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Reef Corals of the South African Coast.

By the late

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With addenda by T. A. STEPHENSON.

With Plates V–XIV.

CONTENTS.

I. FOREWORD.

THIS paper was completed by Dr. Crossland in March, 1940, and his intention was to forward it to me for publication in the 'Natal Annals.' Copies were sent by him to Professor Stanley Gardiner and Dr. Boschma, but neither of them reached me, and it was not until 1946 that I was able, through the kindness of Dr. Kramp of the Copenhagen University Zoological Museum, to obtain a third copy which had remained there and had survived the German occupation. I have now edited the paper as regards certain details, such as checking the reference-numbers to the specimens mentioned, but it is otherwise as Crossland wrote it; and I have added a note on p. 176, at the end of the ecological section, which comments on Crossland's views in the light of my own South African experience. Students of coral classification should remember that the arrangement of genera and families used in this paper is necessarily out-of-date, as Crossland was not able to see the most recent literature, more particularly Vaughan and Wells' revision of the Scleractinia, which was published in 1943; and the ecological parts of the text reflect this fact.

T. A. STEPHENSON.

II. INTRODUCTION: THE CORAL FAUNA OF THE "MARGINAL BELTS."

During the ecological exploration of the coasts of South Africa, Professor T. A. Stephenson and his assistants of the University of Cape Town found considerable quantities of reef corals on the coast north and south of Durban, extending almost to 32° S.; *i.e.* a little farther south of the equator than Suez is north of it. Here tropical conditions are carried southwards by the

warm Agulhas current, and, as marine currents generally govern the land climates, it is interesting to know how far the land flora of Durban is tropical in its constituents. Professor Stephenson refers me to a book on the vegetation of South Africa by Prof. R. S. Adamson, published by the British Empire Vegetation Committee, London, 1938, which I have read with great interest, but a quotation from a letter from Professor Stephenson suffices for present purposes: "The picture is more tropical than subtropical, in spite of the latitude. On the land one gets *Ipomea Pes-capri* and *Scaevola Thunbergii*, hearty tropical forms'" (so familiar on tropical beaches from East Africa, all through the Indian Ocean to the Central Pacific, C. C.). "Coconut palms are present, but not very common, the two common palms being *Phoenix reclinata* and *Hyphaene crinita*. There is a good attempt at tropical forest where conditions are undisturbed, with many climbers and epiphytes. Two tropical trees which do well are *Strelitzia augusta* and *Poinziana regia*. In the mangrove areas *Avicennia* may be present" (it is the only mangrove in the Red Sea between lat. 15° 30′ N and Ghardaqa at 27° N, but this may be due to the absence of fresh water; the Pacific Islands east of Fiji are happily free of all mangroves.—C. C.) "but *Rhizophora* and *Bruguiera* are the commonest. *Barringtonia* is a characteristic form along the coast, often behind the mangroves, and *Hibiscus tiliaceus* (yellow flowers) is common by rivers, often with *Barringtonia*."[1] These are all circumtropical trees, the last being the well-known "purao" of the South Seas.

The three collections made by Professor Stephenson and his assistants I am certain give a complete picture of the coral fauna of Natal, which I have been interested to compare with my experience of the eastern marginal belt in the Pacific Marquesas Islands (1927, p. 542). Dr. T. Wayland Vaughan has given the faunas of the north and south Pacific margins, viz. Hawaii and the Kermadek Islands, the latter north-east of New Zealand, also in lat. 30° S.

In the Red Sea, coral growth dwindles in the Gulf of Suez. The fauna at Ghardaqa, just south of the entrance to the Gulf, is nearly complete, and growth is vigorous, though less so than in the central region, between Dongonab and Suakin, where, not only are the raised reefs larger and thicker, but living coral covers reef slopes completely as far down as can be seen, *i.e.* to 10 fathoms or more. Tor, near the south end of the Sinai peninsula, was the scene of Ehrenberg's well-known collection, and quite a number of species, without reef formation, occur at Moya Sukna and Ghubbet el Bus, not far south of Suez. The marginal belt begins several hundred miles south of Suez, and the isthmus is not its boundary, but cuts off its northern rim.

Yonge (1930, pp. 206–209) made a brief examination of the Capricorn Islands, which are distinctly south of the Great Barrier Reef in lat. 23° 30′ S, and concluded that "although detailed analysis of the coral population was

[1] Part of this information came direct from Professor Adamson.—T. A. S.

quite impossible in the short time, the impression gained was that there were rather fewer kinds of coral there than in the more northern regions, but that the growth of those that flourished there was no whit less luxuriant," and illustrates the fact by three plates. Possibly growth is slower. How far further south reef corals live, how rapidly they die out, what species first disappear and which survive the longest, remain unknown. Hedley (1925, p. 149) states that corals grow vigorously near Moreton Bay, 27° 50′ S. He examined a bank at Pearl Island, and hoped to describe it in the future.

The present collection, then, gives the only information we have of the dying-out of a coral fauna on a continuous continental coast, but here also the steps of the process can be given only incompletely (see table on p. 180). Even the tropical fauna of the western Indian Ocean is not at all fully known. Gardiner's collections are from oceanic islands, where the fauna is generally less rich ; Stuhlman's collection from Zanzibar, listed by Marenzeller (1901), contains only 51 species, of which *Favites* (*Goniastrea*) *halicora* is the only one represented in the Durban collection—a somewhat strange result, since all the Durban corals but the three new species are of wide distribution in the Indian Ocean. Stuhlman's collection should be re-examined and completed. Matthai (1924) found in the Indian Museum 30 genera and 90 species of the families Astræidæ and Fungiidæ, to which nearly 600 hard coralla have been assigned. Of these only 17 specimens, of 3 genera and 4 species, are from the western side of the Indian Ocean (Mauritius and Rodriguez), 7 specimens from Ceylon, and the rest from the eastern archipelagoes. No single locality has been thoroughly collected, and of 183 specimens the origin is unknown. The following of these species are found at Durban : *Leptastrea roissyana*, *Favia favus* (probably ; see under *F. magnistellata*), *Favites abdita*, *F. pentagona*, *F. halicora* and *Psammocora profundicella*.

The characteristics of the faunas of these marginal belts are as follows :

I. Hawaii.—Of the 129 species recorded and described by Vaughan (1907) only thirty are reef-corals. They were collected mostly from the large islands at the south-eastern end of the group, around 20° N, the reefs and islets to the north-west being represented only by 9 species from Laysan Atoll, about the middle of the line, at 25° 40′ N. There is at present little or no reef building in the group, the existing reefs being now in decay. Of the Imperforata the genus *Pocillopora* is the most important, *Leptastrea* and *Cyphastrea* are common, and there are two doubtful records of *Favia*. The Fungiidæ are fairly well represented, the free forms by two species of *Fungia*, the fixed ones by *Pavona* and *Psammocora ;* but there is nc leafy species of the former. Of the Perforata only *Montipora* and *Porites* have any importance. The latter genus has 9 species, of which 5 are new, and there are many varieties. As I believe is the case in the Pacific Marquesas and in Tahaiti, this genus would seem to be evolving locally. Of *Acropora* there is only one record, and that is more than doubtful. Neither Edmondson (1928) nor any other collector

has found it, and Verrill reports that corals are brought in quantities from other Pacific Islands for sale in the curio shops of Honolulu (' Trans. Connect. Acad.,' Vol. ii, 1901–3, p. 211). The absence of *Millepora* is remarkable. It is not recorded by Vaughan or Edmondson, and Yonge, in a letter, remarks on the strangeness of its absence.

II. Fanning Island is an isolated island on the edge of the archipelagoes of the west Pacific, though a degree west of Tahaiti (4° N, 159° 40′ W). Mr. Elschner's collection, described by Vaughan (1918, p. 64) is obviously incomplete ; of the 28 species named, seven of the Imperforata do not occur in Tahaiti. What evidence there is, therefore, shows that Fanning Island is well within the marginal belt, and, in spite of its isolation, the fauna is probably richer than in Tahaiti, and therefore, the progressive impoverishmant of the fauna as one passes eastwards into the ocean from Fiji, through Samoa to Tahaiti, is not due solely to the isolation of those islands. The fact that the coral *Cœloria*, absent from Tahaiti, is found in the Tuamotu Atolls, still further eastwards, I have already remarked (1928, p. 719).

III. The Marquesas Islands lie round 10° S and 140° W. Their coral fauna is greatly restricted, largely by physical conditions, but mainly by their position with regard to ocean currents. It is to be noted that the north-western group is distinctly richer, both in species and in quantity, than is the south-eastern, and only in the former are there any coral accumulations, which, however, can hardly be called reefs. The writer spent six weeks examining the coral fauna round most of the islands, but was unable to bring away a collection. *Pocillopora* and *Porites* are again the principal genera, five species of the former and three of the latter, two of which form large masses in the north-western islands ; and in these islands only, *Montipora* is abundant in certain places. Fungiidæ are rare, *Psammocora gonagra* occurs as nodules, *Pavona varians* was seen once, and there was one group of four small specimens of a *Fungia*. *Millepora* is generally abundant as an incrustation, but in favourable situations grows up into the form *truncata*, or as large masses of plates joined like gigantic honeycombs.

The shore recalls that of Isipingo (near Durban), with similar shelves with pools between tidemarks, the whole coast, even in the bays, affected by the surf. There are similar great sheets of a slate-coloured *Palythoa* with bright green tentacles, a dull yellow form with larger polyps being also abundant ; but there are few weeds of any kind. Corals in the Marquesas extend below low water of springs for a fathom or two, which does not seem to be the case near Durban, where apparently they are choked off by algæ. A difference worth recording is the absence from the Durban region of a crust of the calcareous tubes of a *Bispira* with lithothamnion and a minute *Vermetus*,[1] which in the Marquesas occupies every surface not otherwise covered.

[1] The small *Vermetus corallinaceus* appears in southern Natal, where it is sometimes locally abundant.—T. A. S.

In Natal the serpulid *Pomatoleios* makes continuous crusts in places, but apparently as a pure culture, as it does in Zanzibar, typically at higher levels.

IV. TAHAITI[1] is, of course, well within the marginal belt, but has a restricted fauna, and, at the present time, the reefs are receding. The Astreans are few in species and of small size, variable and degenerate in structure, but the Fungiidæ and Perforata, especially the genera *Pavona*, *Fungia*, *Montipora*, *Acropora* and *Porites*, are very well developed. The lagoons are striking for their growths of the Fungiidæ, free and fixed, and the violet and lilac-coloured cabbage-like masses of *Montipora*. Leafy *Pavona* in large colonies of several species and great masses of *Synaræa convexa* make the mass of most lagoon reefs, and smaller colonies of *Psammocora*, *Agaricia* and *Fungia*, with *Herpolitha limax* in its several forms, make the island specially rich in Fungiidæ. Species of *Pocillopora* abound near the shore, and show series of surf-affected forms which have been described as distinct species. On outer reefs the big branched *P. eydouxi* is often dominant, and may form considerable deposits on reefs and beaches. *Millepora* is common, its chief function being to form protective encrusting patches on the barrier edge in the actual surf.

V. THE KERMADEK ISLANDS, north-east of New Zealand, about 30° S and 178° W, have a fauna quite unlike the preceding. Oliver collected there under great difficulties, and only 8 species were obtained; but of these 4 genera are absent from the other localities, including Tahaiti. The collection must have been incomplete, since there is no *Acropora*, *Porites*, *Favia* (in the broad sense), no Fungiid of any genus, and no *Dendrophyllia*. I mention the last genus, which is no reef builder, as it is typical of all the marginal belts, *e.g.* it abounds near Panama as well as in the Marquesas, Tahaiti, etc., but strangely is not recorded from Murray Island. Several species occur on the Durban coast, though specimens have not reached me.

VI. SUMMARY.—In short, the most important respect in which the faunas of the marginal belts agree is in the absence, or almost absence, of the great reef builder, the genus *Acropora*, of which abundant growth, in many species, is the characteristic of all coral seas in the eastern hemisphere. Genera important as reef builders which are absent or poorly represented from all the localities under consideration are *Seriatopora*, *Stylophora* (small and not very common in Natal, exists as small crusts in Tahaiti), *Echinopora*, *Galaxea*, *Cœloria* (I have seen small examples from the Tuamotu Atolls), *Platygyra*, *Hydnophora*, *Lobophyllia* (rare and small in Tahaiti), *Favia* (and its subgenera), *Goniastrea* and *Cyphastrea*. On the positive side they agree in a relative abundance of *Pocillopora* in several species, and of *Porites*, which seems to evolve local species. The Durban coast is exceptional in that only one species of *Pocillopora* is known to occur, though that is one of the commoner

[1] I am now adopting this spelling as better representing the pronunciation of natives and old residents. In the old days when the usual spelling was "Otaheite" a missionary wrote to a friend that the name rhymes with "mighty."

corals ; and the apparent rarity and small size of *Porites* makes the fauna of this coast unique. In Table I a comparison is made of the faunas of four of the regions mentioned above.

III. THE ECOLOGY OF THE NATAL AND PONDOLAND COASTS.

The reef-corals extend a little beyond the border of Natal itself, at least as far as Port St. Johns in Pondoland (31° 37′ S). The conditions in Natal are most close to those of the Marquesas ; in both there are, at least in places, shore terraces with pools, much sharp sand and a heavy sea which penetrates into every bay. The shores of the Marquesas are of a hard volcanic rock and the sand less coarse, those of Natal often of sandstone, though, where dolerite occurs, as at Inyoni and Winkle Spruit, it is found that the zonation and general ecology are but slightly varied. For a general description and views of the coast see : 'Annals of the Natal Museum,' vol. ix, 1938 ; "A Sub-tropical Indian Ocean Shore," by Joyce Eyre and T. A. Stephenson. For a temperature chart see T. A. Stephenson, " The Constitution of the Intertidal Fauna and Flora of South Africa," Part I, 'Journ. Linn. Soc. Zool.,' vol. xl, 1939. The corals are mostly confined to pools and appear rarely to descend below low water of springs where, apparently, they are choked out by seaweeds and other organisms. A local peculiarity is the growth into thin crusts of species which, in coral seas, usually form knobs. This may be due to the nature of the substratum and absence of competition from other corals, but not to exposure to surf, since (for instance) Gardiner found various species of *Favites* (*Prionastrea*) (1904, p. 785), including those found in Natal, to be " a common reef builder, great masses on the outer slope to 15 f., small colonies on the reef flat even under the breakers." The occurrence of certain species as crusts has made their determination more difficult than usual. This is illustrated in the case of *F. pentagona* on Plate VI.

The distribution of the species in the present collection, in Natal and Pondoland, is shown in Table II ; and there are also included some records made by Professor Stephenson, but not supported by specimens. This table shows that of the 21 species recorded altogether, only *Anomastræa irregularis* and *Favia magnistellata* were seen at all six localities. The former is small and extraordinarily degenerate at most of them (in so far as it is represented in the collection), though fairly common ; the latter was nowhere common. Of the other species *Pocillopora damicornis* was seen at five localities, *Favites abdita* at four, *Stylophora erythræa* and *Symphyllia simplex* at three, the rest being occasional. As Professor Stephenson and his assistants were engaged upon an ecological survey, not merely collecting excursions, I take it that this represents real facts of local distribution, and indicates that for 15 species out of 21 the distribution is irregular, as would be expected where the chances of survival are small.

TABLE I.

	Hawaii. 9 genera, 30 species.	Marquesas. 7 genera, 13 species.	Tahaiti. 11 genera. Astreans and Perforata numerous.	Natal. 9 genera, 17 species.
POCILLOPORA	A principal constituent. *P. cæspitosa*. *P. ligulata*. *P. eydouxi ?* *P. meandrina*.	A principal constituent. Probably sp. No. 2. Probably sp. No. 1.	Abundant, dominant in places. *P. cæspitosa*. *P. eydouxi*. *P. meandrina*.	Fairly common, but only one species, *P. cæspitosa* (= *damicornis*).
CYPHASTREA	*C. ocellina*, a species not recorded elsewhere	—	*C. microphthalma*, in small crusts only	—
LEPTASTREA	Three species, probably variations of one, as in Tahaiti	—	Abundant, two species. Remarkable variation	Two species, not common
FAVIA (including FAVITES).	Two species, both degenerate and both doubtful records	—	Five species, none the same as those of Hawaii or Natal. Variation and degeneration	Five species, not common, widespread in the Indian Ocean
GONIASTREA	—	—	—	*G. seychellensis*, *G. columella* n.sp.
FUNGIA	*F. patella* and *F. scutaria*, both species of wide distribution	Only seen once	Abundant, Hawaiian species included	—
PSAMMOCORA	Three species, two being new	*P. gonagra*, rare	Common, including *P. gonagra* and *P. contigua*	*P. profundicella*
ANOMASTRÆA (if distinct from *Psammocora*)	—	—	—	Relatively abundant and widely distributed, but degenerating
PAVONA	*P. varians*, *P. duerdeni*. No leafy forms	*P. varians* very rare	The two Hawaiian species. Leafy forms very abundant	—
MONTIPORA	Four species	One species ; local	Several species very abundant	Only one specimen, not identified
ACROPORA	Absent (one doubtful record)	—	Abundant, many species	Only two species, rarely seen
PORITES	Abundant, nine species, 5 of them new, many varieties	Four species, locally abundant, some certainly new	Abundant. Possibly local evolution	Rare and small. Two species
MILLEPORA	Absent	Sometimes abundant	Abundant	Not recorded.

Only three of the previously known species are not recorded also from the Red Sea. Of these, two are now recorded from the Indian Ocean for the first time. The presence of coarse siliceous sand in the bases of nearly all the specimens, often in layers between encrusting growths, reaches its climax in the forms of *Acropora pectinata*, where broken shells and pebbles are embedded in the actual substance of the growing coral. These points indicate the struggle the corals have against adverse conditions, resembling somewhat those of the Marquesas islands. It seems to indicate that even in warmer climates no reef is likely to be formed by direct outgrowth from a shore, but by first forming banks on a shore platform of some depth (3–5 fathoms is indicated in Tahaiti). Quite irregular banks would be formed in the first place, and under their protection corals would colonize the partly sheltered shoreline.

Movement of coarse sand seems to be indicated along the whole coast, but is specially referred to in notes made by J. H. Day at Umpangazi, where corals " on the whole were scarce and were entirely confined to pools," but the locality is not one favourable to corals, as " large parts of this reef " (*i.e.* rock platform) " are covered by sand from time to time." Far the greater part of the specimens collected along the coast were taken from pools (where they would have the advantage not only of being always under water but of some shelter from the surf), the only definite reference to growth in the open is at Umhlali, where " most of the corals seen were, as at Isipingo, in pools, but in one place small colonies of *Anomastræa* occurred on an open wave-washed slope." The collection does not, of course, connect up with the full coral fauna which probably occurs in Portuguese East Africa, but gives a picture of its dying out in the south, which will be described further by Professor Stephenson in a forthcoming paper.

ADDITIONAL NOTES ON THE ECOLOGY OF THE NATAL CORALS.

By

T. A. Stephenson.

As I have personally visited five of the six districts from which the corals described in this paper were obtained, some of them more than once, I should like to add a few comments which will amplify the information presented by Crossland. The sixth district (Umpangazi) I was not able to see myself, but it was visited by J. H. Day on behalf of our survey ; it lies about 20 miles along the coast beyond St. Lucia Bay. The specimen of *Pocillopora* mentioned by Crossland as coming from St. Lucia Bay was a casual accession ; I cannot now remember who collected it and, as " there are no rocks on the shore at the estuary of St. Lucia Bay " (J. H. Day), it may have been merely washed up.

It is probable that Crossland supposed our collection of Natal corals to be

more complete than it actually is. It must be remembered that the object of our survey was to produce a preliminary general picture of the distribution of the common larger invertebrates and algæ along the coast, and that consequently, in the time available, no single group could be collected as intensively as we should have liked. Besides this, the corals are not one of the most important items, ecologically, in Natal. I think, therefore, that anyone who gave his whole attention to collecting corals there could easily find more species than we did, and it would be very interesting to carry out further work on them quantitatively. At the same time I think that, as Crossland assumes, our observations on the corals do represent the true state of affairs as far as they go : the picture they offer can be painted in fuller detail, but is probably correct in outline.

For the sake of completing the account given by Crossland, I append a summary of our own observations. A similar summary was given in a paper published since Crossland's death (' Ann. Natal Mus.,' vol. x, 1944), but the present version includes addenda not previously published, and comments referring to Crossland's account.

On p. 280 of the 1944 paper mentioned a list of Natal corals (as determined by Crossland) is given, which differs from the final determinations as shown in the present paper on three points which Crossland subsequently revised : (*a*) The species there named ? *Acropora nasuta* Dana was ultimately referred to by Crossland simply as *Acropora* sp. ; (*b*) the form there referred to as *Psammocora* sp. was finally included by Crossland under *P. profundicella ;* and (*c*) *Porites arenosa* was added to the list by Crossland subsequently. These changes leave the total number of species in the collection, as before, 21.

The features of the coral fauna of Natal are as follows :

1. Very few species seem to be really common, the most plentiful being probably *Anomastræa irregularis*, with *Pocillopora damicornis* and *Stylophora erythræa* perhaps next in importance. It is interesting to note that while *Pocillopora* is a general feature of the marginal belts of coral seas, as Crossland has noted, the prevalence of *Anomastræa* in Natal seems at first sight to be a feature special to the Natal coast. When we realize, however, that *Anomastræa irregularis* is a fixed Fungid closely related to the genus *Psammocora* and perhaps actually a member of it (see p. 193), the distinction seems less marked, as species of *Psammocora* are characteristic of other marginal regions. It is of further interest in this connection that at Isipingo itself (as distinct from the Natal coast as a whole) *Psammocora profundicella* was common in pools during our visits.

2. The total number of species present is small (despite the fact that the list here presented is probably incomplete) as compared with a healthy coral reef, and although most of them occur in relatively small numbers, several of them may form large colonies (*e.g. Favia dipsacea*, *Favites abdita*, *Leptastrea bottæ*, *L. purpurea*, *Symphyllia simplex*).

3. The apparent absences are remarkable, as Crossland has noted. Thus some of the most important reef-builders (*Acropora*, *Porites*, *Montipora*) are reduced, so far as our experience goes, to an occasional, rather small colony in Natal; and we have not been able to find any *free* Fungids. As far as *Acropora* is concerned this agrees well with other marginal regions, but for *Porites*, and in lesser degree for *Montipora*, it does not. Free Fungids are a variable quantity, but the apparent absence of species of *Fungia* from Natal is also noteworthy.

4. In some parts of Natal (*e.g.* Isipingo) there is a surprising number of species of simple corals, not belonging to reef-building genera, and occurring in caves, under overhangs, and in pools. Crossland does not deal with these at all in the present paper, nor has it yet been possible to get them identified. This is unfortunate, because they appear to be particularly interesting, and show a great variety of colours, such as bright blue, pale yellow, bluish black, pale pink and red. How many species are represented cannot yet be decided, but it is likely that there are more kinds at Isipingo than is at all usual between tidemarks. Speaking for the South African coast as a whole simple corals are not uncommon between tidemarks, but in our experience they belong, on the cooler parts of the coast (south and west coasts), to the genus *Balanophyllia*, which is represented by at least three species—*B. anneœ* from Still Bay, *B. bonœ spei* from East London and Oudekraal, and *B. capensis* from Cape Agulhas. In addition to these should perhaps be mentioned two species of the Corallimorpharia which, classified in the past sometimes as sea anemones and sometimes as corals, are now regarded as belonging to a separate group distinct from either. These are *Corynactis annulata*, which occurs intermittently at least from Port Nolloth to Mossel Bay, and is locally common; and the extraordinary species *Rhodactis rhodostoma*, which has a superficial resemblance to contracted polyps of *Lobophyllia*, but has no skeleton. This we have found only in a single pool at Isipingo.

5. Crossland has commented upon the important ecological feature that the reef-corals of Natal are largely confined to pools, having rarely been seen by us in other habitats. This is in strong contrast to the state of affairs on a typical coral reef, where a strong growth of corals on open rock is found in the sub-littoral fringe. The latter zone in Natal is commonly dominated by algæ. As a specific example of the mode of occurrence of the corals in the pools, it may be mentioned that a large deep pool at Umhlali contained a colony of *Favites abdita* about 3 feet in diameter; a colony of *Goniopora lobata* a foot across, with expanded polyps; a colony of *Symphyllia simplex* with green polyps; and another colony of a species of *Favia*. In another deep pool close by were colonies of *Favia magnistellata*, *Acropora pectinata* and *Anomastræa irregularis*.

6. The dying-out of reef-corals on the Pondoland coast has not yet, of course, been followed in detail. While we found some of them at Port St. Johns, none were seen at the two next stations to southward, the Haven and

Qolora River, and it is probable that they disappear finally within 50 miles of Port St. Johns. The tropical zoanthids so characteristic of Natal behave similarly. They seem to be more in evidence than the corals at Port St. Johns, but only one species (*Palythoa nelliæ*) was found at the Haven and none at Qolora. This disappearance of the corals and zoanthids is, of course, part of the general diminution of the warm-water component of the intertidal fauna, which, as we have already shown, takes place most rapidly on the stretch of coast between Port St. Johns and Qolora (1944, p. 278).

IV. SYSTEMATIC.

Family SERIATOPORIDÆ.

Vaughan (1918, p. 73) writes, "As I see no valid reason for referring *Seriatopora* and *Pocillopora* to different families, these genera are placed in the Seriatoporidæ, a name 20 years older than Verrill's Pocilloporidæ. While seriously doubting the propriety of placing *Stylophora* in a separate family, as the similarity between it and *Seriatopora* is great, I adhere to the traditional usage." In 1919[1] he wrote, "Additional study since that statement was written has convinced me that *Stylophora*, *Seriatopora* and *Pocillopora* all belong to the same family. In fact it seems that both *Seriatopora* and *Pocillopora* are derived from *Stylophora* mostly through retrogression in the development of the septa. It is hoped to present in a future paper the evidence on which this is based."

While nothing could be more distinct than the average *Pocillopora* and *Stylophora*, certain species of both are, in fact, closely related. The latter genus is remarkable for its styliform columella, but the same thing is found in certain species of *Pocillopora*, most species of which have only a trace of this structure (see Gardiner, 1898, pl. lvi; Vaughan, 1918, pl. xxiv, and 1907, pls. xiii and xxiv). These species have the verrucæ characteristic of *Pocillopora*, but verrucæ are absent or half developed in some forms of *P. damicornis*. In *Stylophora* on the other hand there are species in which the columella, over the whole or the greater part of the colony, is reduced to its condition in a normal *Pocillopora*. In fact the only differences between the two genera are the presence of verrucæ in the one and of hoods or arches over the calices in the other, both of which characters are not invariably found.

I find it therefore impossible to separate these three genera into distinct families.

Another fact which seems to have a bearing on these relationships is that all three genera, and no others, may be infested by the "gall"-forming crab *Hapalocarcinus*.

[1] 'Bull. U.S. Nat. Mus.,' vol. ciii, 1919, p. 333.

Table II.

Species.	Localities from north to south. St. Lucia and Umpangazi.	Umhlali.	Isipingo and district.	Umtwalumi.	Port Edward.	Port St. Johns.	Further distribution.
Pocillopora damicornis	+	+	+	+	?*	..	Red Sea, Indian Ocean atolls, Dar-es-Salaam, Ceylon, Mauritius, Pacific to Hawaii, Marquesas and Tahaiti.
Stylophora erythræa	..	+	..	+	+	..	Red Sea, Gulf of Aden, Philippines ?
Leptastrea purpurea	..	..	+	..	..	..	Red Sea, Indian Ocean atolls, Dar-es-Salaam, Ceylon, Pacific to Tahaiti, Paumotus and Hawaii.
L. bottæ	..	..	+	..	..	..	Red Sea, Indian Ocean atolls, Cocos Keeling, Philippines, Hawaii.
Favia magnistellata	?*	+	+	+*	+*	+*	Widely distributed in Red Sea and Indian Ocean.
F. dispacea	..	..	+	..	..	..	Red Sea ; only one previous record 114 years ago.
Favites abdita	+	+	+	+	..	..	Red Sea, Maldives, Malay region as far as Fiji and Samoa, but not Tahaiti. This is the first clear record from the east coast of Africa and Mauritius.†
F. halicora	+	..	..	+	..	..	Red Sea, Maldives, Zanzibar, Ceylon, Torres Straits to Samoa and Fanning Island, but not Tahaiti.
F. pentagona	..	..	+	..	..	..	Red Sea, Gulf of Aden, Maldives. Not from the Pacific.
Symphyllia simplex	+	+	+	..	..	..	..
Goniastrea seychellensis	..	+	+	..	..	..	Apparently widely distributed, but never common, in the Indian Ocean and Red Sea.
G. columella	+	..	..	..	..	..	..
Psammocora profundicella	+	..	+	..	..	..	Funafuti and Fanning Island ; Mauritius.† This is the first certain record from the Indian Ocean.
Anomastræa irregularis	+	+	+	+*	+*	+	Tropical East Africa only.
Porites solida	+	..	..	..	..	..	Red Sea, Cocos Keeling, Mauritius.† Probably abundant throughout the Indo-Pacific.
P. arenosa	..	..	..	+	..	..	Red Sea, Seychelles, Mauritius, Fiji, Funafuti.
Goniopora crassa	+	..	..	..	..	..	..
G. lobata	..	+	..	+*	..	..	Red Sea, Amboina (Dutch E. Indies).
Montipora sp.	..	..	+	..	..	..	..
Acropora pectinata	..	+	..	..	..	..	Great Barrier Reef to Samoa and Tahaiti. This is the first record from the Indian Ocean.
Acropora sp.	..	?	+	..	..	..	..
Number of species	10	10	13	8	4	2	

Genus *Stylophora*.

This genus is badly in need of revision, and, as in the case of *Pocillopora*, no satisfactory result is likely except from work, both observational and experimental, on the reefs, at such a station at Ghardaqa in the Red Sea. Marenzeller assumes, but offers no proof, that *S. pistillata—S. digitata* and *S. palmata—S. prostrata* and *S. sinaitica* are one species. That is to say that in Marenzeller's opinion, the development of the arch over the mouth of the calyx is of no value in the distinction of species. As the thickness and arrangement of branches may vary within very wide limits, the columella and septa may be conspicuous or practically absent, little remains upon which species could be founded. The difficulty is increased because little information about the variation of the columella and septa in different parts of the colony is given by authors, except Gardiner (1898).

Stylophora erythræa Marenz.

1906, p. 49, Taf. xxvii, figs. 100–105.

" The principal character of the species lies in the nearly equal height of borders of the calices and in their six small thin septa." As regards the last feature, an examination of Marenzeller's figures shows that in some cases the upper parts of the septa are thickened, but as a rule the border of the calyx is surrounded by a ring of spines of nearly equal size. In many cases these are more opaque than the cœnenchyme and so whiter, and make the border conspicuous ; in other parts of the same colony they are small and inconspicuous, but typically they are much larger than the spicules of the cœnenchyme, which indeed are microscopic and often practically absent. This may distinguish the species from *S. pistillata*.

The collection contains two fair-sized and one very small specimen, U 8 C from Umhlali, north of Durban ; M 12 D from Umtwalumi just south of it ; and some broken branches (WW 2 A) from Port Edward farther south again ; also W 10 J and W 13 A. The larger specimen U 8 C, apparently a flat branch of a large colony, is massive and heavy, but giving off short branches which are flattened and divide into two or three branches at their ends, both flattening and branching being in a plane at right-angles to the main mass. The rings of spines round the borders of the calices make them conspicuous all over the specimen. Six of these spines correspond to the six very thin and narrow septa ; the others are relics of a second cycle which has mostly disappeared. Within the calyx the septa may meet regularly in the centre, or may be quite irregular, though in all cases except the young calices at the tops of the branches bilateral symmetry is more marked than radial. There may be a very small pointed columella in the calices of the tops of the branches ;

elsewhere there is none, but for one small area near the base where the calices are shallow.

The remarkable arrangement of the septa can be described only by sketches. This is practically what is found in most species of *Pocillopora*, and illustrates Vaughan's remark that this genus is derived from *Stylophora* mostly through retrogression in the development of the septa. Specimen M 12 D consists of four sets of parallel flattened branches springing from a solid base. In this case the terminal branchlets are generally in the same plane as the rest. Teeth round the calyx borders generally much less conspicuous, in many places being nothing more at all than the upper ends of the septa, scarcely exsert and not spreading over the cœnenchyme as costæ. Near the base of the colony six septa meet quite regularly, and sometimes a small point represents the columella ; on the branches nothing can be made out in most of the deep thecæ except the very narrow septa on the walls and perhaps the directive septa below. As in the previous specimen, the spines on the cœnenchyme between calices are very minute, in places practically absent.

The fragments WW 2 A from Port Edward consist of irregular broken branches without bases, and two very small colonies. They are characterized by the emptiness of their calices ; even when these are quite shallow they show neither septa nor columella on their floors as a rule, though one small area on one of the specimens shows regularly meeting septa. Teeth at calyx borders conspicuous, between calices spaces nearly smooth, as the cœnenchymal teeth are so minute.

The other specimens from this place are very small colonies, each of a few slender slightly flattened branches up to 3 cm. high. These show marked differences in the calices on either side ; in an extreme case on one side they are empty or nearly so, or, if septa are visible, irregularly bilateral, on the other regular, the six thin delicate septa meeting a tiny point representing the columella.

The points on the cœnenchyme vary from very fine to comparatively coarse. None of the specimens in the collection shows any enlargement of the upper lip of the calices.

To give the distribution of the species is difficult, because its relations to *S. pistillata* and *S. danai* are not yet worked out. I have here a number of the latter from Singapore, and believe it to be distinct ; also a specimen from the Philippines which may either be this or *S. pistillata*. It is not recorded by subsequent workers under Marenzeller's name except by Gravier from the Gulf of Aden, nor do I find figures showing the characteristic calices and nearly smooth cœnenchyme.

It is thus, for the present, known only from the middle and southern parts of the Red Sea, from the Gulf of Aden and from Natal, possibly from the Philippines, though not recorded by Faustino. It was not seen in the Northern Red Sea by Ehrenberg, Klunzinger, Marenzeller or myself. Milne Edwards

and Haime record *S. palmata* from the Red Sea, the Seychelles and Cape of Good Hope. The species is quite different from ours, and the record from the Cape may be ignored.

Genus *Pocillopora.*

This genus is even more difficult than *Stylophora* on account of the even greater variability of its species. Apart from alterations due to conditions such as wave action, the most widely different forms connect with each other : of the numerous species described it is probable that no more than six are valid.

Owing to this flexibility, the genus offers excellent material for observation and experiment on the reefs. Examination of the polyps might also help ; though so far Gardiner finds that it has given no clues, it should be carried much further.

Pocillopora damicornis (Pallas).

This species is represented by 12 specimens, and is one of the commoner corals of the coast. Of these specimens, however, only three are normal bushy colonies, viz. the largest (DC 2) from Inyoni,[1] 14 cm. in diameter and 10 cm. high, one from Umtwalumi (M 12 E) 6 cm. across and 4 cm. high, and a worn fragment from St. Lucia Bay (LC 1). The rest are more or less deformed or small.

There are also two small bushy specimens from Souillac, Mauritius 199.

The specimens form a complete series from the typical bushy growths from Reunion (Natal) and Umtwalumi to an almost flat incrustation from Isipingo. Judging from similar series seen in Tahaiti, formed also by larger species, I have no hesitation in ascribing these striking modifications entirely to wave action, though species have been described as new which had a similar origin. Compare Wood Jones' observations on growth-forms of *P. bulbosa* growing in different positions on a floating tree-trunk, quoted by Vaughan (1918) ; but in this case the modifications were not due to water-movement alone, which would not be so greatly different at the sides and below the trunk, but also to light and deposition of sediment, both factors of great and, in this case unknown, importance.

From St. Lucia Bay, 28° S., come four worn pieces of a very much larger colony with thick branches and typical verrucæ. To ordinary observation these appear to be a very distinct species, and I can only refer to Vaughan, who includes them here ; see his pl. xxi, 1918, in which the bushy colonies are

[1] For the positions and descriptions of the localities mentioned in this paper, see Eyre and Stephenson, " A Sub-Tropical Indian Ocean Shore," ' Ann. Natal Mus.,' vol. ix, 1938, p. 21 ; Stephenson, " The Constitution of the Intertidal Fauna and Flora of S. Africa," Part II, ' Ann. Natal Mus.,' vol. x, 1944, p. 261 (see map on p. 264).

shown by fig. 3, while 3*a* resembles exactly the St. Lucia pieces ; and fig. 2 therefore gives an idea of what the whole colony was like.

(Material collected later at Umhlali, UU 3 H, is also *P. damicornis*.—T. A. S.)

It is desirable to be certain whether this species also occurs in Hawaii, where the genus is dominant ; Vaughan (1907) describing no fewer than seven species, two of which are new, with three new varieties. I agree with Hoffmeister (1925) that *P. cæspitosa* and *P. damicornis* are the same, and therefore the distribution of the species is over the whole Indo-Pacific, including the marginal belts, but this is the first record from the eastern side of the Indian Ocean. Ehrenberg's *P. favosa*, described and figured by Klunzinger from the Red Sea (1879, p. 68, pls. VII and VIII), is very likely the same.

Distribution through the whole Indo-Pacific, Red Sea, Hawaii, Marquesas and Tahaiti included.

Family FAVIIDÆ.

Genus *Leptastrea*.

Only two specimens are present, one of each species. Neither of them shows any of the degeneration characteristic of the Tahaitian series, in fact one, *L. bottæ*, is a peculiarly fine specimen, with calices larger than the normal. The form *L. ehrenbergana*, generally characteristic of wave-swept reefs, is not recorded from this wave *battered* coast.

Leptastrea purpurea (Dana), var. *roissyana*, M. E. and H.

One massive specimen (DC 16) from Isipingo forms a crust growing on a dead surface of the same species, from which it is separated in places by thin deposits of brown, apparently siliceous, sand. This upper crust is roughly triangular, 9·0 × 5·5 cm., 15 mm. thick on one side where it is broken, 1 or 2 mm. thick on the other. This is part of " a large expanse which covered the sides of a fairly shallow pool towards the inshore half of a lower platform. Flesh brownish mauve." The formation of large thin crusts like this is very exceptional, and is evidently an adaptation to conditions, as in Tahaiti, where similar extensive but thin crusts occurred on the floors of the Pa'ea lagoon (Crossland, ' P. Z. S.,' 1931, pp. 352 and 365), the usual knob-like forms being found only inshore or on the barrier edge where free from the rasp of sand. Dr. Eyre's reference to colour, " flesh brownish mauve," is interesting as being the first reference to a purplish colour since Dana gave the name " *purpurea*." All the many specimens handled by me in Tahaiti and the Red Sea were deeper or yellower shades of umber-brown.

Septa generally in three orders, in some larger calices four. Columella well developed, tuberculate ; ends of the septa may meet, or nearly meet,

over its surface ; in a few calices they meet without forming a columella ; but comparison with Matthai's and Vaughan's figures shows that there is no more degeneration than is general in the Indo-Pacific area. Compare the state of the species in Tahaiti (Crossland, 1931).

Distribution.—Red Sea, the Indian Ocean Atolls, Dar-es-Salaam, Ceylon, Pacific to Tahaiti, Paumotus and Hawaii.

Leptastrea bottæ (M. E. and H.).

Vaughan, 1918, p. 94 ; Matthai, as *L. solida*, 1914, p. 69.

One fine specimen (DC 5, Inyoni), of encrusting form, 16 × 12 cm., 2 cm. thick, was identified by Dr. Boschma (as *L. solida*), who remarks on its agreement with Matthai's fig. 6, pl. xviii. In this example, however, ordinary calices are 3 to 5 mm. in diameter, while giant calices are 6 to 8 mm., the averages therefore being higher than usual. They are generally round, very few having one or two more or less straight sides. Columella in all cases well developed.

This species, or variety, is generally much more rare than the others of the genus.

" Large sheets of this species in a fairly isolated pool high up on the rocky mass—all belonging to one colony."

Distribution.—Red Sea, Maldives and other Indian Ocean Atolls, Cocos Keeling, Philippines, Hawaii.

Genus *Favia.*

The species belonging to this genus in the collection are all of wide distribution, except that *F. dipsacea* is here recorded for the first time outside the Red Sea, from which it was described 114 years ago, and apparently has not been seen since.

Favia magnistellata M. E. and H.

Prionastrea magnistellata Gardiner, 1905, p. 788, pl. lxiv, figs. 40 and 41.
Favia favus, Matthai, 1914.
Favia favosa (E. and Sol.), Matthai, 1914 and 1924.

There is no doubt as to the identity of the specimen DC 6 with the species clearly described by Gardiner. Matthai (1914) gives Milne Edwards and Haime's species as a synonym of *F. favosa*, while placing Gardiner's specimens under *F. favus*. He doubts the distinctness of the two species in 1914, awaiting examination of the polyps of the former ; but keeps them apart in 1924, and gives six more figures of *F. favosa* (pls. i and ii). It is to be noted that pl. i is printed wrong side up, so that fig. 9 is really fig. 1, and so on. Matthai's synonymy of *F. favus* includes fourteen, and of *F. favosa* three different names

given by Milne Edwards and Haime alone, which illustrates the extreme difficulty of this species. Vaughan (1918, p. 101) writes, " Matthai's No. 20, *Favia favosa* (Ell. and Sol.), seems to be true *Favia* and close to *F. speciosa* (Dana), notwithstanding that he says new corallites are formed by unequal fission " (as in this specimen.—C. C.). " The name *favosa* is invalid for it. If it is not a synonym for a previously described species its name will be *magnistellata* M. E. and H." In any case it is impossible to know what Ellis and Solander's figure represents, their description is nil, and the type is lost. Their name therefore lapses.

In view of these difficulties I can find safe ground only in Gardiner's description and figures, and retain his name, though the species is identical also with one of the varieties of *F. favosa* described by Matthai in 1914 (p. 112, pl. xxviii, fig. 2). One of the distinctive features is the square-cut ends of the exsertions of the septa, but in some cases they are rounded ; in these specimens also the septa are very thin, and do not thicken in the walls, which is probably due to the southern habitat.

I refer also specimens U 15 E, DC 10 and DC 11 to this species, which vary through further thinning of the septa and consequent reduction of the columella, which in DC 10 and 11 hardly exists at all ; but as these are fragments of the edges of two large colonies this may not be a character of the wholes. In U 15 E the septa are extremely delicate, so that their exsert ends are often broken off. The columella is small, 2 or 3 mm. across, but distinct, as in DC 6 and Gardiner's specimens. DC 10 has thin discontinuous connections between exsert septa along the edge of the walls like Matthai's Red Sea specimen (1914, pl. xxviii, fig. 2), which gives a sharpness to the walls and hence a different appearance to the colony. DC 11 has broad walls and more arched septa, and is clearly Matthai's facies 1 (1924, p. 18) and corresponds well with his figures 2 and 9 on pl. ii. It has a distinct bud between four of the seven calices present.

Distribution.—The species is not common near Durban, but widely distributed in the Red Sea and Indian Ocean.

Favia dipsacea Aud. et Sav. 1825. Pl. V.

This Red Sea species has remained unrecognized for 114 years. It is represented in this collection by two fragments of a " large colony in a deep pool at seaward edge of a lower platform. Not seen elsewhere. Flesh brownish green." Number DC 4, Isipingo.

There has been much confusion over this species, its spiny exsert septa having been taken to resemble those of species of Milne Edwards and Haime's genus *Acanthastrea*. The descriptions of *A. dipsacea* of Quoy and Gaimard, of Ehrenberg and of Lamark are worthless, but it is also certain that their specimens come under *A. hirsuta* M. E. and H. (*A. echinata* Dana, according to

Vaughan). Milne Edwards and Haime (' Ann. Sci. Nat.,' vol. xii, p. 145) state that Lamark's *A. dipsacea* may be one of their *Acanthastrea* species, but they cannot be certain without the type, which is lost ; but Matthai (1914, p. 102) says that it is similar to *megalostoma* examples of *F. hirsuta*. In 1849 Edwards and Haime (p. 173) recognize that Audouin and Savigny's species is not an *Acanthastrea*, and change its name to *Parastrea savigni*, for reasons not stated, this becoming *Favia savigni* in 1857. Their description states, " Cloisons . . . très épaisse dans leur moitié extérieur," which is the reverse of true of Savigny's figure. Matthai (1914, p. 102) remarks that " if Klunzinger is correct in identifying it with *Acanthastrea hirsuta*, then the present species would be named *Favia dipsacea*." Klunzinger was mistaken, probably through distrust of Savigny's drawing, and through not having seen a specimen of *F. dipsacea*. It is certainly curious that Savigny should draw a species not seen by Ehrenberg, Klunzinger, Marenzeller, Gravier, or myself in the Red Sea, while omitting the more striking and not very rare *Acanthastrea echinata*. Savigny evidently made a selection of rarities, such as *Coscinaræa* as an example of a meandrine coral, *Astrea galaxea* (*Siderastrea radians*) which has not been seen since from the Red Sea, and others. Marenzeller and Vaughan identify *F. savigni* M. E. and H. with *F. clouei*, *F. ehrenbergi* and *F. versipora*, Matthai with *F. favus*, all species distinct from *F. dipsacea* in having " cloisons épaisses dans leur moitié extérieur." The relationship of the *Acanthastrea* group to *Lobophyllia* and its allies, indicated by Milne Edwards and Haime, followed by Vaughan, and implied by Matthai (1924), is shown by the structure of the septa and the spines they carry, the former being much swollen towards and in the walls, and the latter having thick hollow bases, which, in many cases, are all that remains after the coral has reached Europe, and show as black dots in illustrations. (For a complete specimen see Crossland, 1931, pl. xxi.) These spines appear to be special structures, not merely due to incision of the septum, as is so often the case, and appears to be so in *F. dipsacea*. The thickness and toughness of the flesh in *Acanthastrea* is another likeness to *Lobophyllia*.

Corallum encrusting or cushion shaped ; Savigny's specimen is the latter ; Stephenson's consists of two fragments, one 9 × 7 cm., 6 cm. thick, the other, from the edge, 6·5 × 4 cm., 2 cm. thick, the edge about 0·5 cm. thick, free for about 3 cm. and covered underneath by a wrinkled epitheca.[1] In spite of the thinness of septa, endothecal and perithecal dissepiments, they are numerous enough to make the corallum heavy.

Calices large, some perfectly round, others oval, internal diameter 8 to 12 mm., the largest, which are oval, 15 × 10 mm. Multiplication by equal division, but budding takes place in the spreading edge. There is no tendency to form valleys, as there is in *Acanthastrea*. Spaces between thecæ 4 to 10 mm., usually the former, and sometimes less. Peritheca spongy, smooth on surface,

[1] Compare *F. pentagona* below.

and flat between the calices, which are never in the least exsert. Septa numerous ; 24 to 33 are long, and reach, or nearly reach, the columella ; between these are rudimentary septa represented only by two or three spines, or a small plate. All septa remarkable for their thinness, and for never thickening near or over the wall, and for the long teeth they bear, not only within the calyx but on the costæ which connect the septa of adjacent calices. Inside or outside the thecæ the ends of the teeth are slightly thickened and spinulose. Within the calyx, at a depth of four or five millimetres they meet to form a loose, but well-developed columella, about a third the width of the calyx, with upturned spinulose papillæ.

There is some resemblance between this species and the preceding *F. magnistellata*, the larger and more widely separated calices of *F. dipsacea* not being, alone, of specific importance. The following features appear fundamental, in the latter :

(1) Septa thinner and more numerous, and almost all of the same length.

(2) Intermediate septa rudimentary and not continued over the walls.

(3) Teeth of septa the same length at the top of the wall as near the columella—a rare feature shared only by *Acanthastrea echinata* Dana and *F. halicora* (Ehr.).

Distribution.—Red Sea and Natal, in both places rare.

Genus *Favites.*

Favites pentagona (Esper). Pl. VI, lower figure.

Vaughan (1918, p. 112) says this is not *Favia pentagona* as described by Matthai in 1914.

One specimen, labelled DC 7, was given this name by Dr. Boschma. It is encrusting, part of a large colony, with a tendency to hillocks, measuring 16 × 10 cm., at one end 3 cm. thick ; at the other it thins out into a free sheet, covered above by costæ, below by an epitheca with rounded radial and flat circumferential lines.

I have seen and examined a number of specimens of this species at Ghardaqa in the Red Sea, but have seen none with this spreading edge, nor do I find an example in the literature. It would seem to be a peculiarity of this area, where the nature of the substratum is so different from that of a coral reef. On this edge-area multiplication, though really by marginal fission, has the appearance of being by budding, whereas on the main mass, as on the solid specimens at Ghardaqa, it is by marginal fission in the way characteristic of the genus, or sub-genus, *Favites.*

Not common ; the specimen collected came from a deep pool on the seaward edge of a lower platform at Isipingo.

Distribution.—Red Sea, Gulf of Aden, Maldives. Not reported from the Pacific.

Favites abdita (E. & S.).

Two larger specimens are certainly this species, though differing greatly in appearance owing to the thinner walls and septa of the Souillac specimen. U 8 A from Umhlali, north of Durban, is an irregular mass growing on a large *Vermetus* tube (not *V. gigas*), about 7 cm. across × 5 cm. high, with a spout-like projection at one end where lies the mouth of the tube. This is part of a colony about a yard in diameter in a deep tidal pool, presumably encrusting. The other is No. 218 from Souillac, Mauritius, a crust with small hillocks, the mere beginnings of the irregularities typical of the species, so well illustrated by Matthai, 1914, pl. xxxv. Only Gardiner (1898) has recorded that this species may grow to a large size ; it may be a yard or more across as well as high in the central Red Sea, though in the north (Ghardaqa) most specimens are small, only 9 inches or so in diameter. Vaughan (1918, p. 111) writes : " Some specimens of *F. halicora* have a most perplexing resemblance to some specimens of *F. abdita*, as Matthai has pointed out," I therefore identify DC 9 and DC 17 from Isipingo with some doubt as this species. They are very small, with thin walls and septa, colour recorded as brown and green (DC 9) like some of Gardiner's specimens. Presumably the green is the oral disc, which may or may not be green in this species, as in others seen in Ghardaqa and Tahaiti. The brown is usually nearly yellow, hence the synonyms (Matthai, 1918, p. 91) "*fusco-viridis*" and "*sulfurea*" of various authors. Dana calls it "*purpurea*," but so he did species of *Leptastrea* which are never anything but brown. His specimens were probably stained accidentally, for instance by being in the same jar of preservative as purple crinoids.

The following four specimens, DC 8, DC 17, M 12 A and G 11 D, I include in this species with some doubt. The tendency of all these Natal corals to form crusts instead of lumps on this coast has been referred to, and this adds to the difficulty, experienced also by Matthai and Vaughan, of distinguishing between certain variations of *F. abdita*, *F. halicora* and *F. pentagona*. These specimens are clearly distinguished from *F. halicora* by the fineness of the septal teeth, which do not increase in size at the margin of the calyx, and by the columella, which, like that of *F. abdita*, is formed of smooth flattish trabeculæ, the ends of which are pointed, often forked, and do not stand up vertically ; whereas in *F. halicora* the columella is covered with thick blunt spinulose ends standing vertically. They differ only from typical *F. abdita* in the thinness of their walls and regularity of the calices, only the two thicker specimens showing the merest traces of the irregularity characteristic of the species. The columella of my only specimen of *F. pentagona* is like that of *F. abdita*, only the trabecular ends differ slightly. These specimens recall Gardiner's (1904) description and figure of *F. robusta* Dana, of which I can find

no subsequent mention in the literature. The specimens given this name by Bedot (1907, pl. xxx) are typical *F. abdita*.

Distribution.—Red Sea, Maldives, Singapore, etc., as far as Fiji and Samoa in the Pacific, but not to Tahaiti. This is the first clear record from the east coast of Africa.

Favites halicora (Ehr.).

Matthai, 1914, p. 106, pl. xxvi, figs. 3, 5–7.
Vaughan, 1918, p. 111, pl. xli, figs. 1–3.

Specimens G 11 E and M 12 B from Umpangazi and Umtwalumi.

The species is generally easily distinguished by the characteristic septal teeth, as pointed out by Vaughan. "Within the calices, just below the top of the wall, are usually one or two prominent pointed teeth below which are shorter teeth and near the columella are longer teeth. The last may simulate a palar crown round the columella." This feature serves to distinguish the species from *F. abdita*, which otherwise some specimens resemble. It is shown in two of Matthai's four figures, if carefully looked for, clearly in one of Vaughan's three figures (which is quite like these specimens but for thicker walls), and hardly at all in Gardiner's two. In fact full-face views of corals rarely show the septa to advantage, and oblique ones would often be preferable. These large and thick upper teeth with the thick but narrow costæ, the walls being thinner in these specimens than in Matthai's fig. 1, give the coral a characteristic appearance, which is shown in Vaughan's fig. 1, and recalls that of *F. rotumana* Gardiner. In these specimens the columella also affords a marked distinction, which is not alluded to in published descriptions, from that of *F. abdita*, being covered with thick upstanding spinulate trabecular ends.

Distribution.—Red Sea, Maldives, Zanzibar, Ceylon, Torres Straits and out to Samoa and Fanning Island, but not Tahaiti.

Genus *Goniastrea*.

Goniastrea seychellensis M. E. and H. Pl. VI, upper figure.

Only one specimen, DC 18, Isipingo, "from a pool on a lower platform." After examination of Ehrenberg's and Milne Edwards' and Haime's types, with a large series in other collections, Matthai agrees with Klunzinger that *Astrea deformis* and *Prionastrea seychellensis* are the same, but awaits examination of the soft parts to decide whether the genus should be *Favia* or *Goniastrea*—"probably the latter." It is like the latter in its tendency to form valleys, in its septa and walls, but unlike it in its well-developed columella.

In this specimen the longest valley is 35 mm. long × 7 mm. wide, the

largest single calyx 25 mm. × 9 mm., the largest polygonal calyx 11 mm. across. Klunzinger's is the only illustration, and, as Matthai remarks (1914, p. 122) there is " a wide and interesting range of skeletal variation." I therefore give a photograph of the present specimen, which differs from Klunzinger's in having a better developed columella, and septa which are thin on the tops of the walls as well as within the calices.

(Further material of this species, UU 3 D, was later collected at Umhlali.—T. A. S.)

Distribution.—Apparently widely distributed but never common in the Indian Ocean. Collected also by Ehrenberg at Tor, near the south end of the Sinai Peninsula.

Goniastrea columella n. sp. Pl. VIII; Pl. X, upper figure.

G 11 C, a single specimen from Umpangazi, north of Durban, is quite anomalous, since this genus is defined as having the columella reduced or absent, whereas in this species the columella is well developed and of somewhat peculiar structure (hence the specific name). Multiplication of calices in *Goniastrea* is by subequal division, whereas in this form it is more frequently marginal. It resembles *Goniastrea* (*e.g. pectinata*) in its tendency to meander, the equal breadth of upper parts of the septa, and conspicuousness of palial lobes. In structure of columella and septa *G. seychellensis* connects *pectinata* to the more typical members of the genus; indeed a long series of specimens *might* bring the two species together. The present specimen is a thick crust, which would probably have become a dome by further growth, the portion collected measuring 9 × 8·5 cm., the whole colony probably 10 or 11 cm. across and about 2·5 cm. thick at its maximum. Calices up to 12 mm. long by 5 mm. broad without showing division; up to 14 mm., though there is no dividing wall, the columella forms two centres. As seen in the photograph, division is also frequently marginal. Walls fused, very thin (about ½ mm.), septa narrow and thin, meeting over walls, 1 mm. wide at top and for more than half-way down to the columella, at which point they broaden to about 2 mm. wide, forming the conspicuous palial lobes which are often, but not always, thicker than the upper parts of the septa. These lobes are sometimes the upper of a series of 2 or 3 teeth, but this has little or no morphological significance. The upper parts of the septa, with the costæ and upper sides of the palial lobes, are finely denticulate, but not nearly so finely as in *G. seychellensis*, and their sides bear slender tubercles rather than granulations, so that these parts of the septa have a characteristic appearance. Below the palial lobes the septa are smooth like the trabeculæ which form the columella. These are broad, horizontal, and end in two or three points which are also nearly horizontal. There is considerable fusion, and the resulting columella is large and dense, in the latter feature contrasting with that of *G. seychellensis*, which is otherwise somewhat similar, and in the others with most other species of Faviidæ, such as *F.*

ehrenbergi Klunzinger (taf. iii), which resembles this species in general appearance. Matthai includes this in *F. favus*, and all his 20 figures of this species show the usual form of narrow septal trabeculæ with upturned ends in the columella.

Family Mussidæ.

Genus *Symphyllia*.

This genus is practically *Lobophyllia* in which adjacent calices are fused. *Lobophyllia* is composed of a series of species differing in the extent of the valley-formation, and beginning with *L. corymbosa*, in which the calices contain but one centre. By analogy one would expect the same thing in *Symphyllia*, but, until now, forms with single calices have not been discovered. Matthai gives 16 figures of his four species, all showing long valleys, among which are found only one calyx with a simple mouth, two have two mouths, and three have three. Klunzinger's *Symphyllia* (*Isophyllia*) *erythræa* is simpler, containing simple thecæ, though valleys with two or three mouths are common. Matthai (1928, p. 236) takes small notice of this interesting species, merely stating that it is not an *Isophyllia* but more nearly related to *Favia hirsuta*, *i.e. Acanthastrea echinata*. That is so, since the genus *Acanthastrea* is closely allied to the *Mussa* group, as Matthai himself tacitly admits in 1924, on the explanation of plates iii and v, though he says nothing about it in the text. This species is also interesting as being the only record from the Red Sea, and it may be more than a coincidence that the two simplest forms, *S. erythræa* Klunz. and *S. simplex* about to be described, come from the two extremes of the coral area of the Indian Ocean.

Symphyllia simplex n. sp. Pl. VII.

The largest and best grown specimen, U 8 B, is from Umhlali, north of Durban, from a deep pool. This specimen is to be taken as the type, the others forming an extraordinary series degenerating into forms resembling *Favites vasta*, with which I had doubtfully identified them before the two larger specimens arrived. G 5 C is from Umpangazi, further north than Umhlali, and is a perfect intermediate between the type specimen and the degenerates from Isipingo and Inyoni near Durban, of which there are three examples, numbered DC 14, 1–3.

To describe the type specimen first (Pl. VII, upper figure), it is a crust of irregular outline, measuring 13·5 × 8·5 cm., but originally broader, consisting of 13 entire calices, apart from small dead ones at one side. The calices are extraordinarily variable in size (as in *S. erythræa*), mostly large, the largest 40 × 40 mm., another 45 × 22 mm., while the smallest is only 18 mm. each way. All are compressed and elongated, though none show more than one columella, and, in this specimen, none show the method of division. The underside shows a well-developed but thin and wrinkled epitheca, so thin that

it has disappeared in many places, exposing the costæ. The thecal walls are thin and fully fused; the septa are numerous, and thin for the size of the calices, 8–10 to the centimetre. Thickening over the walls is slight if present in the thinner septa, but is visible in the larger. They meet over the walls, where they are exsert to 3 mm., generally with a faint notch, but in one place these notches are conspicuous. The toothing of their edges is regular, and, as in all the members of this family, the teeth increase in size from below upwards, the largest teeth being on the sides of the exsert portions, where they are about 2 mm. long and triangular in shape. The septa slope fairly regularly to the columella, which is $\frac{1}{6}$ to $\frac{1}{4}$ of the diameter of the calyx, made of loosely overlapping trabeculæ which are round in section. Palial lobes are entirely lacking.

The differences from *S. erythræa* are obvious enough: (1) no di- or tristomodeal polyps; (2) thinness and number of septa; (3) relative absence of thickening of septa over walls; and (4) better development of the columella.

Specimen G 5 C (Pl. VII, right lower figure) is more massive in shape, measuring 95 × 65 mm., 40 mm. high. There are 20 calices, of which 12 cover most of the colony. All are of irregular shape; the largest (35 × 20 mm.) has 7 sides of different lengths; the smallest are 10 to 13 mm. across. The septa are still thinner than in U 8 B, and a little more numerous, 10–12 per centimetre, and they are narrower, so that the calyx is more open and bowl-like. Walls thinner, upper edges narrower, only 1–2 mm. This lightness of build gives the colony an appearance quite different from that of the type. Septal teeth at the angles where the septa pass over the walls not often prominent, at most 1 mm. long. Columella larger and denser than in type. On the stunted side of the colony where the smaller calices are, there is a tendency to breakdown of walls between adjacent calices, but nothing of the sort on the well-grown side.

No. DC 14, no. 1, has obviously grown under bad conditions, and has only one large calyx, 32 × 14 mm., the rest averaging 15 mm. across. Septa fewer than in the type, and thinner, so the calices are even more bowl-like, but the upper teeth are prominent. Columella fairly dense. DC 14, no. 2 is similar, but all the calices small, 10–20 mm. across, and half the colony dead. In all three DC 14 specimens the larger septa are prominent, and give an appearance of cyclical arrangement, which, however, will not stand examination. DC 14, no. 3 is extremely degenerate, and overgrown with coralline and nullipores. (Material of this species collected later at Umhlali is numbered UU 3 C and UU 3 G.—T. A. S.)

Family Fungiidæ.

Genus *Anomastræa* Marenzeller, 1901.

Pending Matthai's revision of the Fungiidæ I retain Marenzeller's genus, though it is evidently likely to be merged with the genera *Agaricia, Coscinaræa,*

Tichoseris, the Indo-Pacific species of *Siderastrea*, and possibly some of *Psammocora* ; it is also closely related to Ehrenberg's sub-genus *Polyastra* of *Pavona*, resuscitated by Wells. It comes nearest to *Coscinaræa*, *C. monile* being distinguished from *A. irregularis* mainly by the fact that in the former there are no definite walls, only a series of rather irregularly-placed synapticulæ, whereas walls are quite definite in *A. irregularis*. It would seem that, of these two nearly related species, one comes into Ehrenberg's sub-genus *Polyastra* while the other does not.

The chief distinction of *Anomastræa* is the heavily tuberculated columella, which tubercules are enlarged examples of the squarish close-set teeth of the septa. This feature is also found on a smaller scale in many calices of Horst's specimen of his *Siderastrea savignyana*, which is before me. Now no one has seen this species, originally named *Astrea galaxea* by Audouin, and well figured by Savigny, since their time. Horst's specimen is neither of the Red Sea species, and is possibly near to *Agaricia ponderosa* var. *minikoiensis* Gardiner, 1898. The genus is known only from the east coast of Africa.

Anomastræa irregularis Marenzeller. ('Ostafrikanische Steinkorallen,' 1901.)
Pl. IX ; Pl. X, lower figure.

The 22 specimens before me form an extraordinary series, few members of which could be recognized as belonging to this species were the series not complete ; and the least typical end-member is not, by itself, recognizable as a Fungiid of any sort.

Specimen G 5 H from Umpangazi, the northernmost station, is comparatively large and solid, a regular flat-cake 9 cm. in diameter and 2·5 cm. thick in the centre, edges blunt, about 1 cm. thick, specific gravity high. It is Marenzeller's *Anomastræa irregularis* exactly, except that the larger calices are only 4 mm. across, whereas in Marenzeller's specimen they are 4–7 mm. and also shallower. Along the edge of the colony the columella is less conspicuous.

Next follow 10 specimens, of which two (U 1 A and DC 13 D) are 5·5 cm. across, the rest only 2 or 3 cm. They are all encrusting, three of them as much as 2 to 3 cm. thick. In this set the walls are thinner, septa narrower and smoother along their edges, but bearing the characteristic squarish tubercles below and on the columella. Specimen U 1 A is from Umhlali, north of Durban ; the rest, labelled DC 13, are from Isipingo and Umhlanga Rocks, near Durban.

In all the remaining specimens this thinning of the walls and septa goes further, with reduction of the tubercles to fine teeth or mere spinules throughout, and, of course, this involves the columella, which sinks deeper and deeper into the calyx, becomes more and more irregular, and loses its tubercles also. DC 13 E, from Reunion, near Durban, shows this degeneration though it is a large specimen, 12·5 × 7 cm., and is thicker than any others, *viz.* 4·5 cm. on the broken side. This shows that the degeneration is not merely a feature of

immaturity. Thick tubercles are to be seen only on the columella, and only 1 to 6 there.

Seven examples labelled U 1 A 2, DC 13 A, J 4 C (3 specimens) and JJ 20 have deep irregular open calices, very narrow finely-toothed septa, and quite degenerate columellæ. One of the more regular of this series is shown on Pl. IX, lower figure. The less regular show a tendency more pronounced than in the preceding, to form short valleys. These are the most degenerate of all and the majority are from Port St. Johns, the southernmost point at which reef-corals were found, though other tropical species of other orders go somewhat further. These were the only corals collected there, and were locally common, though a *Favia*, possibly *F. magnistellata*, was seen. With this set comes the Copenhagen Museum specimen labelled by Professor Lutken (whose ability and understanding of corals are well shown in his arrangement of this museum) *Cœloria* (?) *Kraussii* n. sp., U.M. 58. It is quite unrecognizable as a member of this genus or indeed as a Fungiid, if examined apart from the above series. This specimen is illustrated in Pl. X, lower figure, and will now be described in detail. It was labelled by Professor Lutken " *Cœloria* (?) *Krausii*, n. sp., 58, syn. *Astrea deformis*. Natal. Mus. Stuttgart (Krauss)," but the name and description were never published. Corallum a small crust, 3·5 × 3·5 cm., about 1 cm. thick ; upper surface rather irregular, as is often the consequence of marginal fission. Calices small, very irregular in shape, up to 3 mm. in diameter, but the more elongated 1·5 to 2 mm. across, the longer 5 to 7 mm. long ; one is 10 mm. long, but is in process of dividing into three. Walls fused, very thin, $\frac{1}{4}$ to $\frac{1}{2}$ mm., but not perforated, and little, if at all, thicker below than at the rim. The cups therefore appear deep and open. The development of the septa differs greatly in different parts of the corallum : (1) At their best development they are narrow, but slope regularly down to a columella made of interlocking septal teeth with upturned ends. In some cases there is little or no fusion, and the columella is small and loose. It is often irregular in shape, and drawn out in the same direction as the calyx. Septa alternate in size and meet over the walls, sometimes large meet large and small meet small in the next calyx, sometimes large meet small. Though thin, they are numerous enough almost to fill the calyx, the spaces between them being about as wide as the septa. Septal edges regularly toothed throughout their length ; teeth long and flat, with spinulose ends, longer near the columella. Costæ on tops of walls with very small teeth. Only about 10 to 13 septa reach the columella, the remaining long ones fusing to the sides of these, the shortest ending freely. In the narrow angles of the calices 6 septa may form a bunch with one which reaches the columella. (2) Septa fewer and thinner, upper parts narrower and dropping vertically, so that the theca appears still more open ; columella very loose or rudimentary. (3) Septa remain normal on tops of walls, but within many become mere slender ridges, or rows of small teeth ; a few may bear teeth nearly reaching the centre, but there is no

columella, so that these thecæ are like holes in the corallum, more or less interrupted by remains of septa.

Number DC 12, from Umhlanga near Durban, appeared at first to be a different, if allied, species, having small shallow calices, all about the same size (about 3 mm. across), giving a smooth regular appearance to the colony, different from that of the others. The finely-toothed septa pass over the top of the columella, which may bear one or two small points only, but the most striking feature is the paliform vertical projections borne by the septa at the point where several meet outside the columella. In a reduced form these paliform lobes are found in one of the specimens numbered DC 13.

The only case of degeneration with which this can be compared is that of *Leptastrea purpurea* as described by me from Tahaiti; but it is to be noted that in Tahaiti no Fungiid shows degeneration, and in Natal the only specimens of *Leptastrea* are very well grown. Dr. Boschma agreed in relating these specimens to *Anomastræa*, though he had not seen the intermediate forms which were collected later.

Distribution.—Tropical East Africa only.

Genus *Psammocora.*

Psammocora profundicella Gardiner, 1898.

For this species use Gardiner's description, adding Vaughan's figures (1918, pl. lix, figs. 4, 4*a*).

I place all the 8 specimens of *Psammocora*, in spite of large differences, in this species, after much deliberation.

They are all from Isipingo, Reunion and Inyoni Rocks (DC 1), near Durban except one from Souillac, Mauritius (No. 223) and one from Umpangazi, north of Durban (G 5 J). It is very common at Isipingo in large pools on the seaward edge of the lower platforms, and in shallower pools more inshore. Flesh mauvish brown. The specimen from Mauritius is quite typical, a loose nodule 7·5 cm. maximum diameter, more irregular in shape than Vaughan's specimen (Gardiner does not figure a whole colony). The Natal specimens are all attached, as would be expected in localities not sheltered by reefs. Five are larger than the above, the largest being a solid crust 10 × 10 cm., 4 cm. thick where it is broken across, showing a solid heavy section; probably only half the colony is here.

The variations are:

(1) Typical form from Mauritius. To the naked eye characterized by crisply outlined polygonal calices, generally single, but a few valleys do occur.

(2) DC 1 B, Isipingo, has the smoothest outline of all, and is in marked contrast to the hummocky growth of No. 1. The lowness and bluntness of the walls and the looser structure of walls and septa alter the general appearance

very much, giving the surface a kind of out-of-focus appearance as compared with No. 1.

(3) Two specimens, DC 1 C, are similar to No. 2 over most of their surfaces, but on the tops of hummocks there are small areas similar to No. 1. They form, therefore, a complete connecting link between Nos. 1 and 2. To one side each colony becomes a thin crust, the calices become quite superficial, and all walls disappear. One corner of the largest corallum is infested by thin brown worm-tubes, but these have not caused the deformation described below.

(4) DC 1 D and G 5 J have grown into a crest- or ridge-like form upon which are long deep valleys crossing over the top. Otherwise DC 1 D is typical; but G 5 J has two other peculiarities, *viz.* the surface below the ridge bears a number of little sharp-angled outgrowths, not due, so far as can be seen, to external influences. The most interesting variation is on the steep side of the ridge (probably the underside of the colony in life—I imagine it to have grown on a vertical rock face, bracket-fashion), where there is simplification and thinning of the septa, distinctness and thinness of walls recalling the similar variations in the *Anomastræa* above described.

(5) Two specimens of DC 1 from Reunion (Natal) and Isipingo have been greatly deformed by parasitization by a polychæte worm, the tubes of which have stimulated the coral to grow into branches. Calices on the branches are entirely different from those on the thin crust below, in much the same way as in the Tahaitian examples of *Cyphastrea* and *Leptastrea* parasitized by the same or a similar worm ('Proc. Zool. Soc., 1931). Those on the "branches" have walls like those of *P. profundicella*; those on the flat are almost perfectly superficial and the general structure is much more solid, *i.e.* the spaces between the septa are narrow and the "cœnenchyme" (so called) between calices nearly solid.

Distribution.—Funafuti and Fanning Island, this being the first record from the Indian Ocean.

PERFORATA.

Family ACROPORIDÆ.

Genus *Acropora*.

This genus is now one of the chief, if not actually the principal reef builder, growing freely in sheltered water, but reaching its maximum vigour on the outer reefs, where the water is most pure. It is also able to modify its growth-forms so as to exist in the surf-floods of barrier reefs as described by me in 'Proc. Zool. Soc.,' 1928, p. 723, pl. ii, and 'Journ. Linn. Soc. Zool.,' 1939, pl. xii. It does not fossilize well, the hard stocks of corymbose forms alone being found in the recent raised reefs of the Red Sea, but evidently the fragile branches supply much of the sand which forms so large a proportion of the most solid-

looking reef. A very large number of species has been made, Brook's British Museum Catalogue, vol. i, containing 221. Unfortunately many species have not been figured, or not in detail, since Dana's time, and several authors have nothing to say about the septa. The influence of environment on form is little known, and what is attributed to environment is often deduced from museum series instead of based on observation on the reef. It is not certain that all species are affected in the same way.

The genus is the first to die out in the marginal belts ; two species occur on the Natal coast, but were seen only once each, and both are surf-swept forms of corymbose species. The enclosure in the corallum of both specimens of *Acropora pectinata* of broken shells and even small pebbles is striking evidence of the conditions under which these specimens lived, and is unique in my experience. Such inclusions are not found in the other species from Reunion, the form of which is modified in the same way, but not so greatly thickened.

Acropora pectinata Brook. Pl. XI, upper figure.

Brook, 1893, p. 95, pl. xxvii, D, E.
Vaughan, 1918, pl. lxxi, 5 figures.
Thiel, p. 120, pl. xiv, 4 figures.

I follow Vaughan in identifying this species with Brook's, as he has given the only figures of any value, and my two specimens, U 15 F from Umhlali, agree completely with his description and figures, the thickened stock being like his fig. 2, but the branches more like fig. 1. This latter figure represents a young and abnormal growth, apparently checked and then rejuvenated on one side. If my recollection of Tahaitian reefs is correct the stalked bouquet form, generally symmetrical, is the commonest, but has not been illustrated, though often described. The figure on Pl. XI is for comparison with Vaughan's pl. lxxi, fig. 2.

(Further material of *Acropora*, later collected at Umhlali and probably belonging to *A. pectinata*, is labelled UU 3 J.—T. A. S.)

Distribution.—Great Barrier Reef (Brook), Torres Straits (Vaughan), Samoa (Mayor), Tahaiti (Hoffmeister). This is the first record from the Indian Ocean, but that is probably due to confusion of the synonymy.

Acropora (*Madrepora*) *africana* Brook.

Brook, 1893, B.M. Cat. i, p. 83, pl. xxxv, fig. B.

This, as shown by Brook's figure, is quite possibly the young bushy form of the corymbose specimen DC 3, though differing in having rather larger calices and the fact that in the radials only the directive septa are usually recognizable. I therefore describe DC 3 separately, but mention this, as " The type specimen was collected by Dr. Krauss on the coast of *South Africa*. The locality is entered in the register as ' Cape of Good Hope,' but I think

it probable that the specimen came from the south-east coast and not from Cape Colony." Other specimens came from the Solomon Islands and Ceylon.

Acropora sp. Pl. XI, central figure.

A single specimen labelled DC 3 from Reunion (in Natal, near Durban, not the Island). Like the specimens of *A. pectinata*, it is the horizontal bracket form of a corymbose species, though, like the latter, growing near the substratum and forming secondary attachments here and there. It is the only colony seen anywhere in the Isipingo district, and was found in a deep pool at the seaward edge of a lower platform.

The specimen was provisionally named *A. forskaali* by Boschma, though it may be new ; but in view of the difficulties mentioned I decline to give it a new name, though it seems to be a well-marked species, and unique among corymbose species, in the development of the septa. (1) In axial corallites two cycles are complete, those of the first cycle projecting about half way to the centre of calyx, the secondaries not quite so far, or only as far as do the primaries. Regular in size and arrangement, in few calices are any of them larger, and in one only does one septum reach the middle. (2) In the upper (younger) radials the septa are thinner, and only the primaries distinct ; in the lower both series are distinct, but the secondaries very small. No enlargement of the directives. (3) In the immersed calices of the base again two cycles are complete, though the second is very small, sometimes rudimentary. Deep down in the calices two septa can be seen to meet. Surface of cœnenchyme finely netted, with pointed spinules at the knots.

Measurements can be taken from the illustration. The form of the radial calices is rare in the genus, as they form short tubes pressed to the sides of the branchlets, with straight cut ends and round mouths.

(Further material of *Acropora*, later collected at Umhlali, may be the same as DC 3. It is labelled UU 3 E.—T. A. S.)

Genus *Montipora*.

The only specimens of this genus are two small encrusting fragments, labelled DC 15, from Isipingo. Not only are they too small for safe identification, but they are also heavily infected by a small polychæte, similar to that in a preceding species, which, settling and making its tubes in the polyp cavities, causes an overgrowth of the cœnenchyme which grows with the worm's tubes, forming large papillæ up to 10 mm. high and 3 mm. thick ; there are no thecæ on these projections.

The cœnenchyme is quite smooth to the naked eye, trabeculæ in section small and close, making, for a member of this genus, a compact and heavy corallum, and the incrustation exceeds 2 cm. in thickness (the base of the

colony is not present). Thecæ small, 0·5 mm., scattered, level with the surface. Primary septa well developed, no directives, secondary cycle incomplete.

Family PORITIDÆ.

Genus *Goniopora*.

I am describing the two specimens U 15 G and G 11 A as two species, *Goniopora lobata* M.-E. and H., and *Goniopora crassa*, which latter I am forced to describe as new. Both are evidently rarities, as neither appeared in the first consignments, and I have a feeling that a long series of specimens, if one could be obtained, would unite the two species, in spite of very real and great differences. Both belong to the small group of species with thick walls and deep calices ; of this group only these two species are without conspicuous pali.

Goniopora lobata M. E. and H. Pl. XII, upper figure ; Pl. XIII, lower figure.

Milne Edwards and Haime, 1857, iii, p. 191.
Klunzinger, 1879, *non G. lobata.*
Bedot, 1907, p. 267, pl. xliii, fig. 242, pl. xliv, figs. 248, 249.

Bedot's figures are the only ones available, his fig. 249 on pl. xliv (of enlarged calices) showing the characters of the species well, especially the absence of pali and the upwardly directed points on the columella. The walls are somewhat thinner than in the Natal specimen, and the septa over the walls less regular. I illustrate the Natal specimen, especially in view of the above remarks ; and to these photographs I refer for measurements of calices, etc.

Bedot writes, " Les specimens de *G. lobata* d'Amboine sont absolument semblables a l'échantillon de cette espèce qui se trouve dans la collection du Museum de Paris et représente très probablement le type de M. Edwards." The present specimen, U 15 G, is a *low* dome, 9 cm. across (originally probably nearly circular) and 2 cm. high, thus much more crust-like than most recorded specimens of the genus. It was closely adherent to the surface, so that undamaged epitheca is visible only here and there. It is smooth, but deeply wrinkled circumferentially. There is no overgrowth of dead parts of the colony, which do not exist in the specimen. Prof. Stephenson writes : " In one deep pool particularly noted (at Umhlali) there was a colony about a yard in diameter of U 8 A (*Favites abdita*), a colony a foot in diameter, with expanded polyps, of U 15 G," *i.e. Goniopora lobata.* The note of polyps expanded by daylight is interesting, as this is characteristic of all the species of *Goniopora* and *Alveopora* I have seen alive, and of no other corals with large polyps. It would be interesting to know the form of this large colony, as it is so much larger than other records, though small compared with *G. columna.*

There are certain differences from Bedot's specimen.

(1) The calices are deeper.

(2) Walls and septa-costæ are more regular.

(3) Septa generally are more finely toothed.

(4) The columella is smaller and more definite in outline. The spinulose upwardly directed trabeculæ are fewer and confined to the top of the columella, rarely lateral and thin, simulating pali.

(5) Tertiary septa often bend sideways and fuse to the next septum of higher grade at the level of the columella; but in other cases septa bear distinct processes, vertical to themselves, at right angles to their sides, which cross the interseptal spaces, completely or incompletely. These fusions are additional to the ordinary septal junctions which occur above the level of the columella and which can be seen in the photographs.

Distribution.—Red Sea, Amboina (Dutch East Indies) and Natal.

Goniopora crassa n. sp. Pl. XII, lower figure; Pl. XIII, upper figure.

The specimen I have, G 11 A, from a pool at Umpangazi, is probably rather more than half the whole colony, a crust of irregular outline, about 10 × 7 cm., 1·5 cm. thick on the broken side, thinning out to 2 or 3 mm. at the others. The edges tend to turn up, thus making the upper surface concave. The whole of this piece seems to have been free of the substratum, and is overgrown by polyzoa, polytrema, etc., but the epitheca is clear and shows close-set radial lines, circumferentially a few wide and shallow grooves in contrast to the preceding species.

The specific name *crassa* therefore does not refer to the colony as a whole, but to the thickness of the thecal walls, in which this species is unique.

The calices are of such irregular shapes and sizes that the photograph is the only possible description. The thick walls are made of septa continuous from one calyx to the next, and numerous synapticula; the exsert parts of the septa are divided by vertical cuts into short lobes, which are spinulose, but there is no continuous dividing line between the calices; in these respects the walls are like the much thinner ones of the Natal specimen of *G. lobata*; in Bedot's they are still thinner and less regular. Thickening of the septa near and in the walls is very marked; their toothing and roughened sides within the calyx are conspicuous. The columella is markedly different from that of *G. lobata* in that the ends of the trabeculæ are blunt, not spinulose, and if any part is upwardly directed, it is short. It is compact, and the upper surface level or concave. Fusing of septa takes place as usual above the level of the columella, but below it they all join the columella directly, and isolated synapticula are very rare.

It is possible that all these differences are due to the more solid growth of *G. crassa*, but most systematists would find their growth-forms irreconcilable,

and I find the columella really different; but, as I said, the separation is provisional until, if ever, a long series of specimens can be compared.

Genus *Porites*.

As mentioned in the Introduction, the collection is most remarkable for containing only three tiny specimens of this genus, from Umtwalumi and Umpangazi, of which the former is south of Durban, the latter north; nor is it recorded from any of the other localities visited. I know of no other place where coral grows at all where *Porites* is not a conspicuous member of the fauna. Even in the southern Marquesas, where it does not form the big masses found in the northern island and so common on all reefs, it is abundant in several species, all of them represented by colonies a hundred times the bulk of these. As these are only crusts 5–10 mm. thick, it is probable that larvæ are continually arriving, but the species is unable to establish itself.

Porites capensis Bernard.

Brit. Mus. Cat., p. 231.

Bernard briefly describes a species from "The Cape of Good Hope," collected by Krauss and Bowerbank, without figures. He refers to the inclusion of large angular quartz grains and pebbles, so common in this collection. The Museum having a specimen "*Cœloria kraussii*" from Natal shows that these collectors worked there, and it is a fair presumption that this species also is from that coast, and not from the Cape. This species has an irregular skeleton and stout pali, and is therefore distinct from those collected by Prof. Stephenson and his assistants; but to identify it with other species elsewhere is impossible.

Porites solida Forssk. Pl. XIV, upper figure.

This species was named by Forsskaal 164 years ago, but no description with figures was published till Klunzinger wrote in 1879, 104 years later. Unfortunately Klunzinger's collections were made at Qoseir, where there are no sheltered reefs, and consequently the coral fauna is often abnormal, and to this, I think, is due his confusion of this species with *P. lutea*, in which he has been followed by a succession of writers, except Vaughan, who (1918, p. 191, pl. lxxxiv, figs. 3 and 3*a*) has given the only description *and figures* which correspond with Forsskaal's specimens, which are before me. This Natal specimen is illustrated on Pl. XIV, with which Vaughan's figure may be compared. Some of Forsskaal's types were seen by Marenzeller in 1906, but he did not publish any details of them, nor any photographs, nor any proof of his assertion that intermediates between this species and *P. lutea* occur.

The species is one of the few, or possibly the only one (it is impossible to say) in which the pali are absent, or developed as mere granules in some calices only, a fact which at once distinguishes it from *P. lutea*. Klunzinger's photographic figures (pl. vi, figs. 14 and 16) when examined under a magnification of ten diameters are found both to refer to *P. lutea*, and in fact he states that the two species are to be distinguished mainly by the fact that in *P. solida* the calices are mostly as deep as broad, in which he is followed by Bernard. Such deep calices occur nowhere in any of Forsskaal's seven specimens, and indeed are very rare in massive *Porites*. (They occur rarely, if ever, in the 500 tons of *Porites* used in the pier and foundations of the biological station at Ghardaqa.)

Two very small pieces, G 11 B from the Natal coast, and one from Mauritius, compare well with Forsskaal's specimens, though they are very young colonies which have attained only the form of crusts 5–10 mm. thick. One end of one of these specimens is exactly like Vaughan's pl. lxxxiv, fig. 3*a*, but elsewhere the columella is broader and more in evidence, giving a different appearance to the calyx. The Mauritius specimen is numbered 214.

Distribution.—Abundant through the whole Indian Ocean, and probably the Pacific. Bernard is very cautious in his identifications, distrusting especially Ortmann's and Rehberg's statements that it is found in Zanzibar, Dar-es-Salaam (Equatorial East Africa) and Mauritius. It almost certainly occurs in the China Sea and Hawaiian Islands. These probabilities become almost certainties now that we have direct comparison between specimens from the Red Sea (Forsskaal), Mauritius and Natal (Stephenson), and Vaughan's description of a specimen from Cocos Keeling.

Porites arenosa Esper. Pl. XI, bottom figure ; Pl. XIV, lower figure.

Specimen M 12 C from Umtwalumi corresponds to Bernard's *P. rodericensis secunda*, which Bruggemann named *arenosa* and labelled *arenacea*. Bernard's is the only description, and it is absurd to imagine that any identification with Esper's or Lamarck's descriptions is possible in this very difficult genus. It does correspond with Milne Edwards and Haime's description, so far as that goes, and, as they record it from Bourbon, presumably they had a specimen from Mauritius before them. I therefore retain the name. Gardiner suggests that the species is synonymous with *P. conglomerata* Dana and *P. lutea* Klunz., which seems to me possible, but not yet proved. Bernard's specimen is nearly smooth, Milne Edwards and Haime's " gibbeuse, lobée et mamelonnée," while the one from Natal rises up into short branches, up to 1·3 cm. high, which, being in most cases due to the brown polychæte-tubes mentioned under other species, are probably so in all. There are, however, a number of " mamelons " less than 1 cm. high which do not show worm-tubes, and so appear to be natural features of the species, as in Edwards and Haime's specimens. This specimen differs from Bernard's in having no slightly thickened walls, and indeed it is

remarkable in this genus for its lightness in every part. I therefore give illustrations of both the general mode of growth and details of the calices. The effect of parasitization is, as usual, an even greater delicacy of structure on the " branches," the calices having the unusual depth, for this genus, of half their breadth.

Distribution.—Red Sea, Seychelles, Mauritius, Fiji, Funafuti.

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EXPLANATION OF PLATES V–XIV.

Illustrating the late Dr. Cyril Crossland's paper on " Reef Corals of the Sout African Coast."

PLATE V.

Favia dipsacea Aud. and Sav. Natural size. Above, part of the spreading edge (left) and part of the main mass (right). Below, the latter in oblique side view to show septal and costal spines.

PLATE VI.

Goniastrea seychellensis M. E. and H. (above). Natural size.

Favites pentagona (Esper) (below). Natural size. The growing edge of an encrusting colony with apparent extra-tentacular budding.

PLATE VII.

Symphyllia simplex Crossland. All natural size, illustrating three stages of degeneration (see text).

PLATE VIII.

Goniastrea columella Crossland. Part of a colony. × 8.

PLATE IX.

Anomastrea irregularis Marenz. Both figures × 8. Part of a normal colony above, part of a degenerate one below.

PLATE X.

Goniastrea columella Crossland (above). Natural size.

Anomastrea irregularis Marenz. (below). × 4. Degenerate *Cœloria*-like form, from Krauss' specimen.

PLATE XI.

Acropora pectinata Brook (above). Natural size.

Acropora sp. (centre). Natural size.

Porites arenosa Esper. (below). Natural size.

PLATE XII.

Goniopora lobata M. E. and H. (above). Part of a colony. × 3.

Goniopora crassa Crossland (below). Part of a colony. × 8.

PLATE XIII.

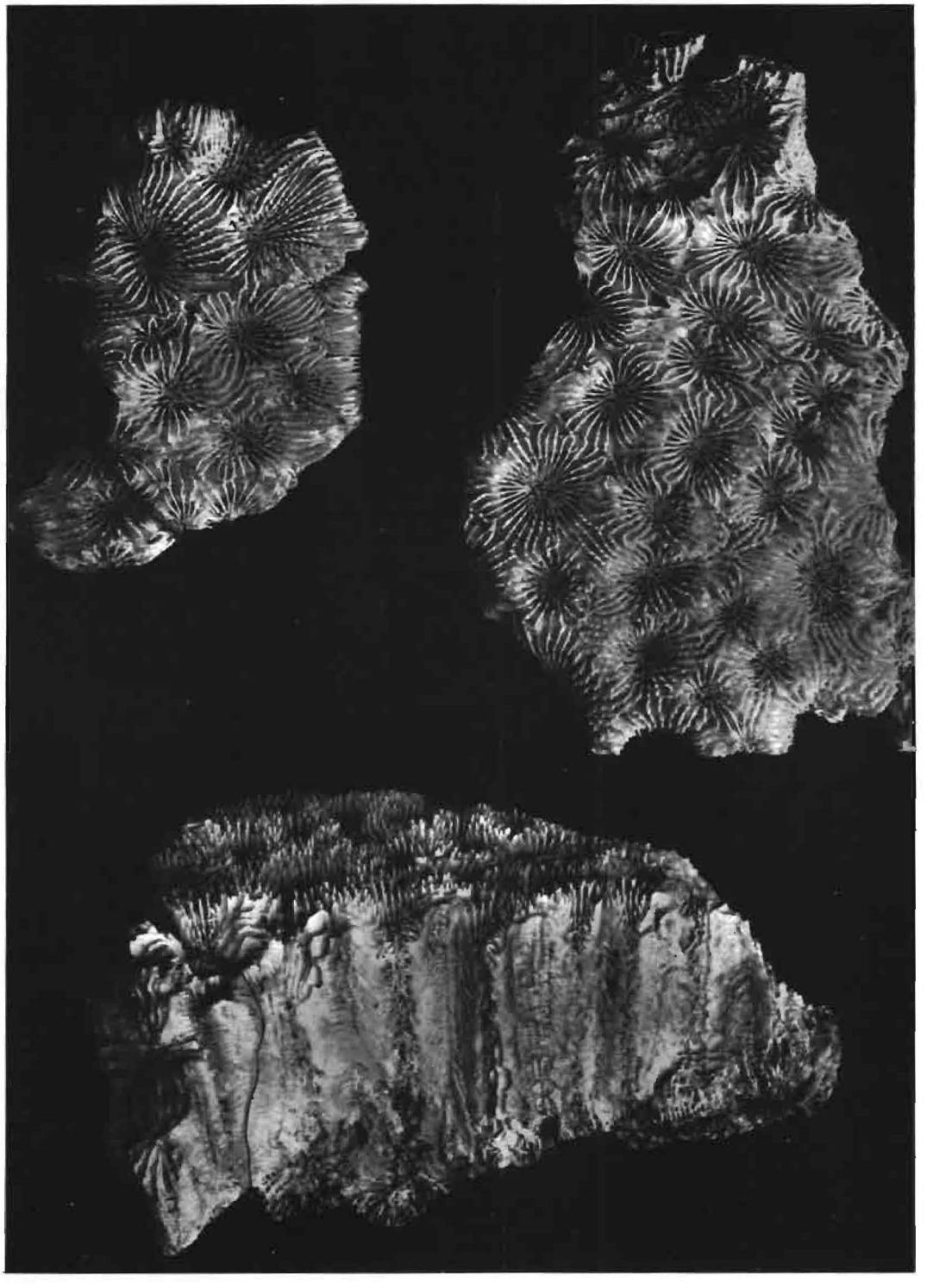
Goniopora crassa Crossland (above). Natural size.

Goniopora lobata M. E. and H. (below). Natural size.

PLATE XIV.

Porites solida Forssk. (above). Part of a colony, × 8, showing two giant calices with 24 and 18 septa.

Porites arenosa Esper. (below). Part of a colony. × 8.



FAVIA DIPSACEA. × 1.

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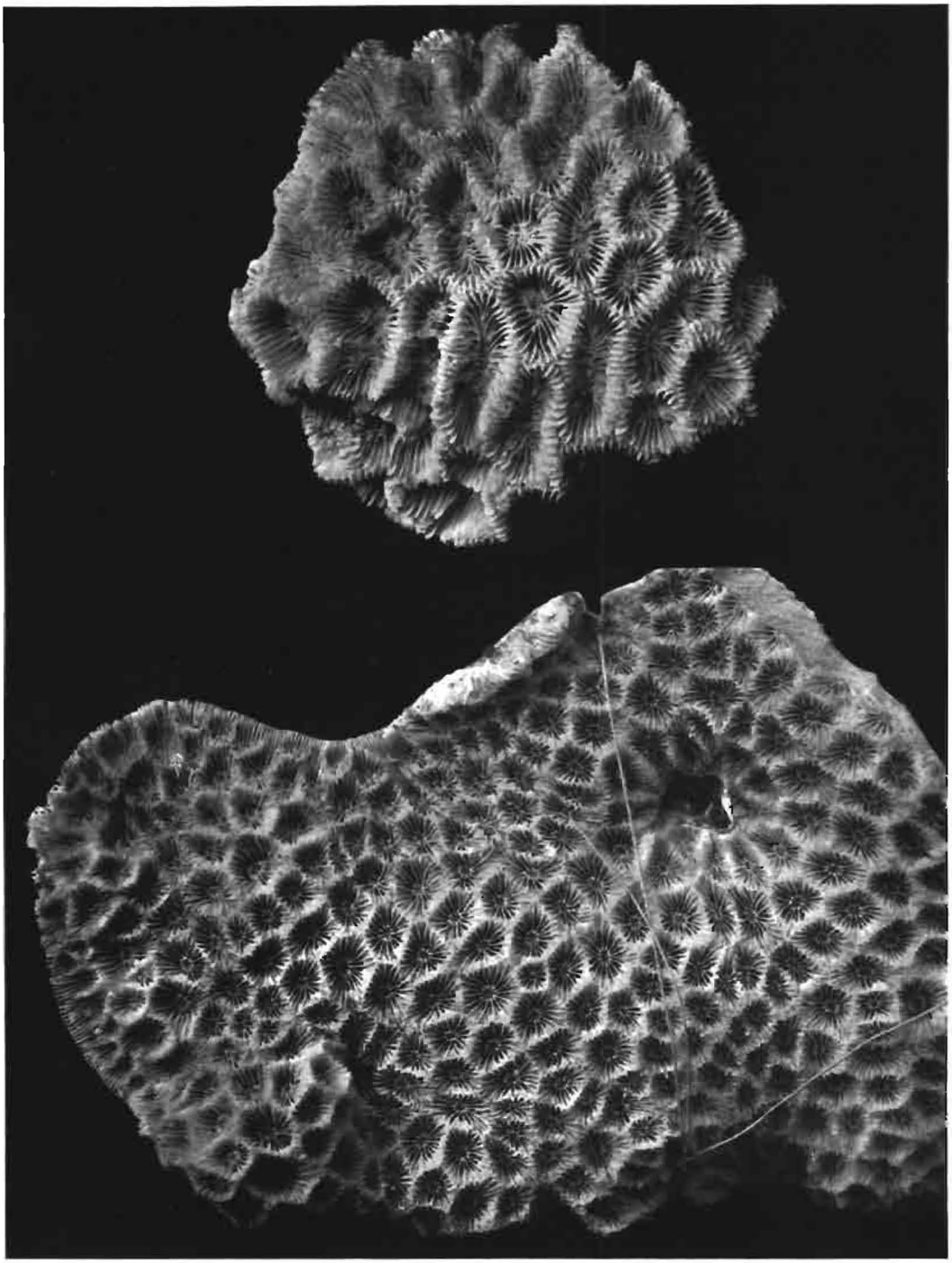

GONIASTREA SEYCHELLENSIS. × 1.
FAVITES PENTAGONA. × 1.

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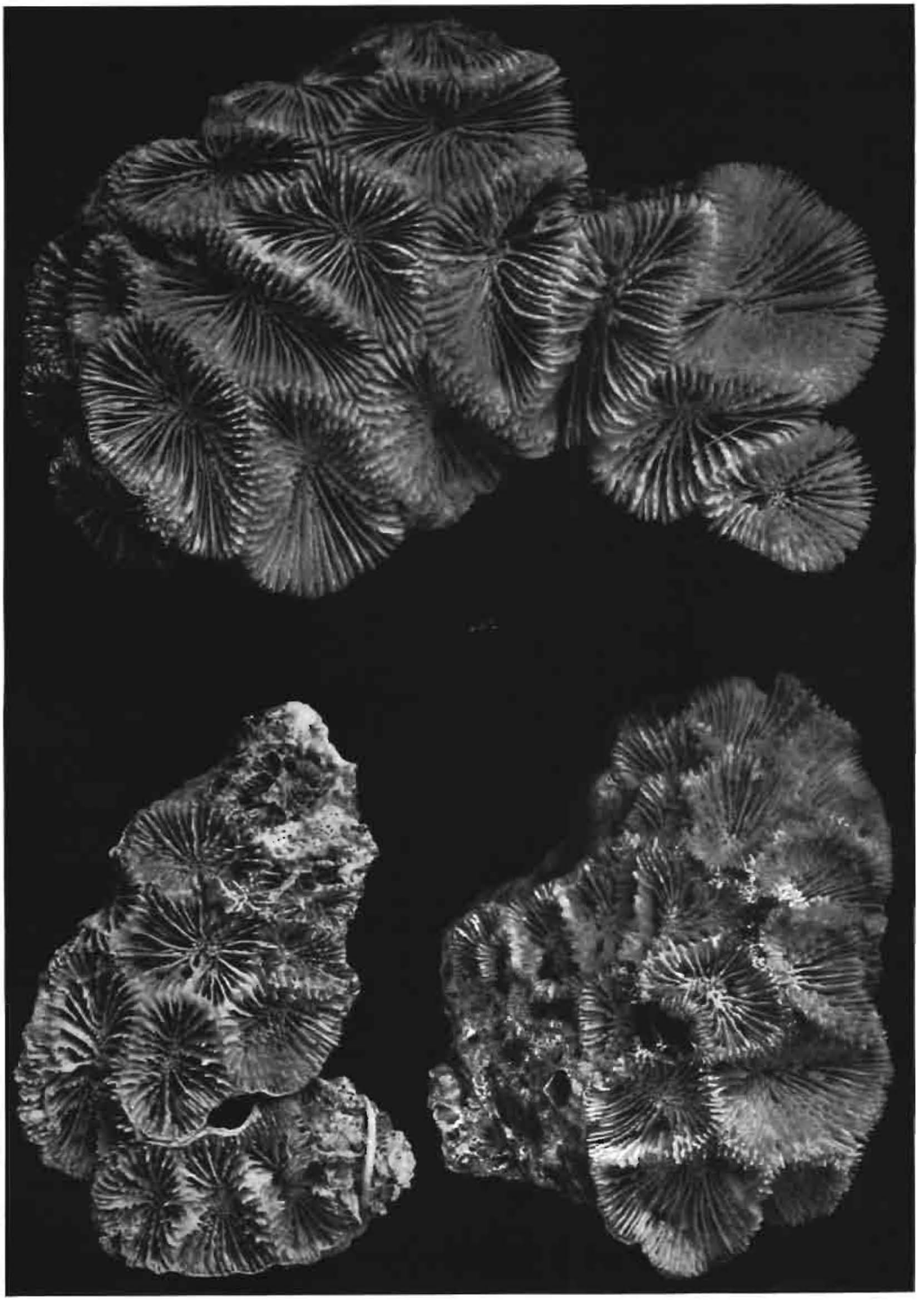

SYMPHYLLIA SIMPLEX. × 1.

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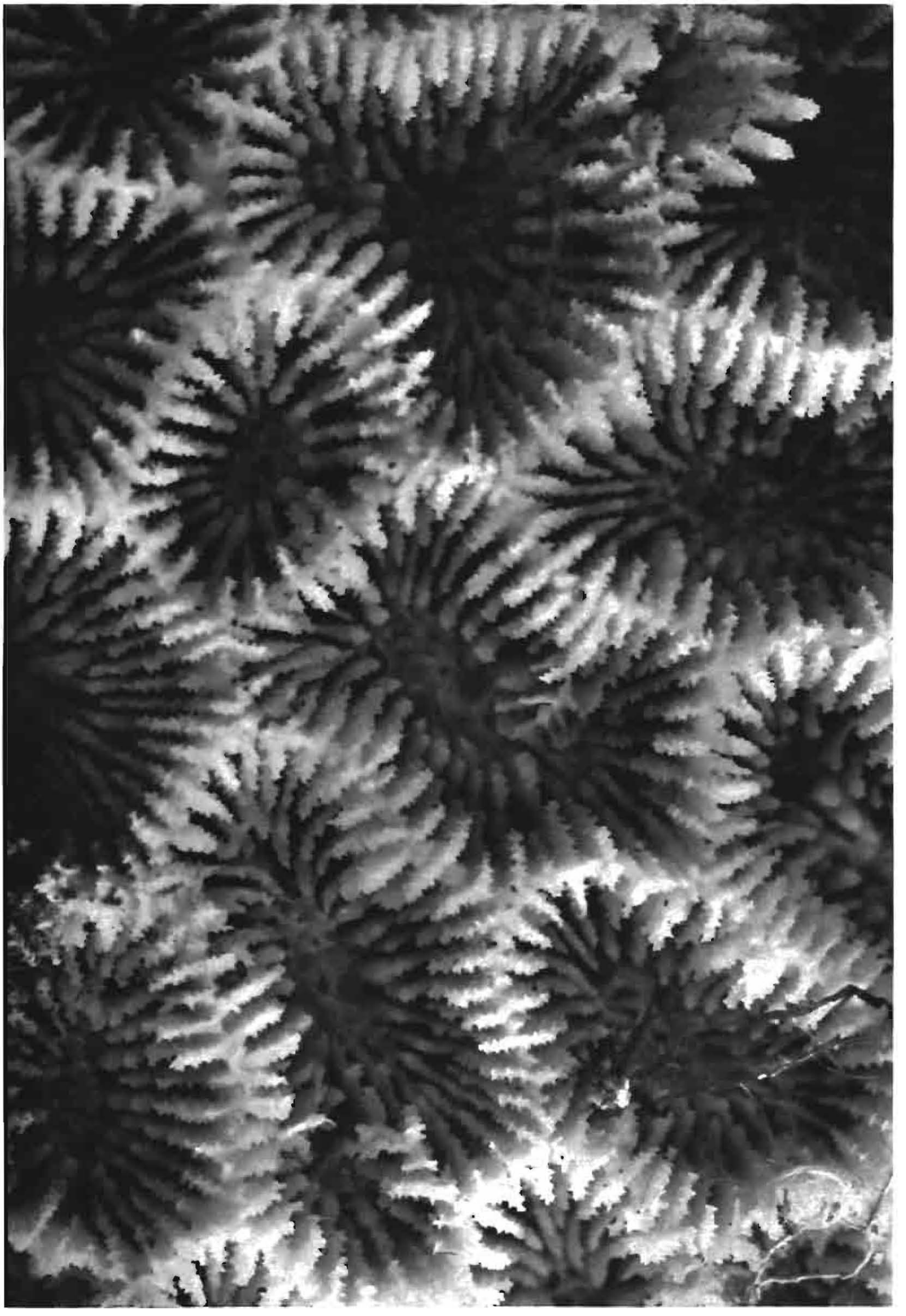

GONIASTREA COLUMELLA. × 8.

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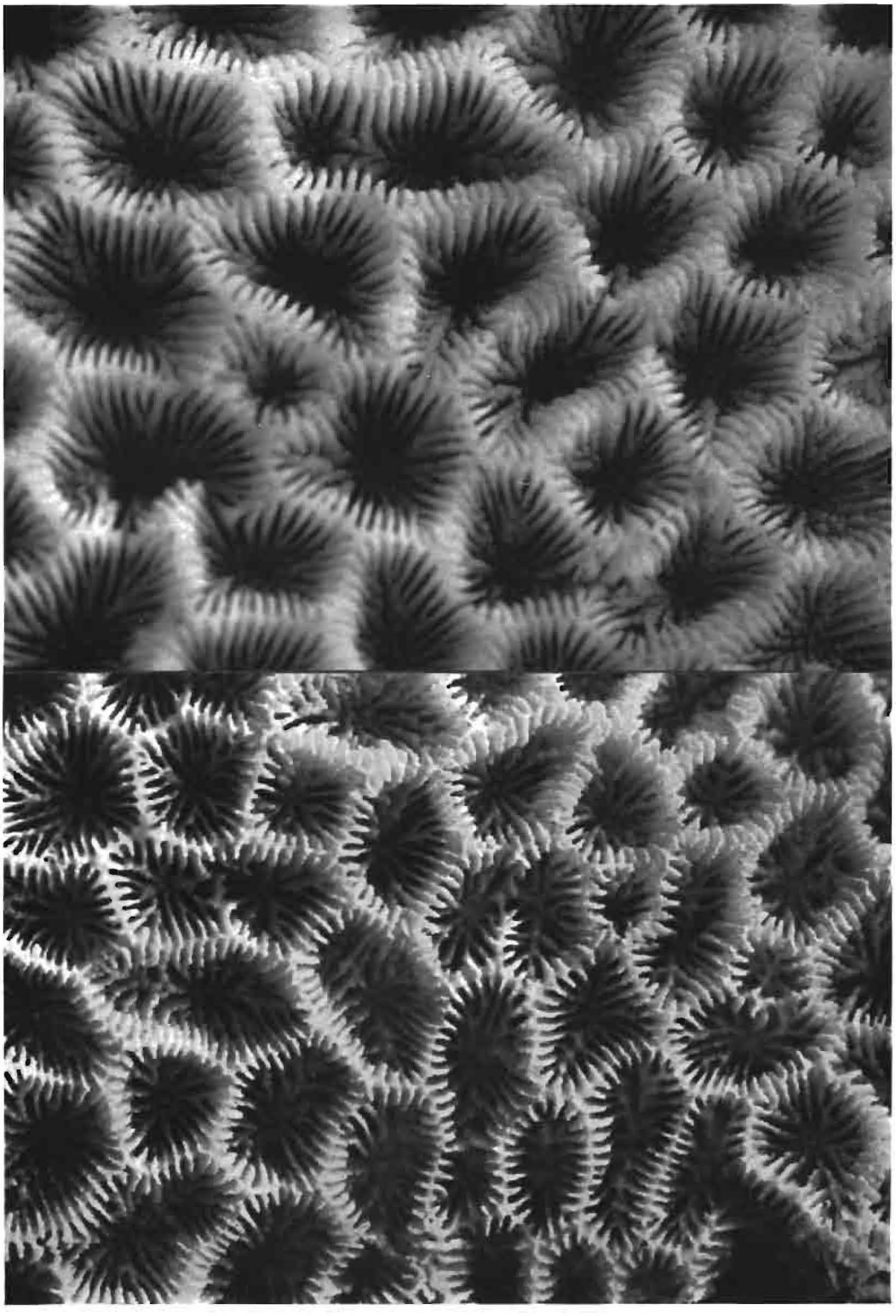
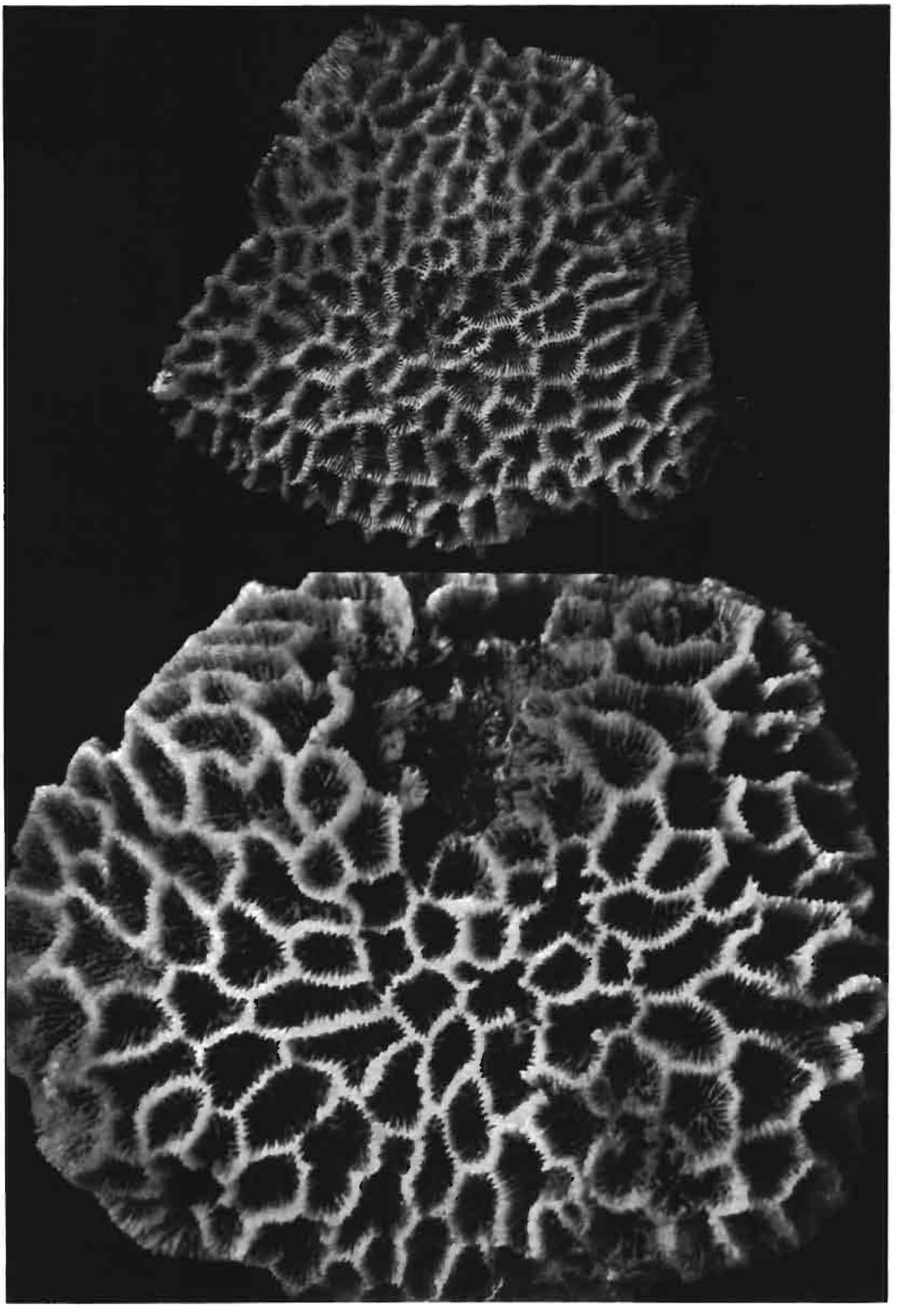


ANOMASTRÆA IRREGULARIS. × 8.

Adlard & Son, Ltd.



GONIASTREA COLUMELLA. × 1.
ANOMASTRÆA IRREGULARIS. × 4.

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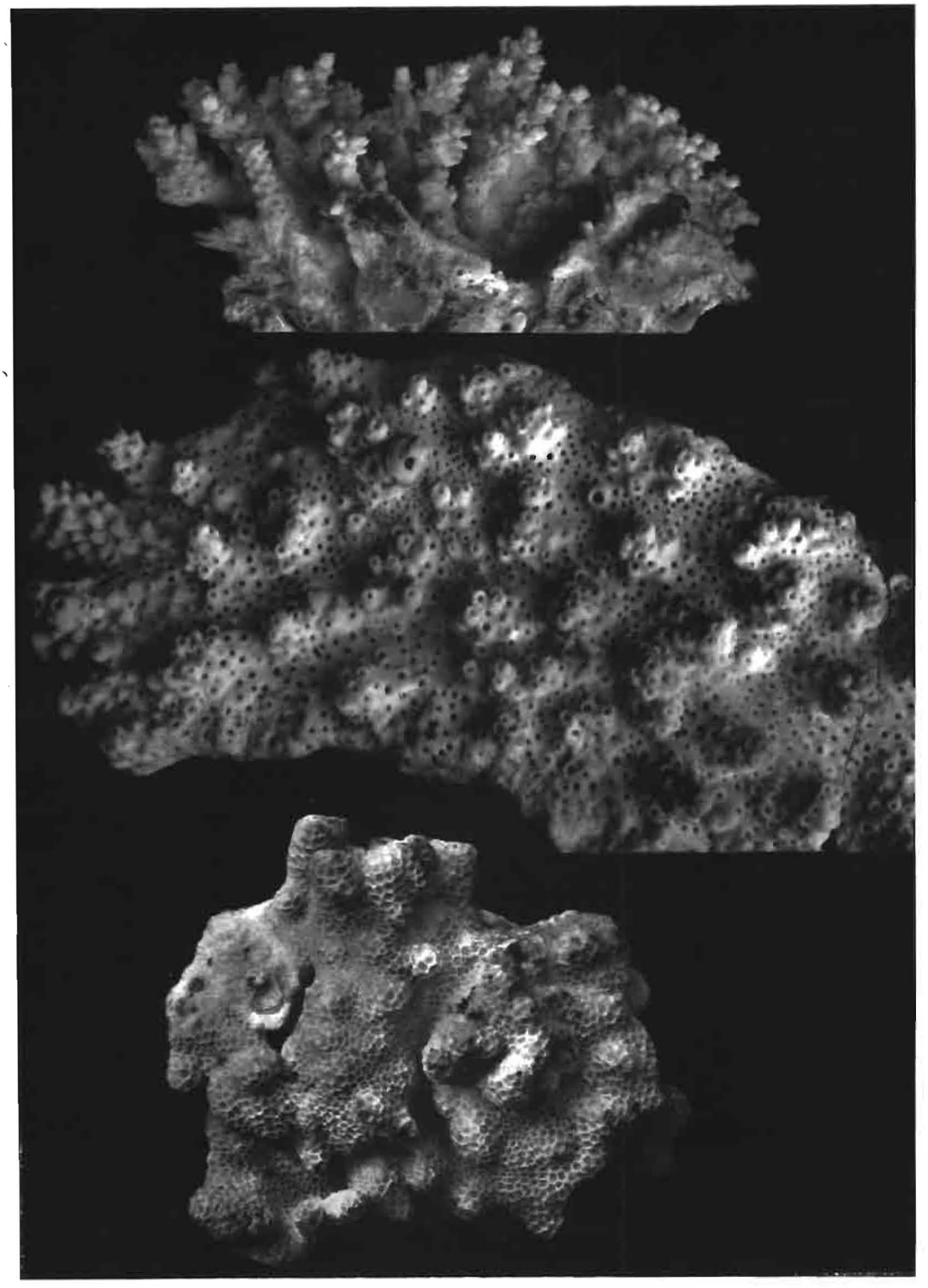
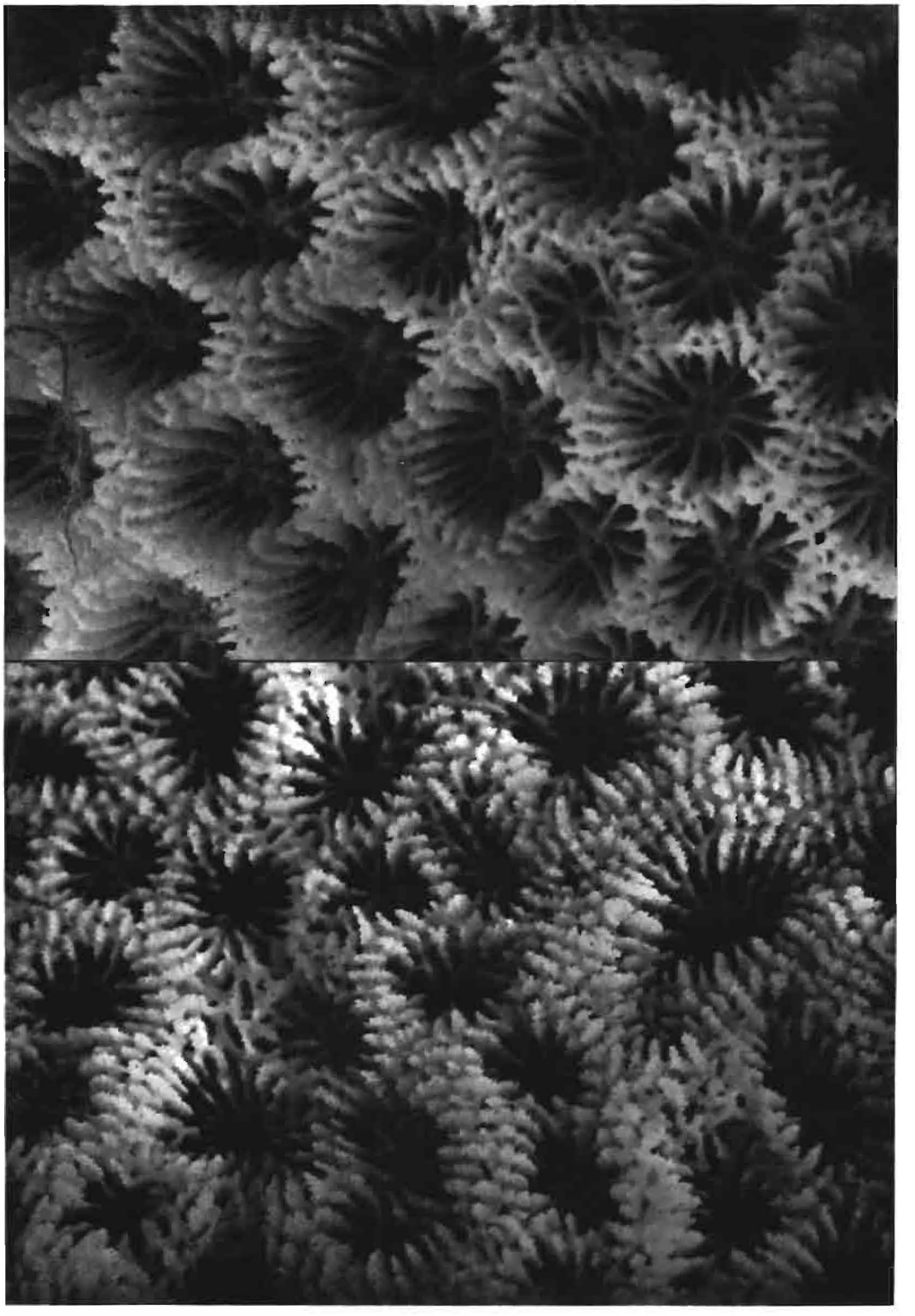


ACROPORA PECTINATA. × 1.
ACROPORA SP. × 1.
PORITES ARENOSA. × 1.

Adlard & Son, Ltd.



GONIOPORA LOBATA. × 3.
GONIOPORA CRASSA. × 8.

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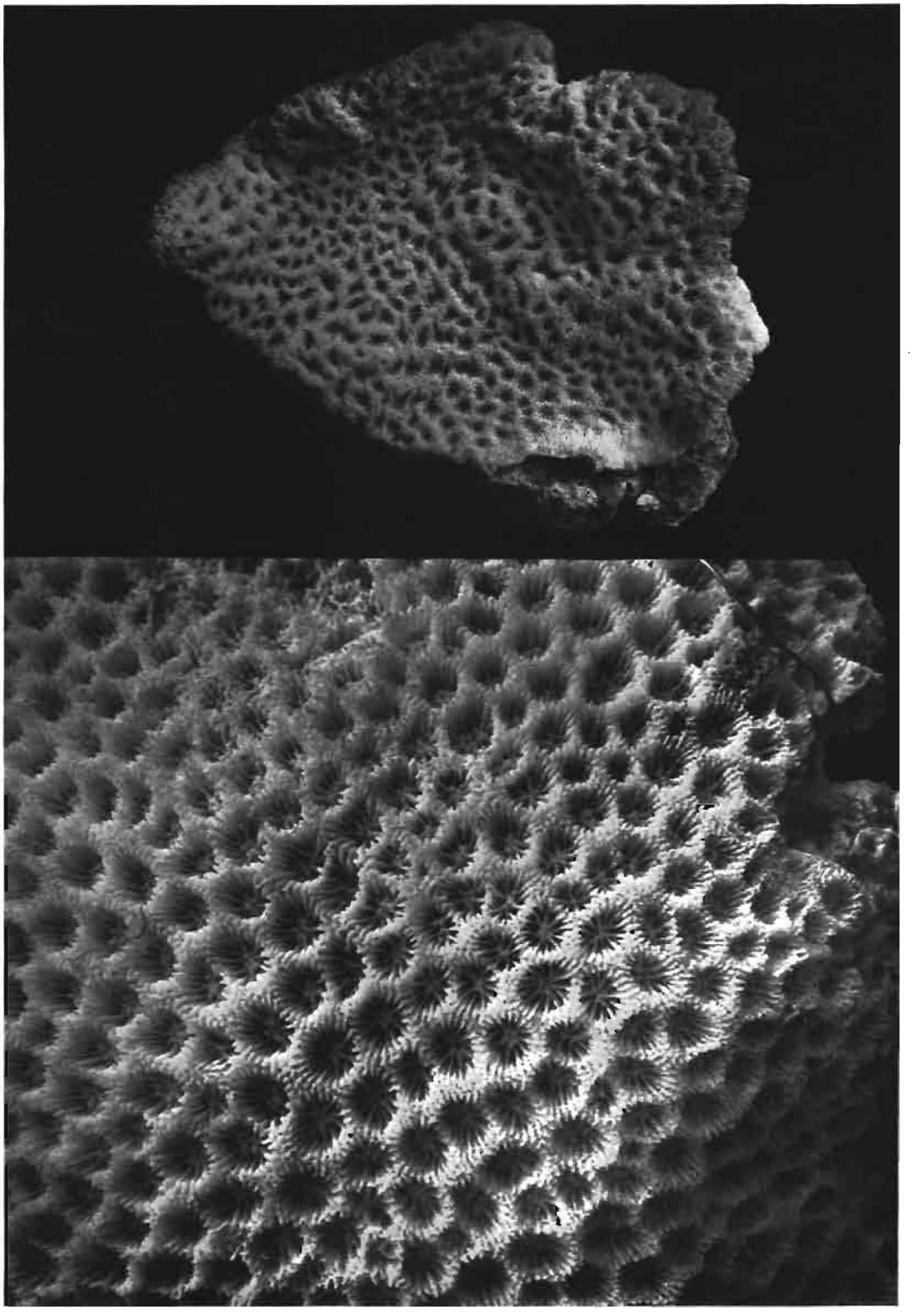

GONIOPORA CRASSA. × 1.
GONIOPORA LOBATA. × 1.

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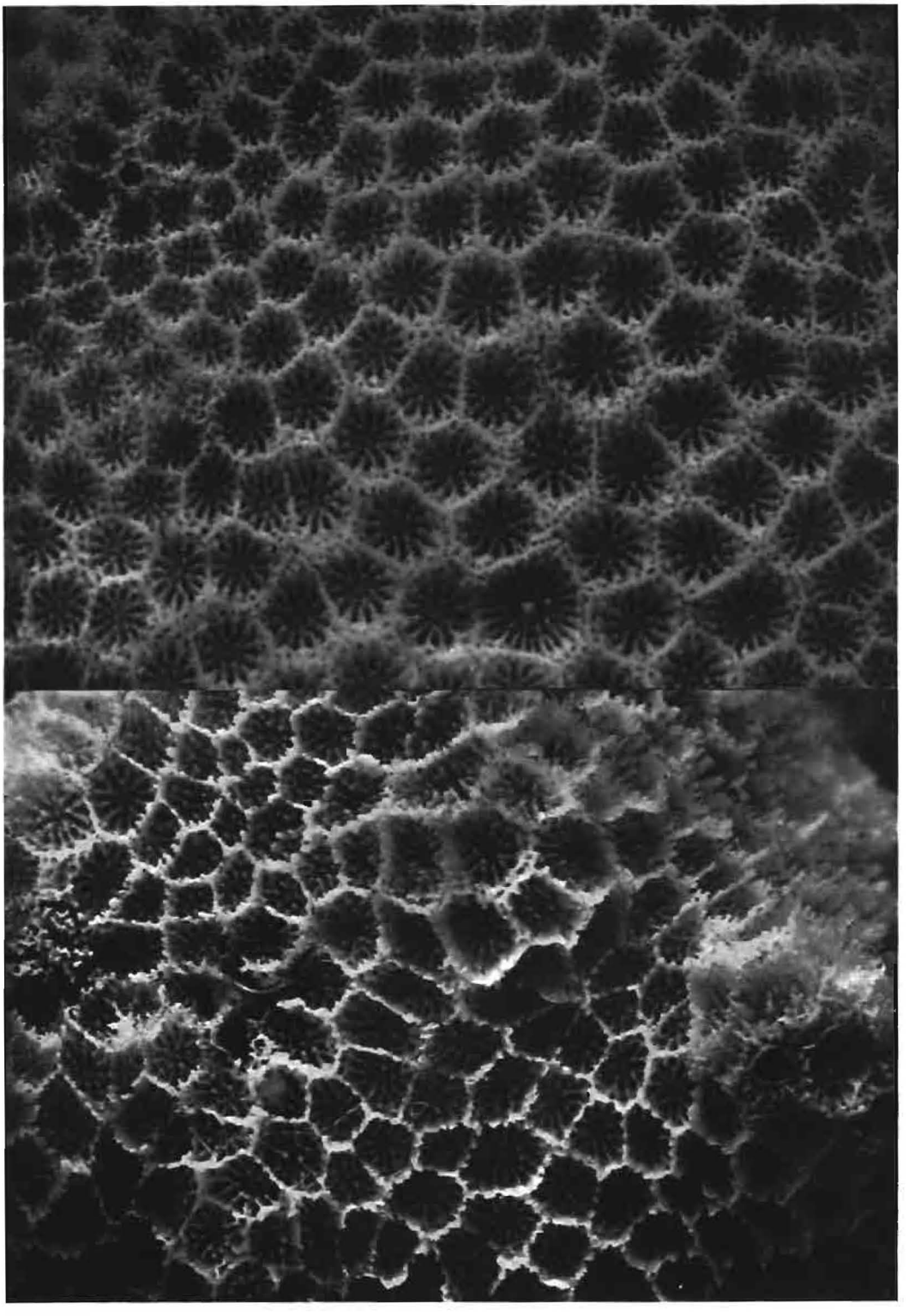

PORITES SOLIDA. × 8.
PORITES ARENOSA. × 8.

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