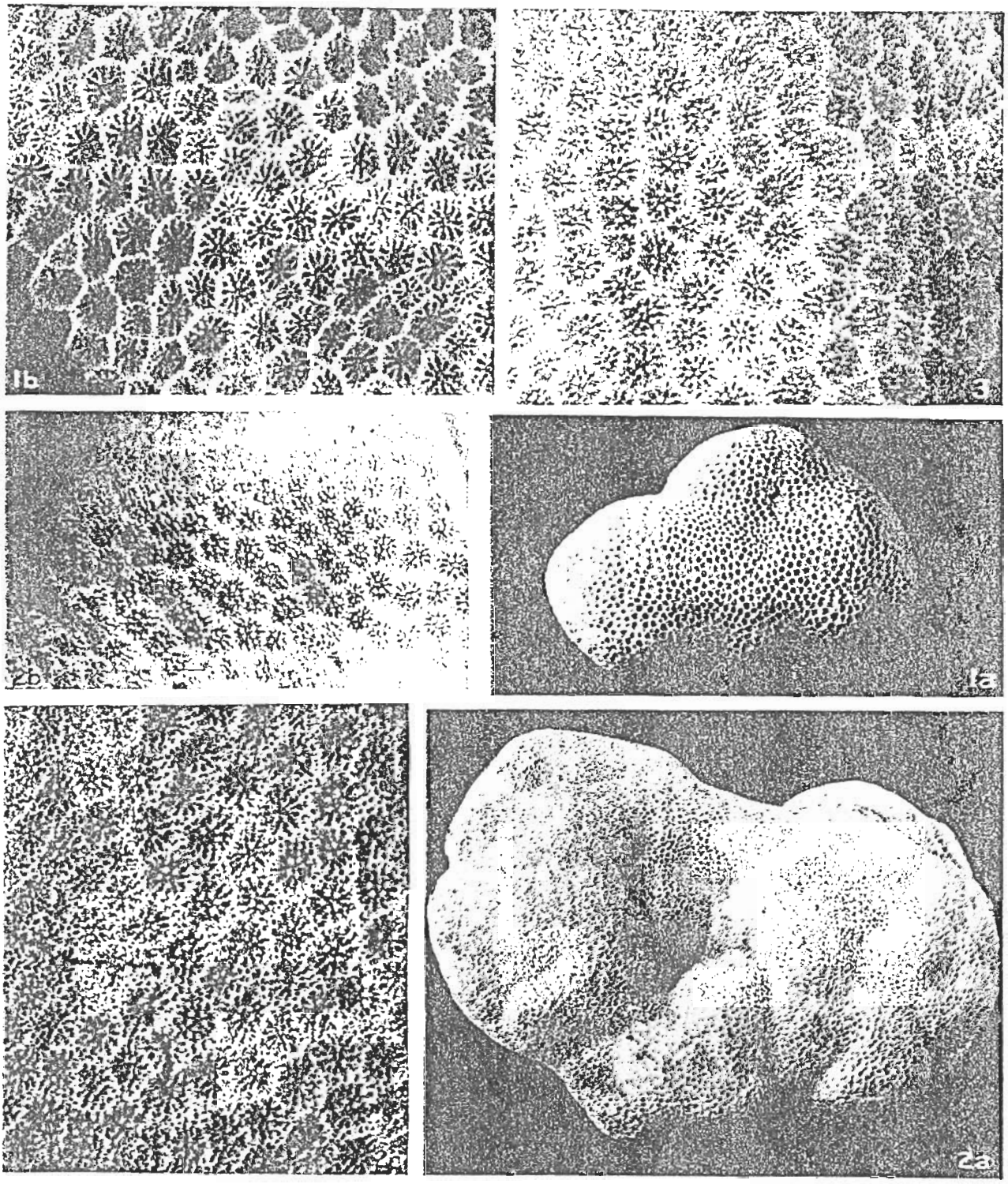
FIGS. 1*a*, 1*b*, 1*c*. *Acropora massawensis* von Marenzeller. FIG. 2. *Acropora vanderhorsti*, new species.



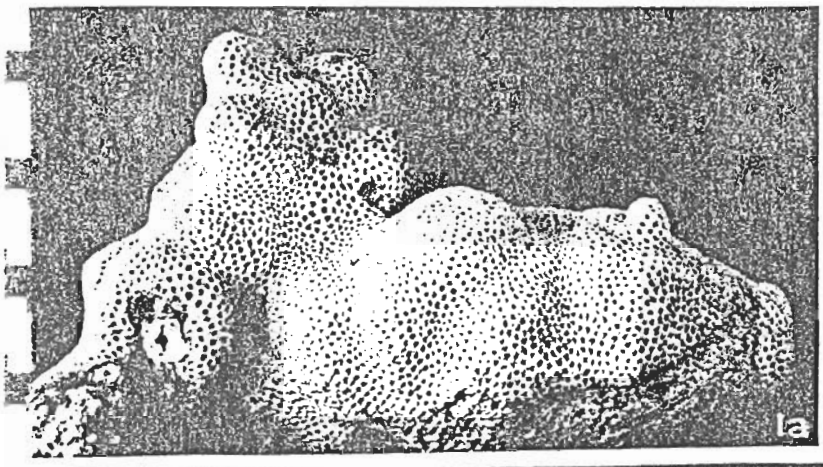
Acropora tutuilensis, new species.

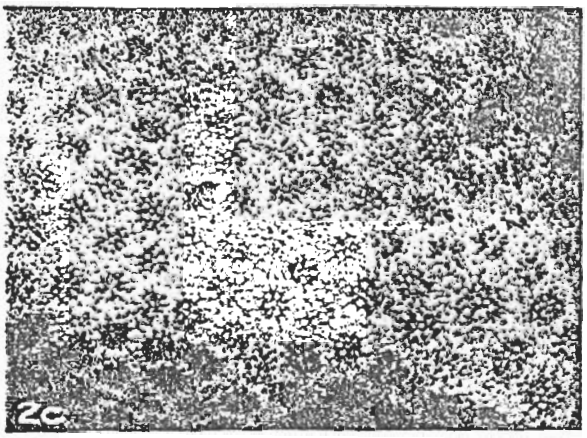


Acropora pagoensis, new species.



FIGS. 1a, 1b. *Porites lobata* forma *nodulosa*, new forma. FIGS. 2a, 2b, 2c. *Porites lobata* M. Edw. and H. FIG. 3. *Porites lutea* var. *laddi* Vaughan.





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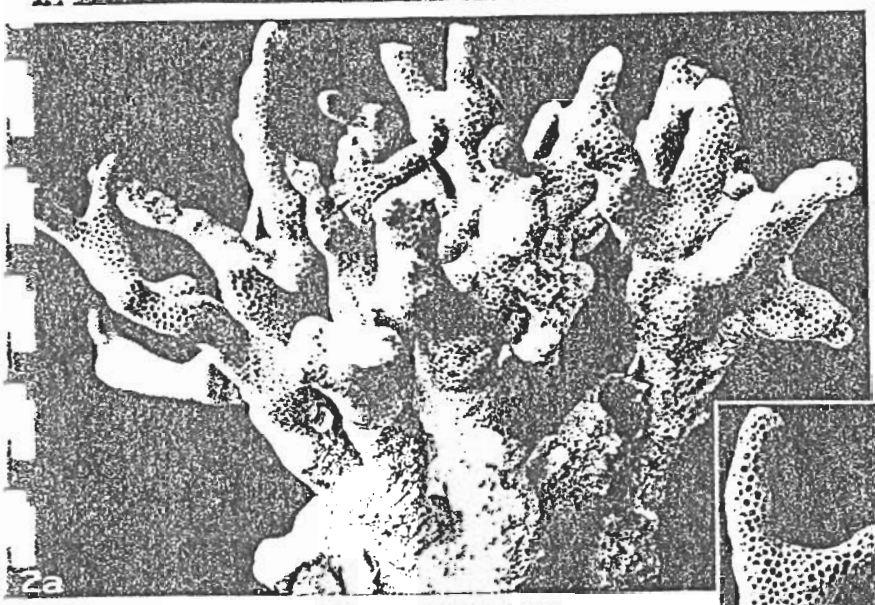

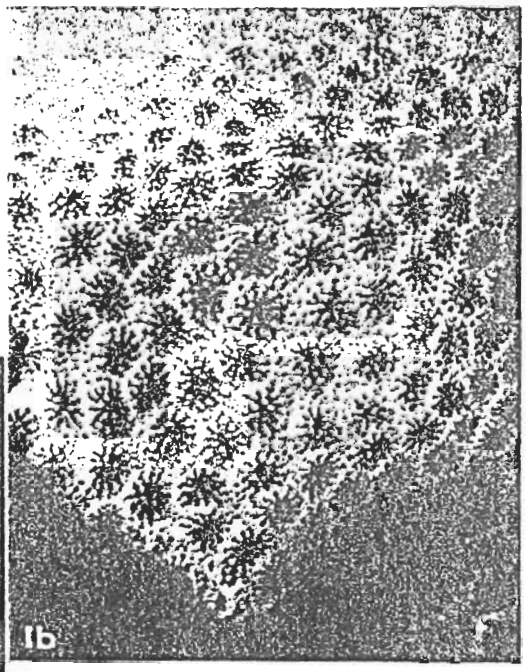

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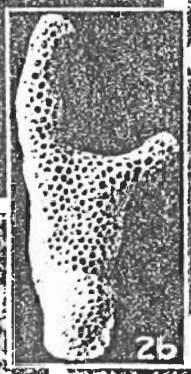
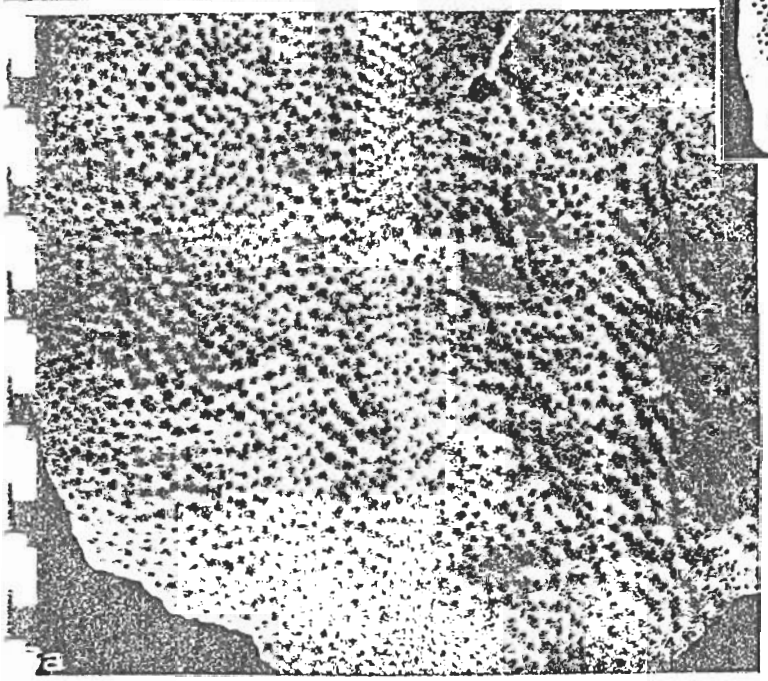
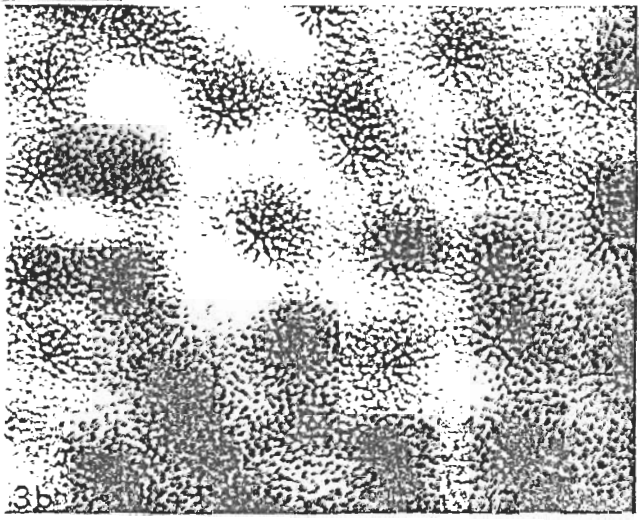
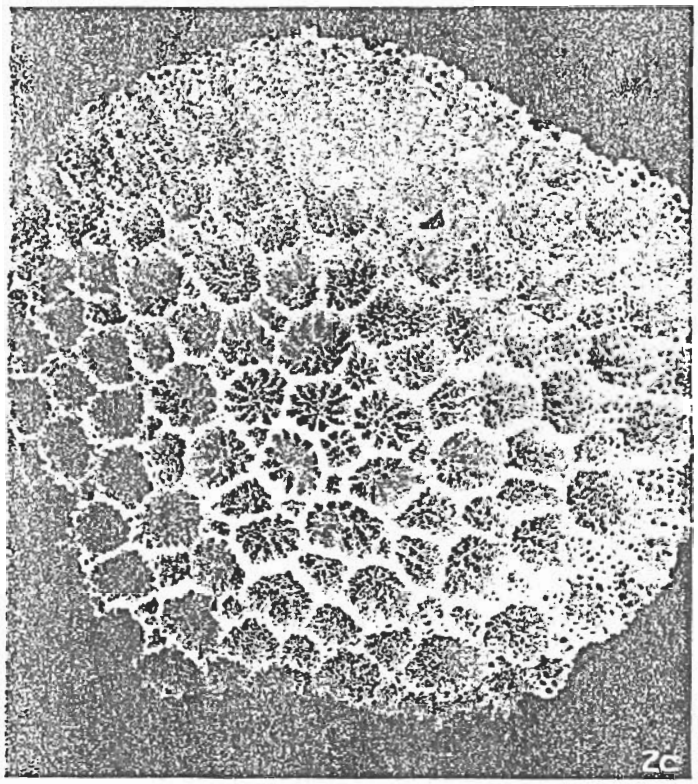


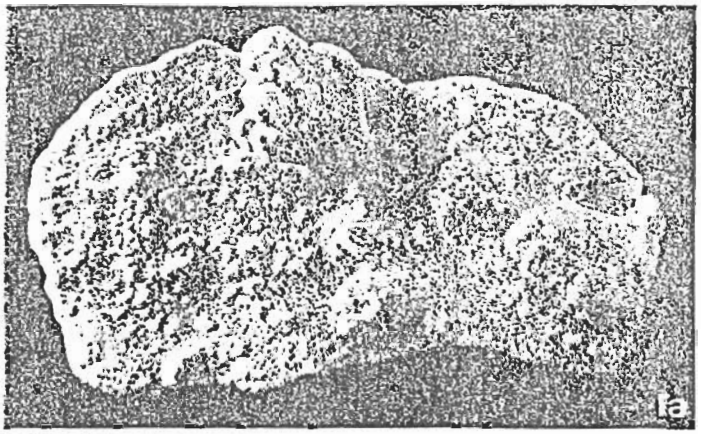


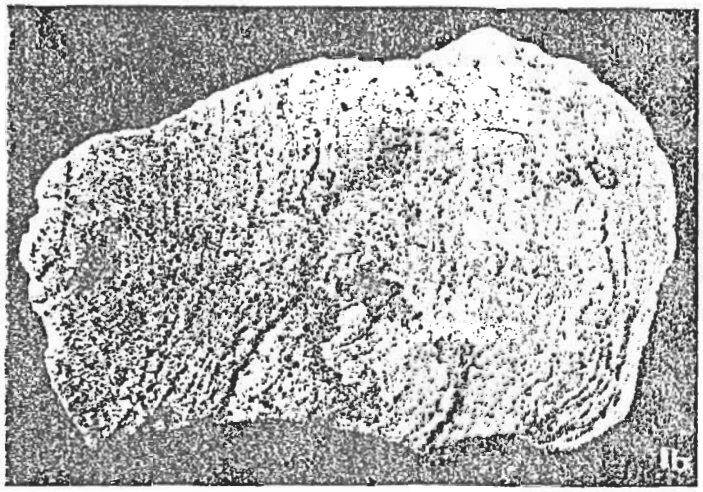


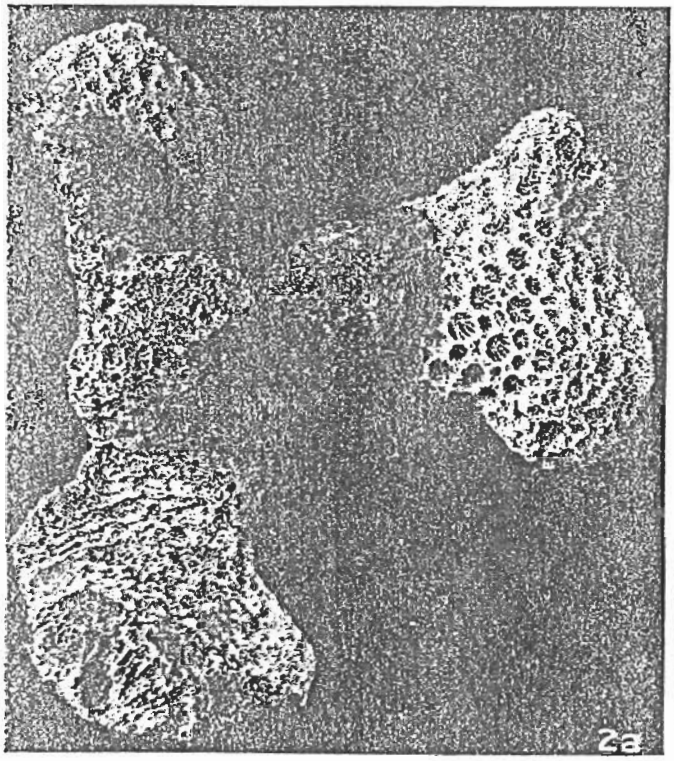
× 8.

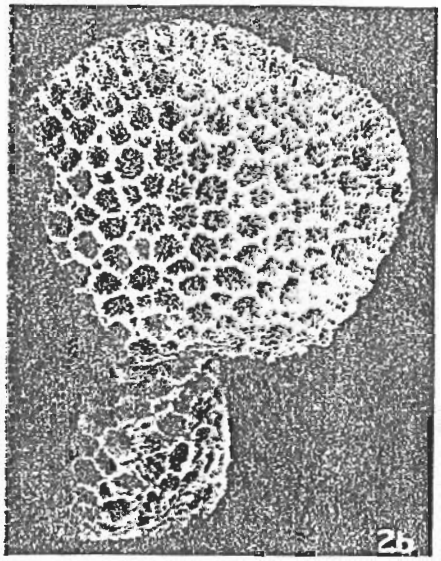
FIGS. 1a, 1b. *Porites murrayensis* Vaughan. FIGS. 2a, 2b, 2c. *Porites andrewsi* Vaughan.
FIGS. 3a, 3b. *Porites (Synarea) horizontalata*, new species.

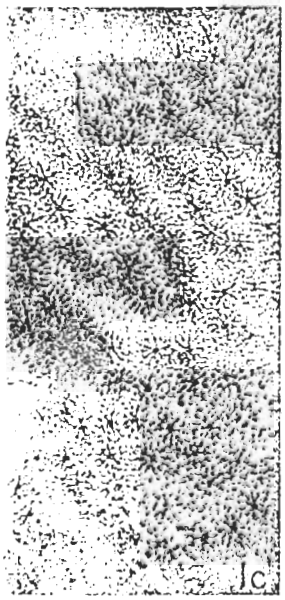












FIGS. 1a, 1b, 1c. *Porites (Synarea) faustinoi*, new species. FIGS. 2a, 2b, 2c. *Alveopora allingi*, new species.

INDEX.

This index includes the names of the higher groups and of the families, genera, species, varieties, and formae of Madreporaria mentioned in this publication. The valid names are listed in roman type and the synonyms in italic. When a species name follows a genus name that is synonymous with another genus name, both the genus and species names of the combination are italicized, even though the species name may be valid. The heavy-faced type used in the figures referring to the pages indicates that the descriptions may be found on those pages.

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